CONTRACT DOCUMENTS AND TECHNICAL SPECIFICATIONS

FOR

WEST HARRIS COUNTY REGIONAL WATER AUTHORITY

Re-Pump Station

90% Submittal

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Prepared by:

Freese and Nichols, Inc.

Consulting Engineers

April 2019

DIVISION 0

BIDDING AND CONTRACT REQUIREMENTS

DESIGN PROFESSIONAL SEALS

Division: 00, 01, 09, 31, 33, 40, 41, 43

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Division 00, 01, 09, 31, 33, 40, 41, 43

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Division: 01, 03, 05, 31

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Division: 22, 23

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SEAL SHEET

Division 31, 32

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Division 25, 40, 43, 46

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Division 06, 07, 08, 09, 010

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WEST HARRIS COUNTY REGIONAL WATER AUTHORITY
RE-PUMP STATION

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HOUSTON AND HARRIS COUNTY STANDARD SPECIFICATIONS

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COH 02512 Water Tap and Service Line Installation
COH 02520 Fire Hydrants
COH 02526 Water Meters
COH 02532 Sanitary Sewer Force Mains
HC 460 Reinforced Concrete Pipe
HC 463 Safety End Treatment

HC 471	Precast Concrete Manholes and Junction Boxes
HC 480	Precast Reinforced Concrete Box Sewers
HC 493	Riprap

Notes

(1) Not included this submittal
(2) FNI standard Division 01 document edited for this project
(3) FNI standard Division 01 document in unedited template format

Date: _____, 2019

Section 00300

BID – RE-PUMP STATION

Bid of _____, an individual proprietorship, a corporation authorized to transact business in Texas, or a partnership consisting of _____, for _____ _____for West Harris County Regional Water Authority, Harris County, Texas.

To: West Harris County Regional Water Authority
Attention: Mr. Bruce G. Parker, President, West Harris County Regional Water Authority
c/o Dannenbaum Engineering Corporation
3100 West Alabama
Houston, Texas 77098-2094

Undersigned Bidder represents and warrants as follows:

1. That bidder has carefully examined the INSTRUCTIONS TO BIDDERS, this BID, the AGREEMENT, its GENERAL and SPECIAL PROVISIONS and/or CONDITIONS, the TECHNICAL SPECIFICATIONS, and the PLANS for the work hereinabove described and referred to in the INVITATION TO BIDDERS, requesting bids on said work, dated _____, 2019, and also that Bidder has followed the instructions on bidding with respect to any apparent conflicts in the BIDDING DOCUMENTS and agrees that the BIDDING DOCUMENTS are sufficient in design and in detail for the construction of the Work described therein; and that Bidder's BID is correct and constitutes an offer to perform each element of the Work under the terms and conditions of the BIDDING DOCUMENTS in consideration of the prices bid for each element of the Work, which BID upon acceptance by the OWNER will form a legally binding contract between the parties; and

2. That Bidder has carefully examined the location where the Work will be performed, and has carefully considered the availability of labor, equipment and materials, the laws and regulations which apply to the Work and the methods, manner and means whereby Bidder will carry out the Work, and has otherwise followed carefully the instructions on bidding furnished to the Bidder in connection with the solicitation of bids; that Bidder's authorized representative attended the pre-bid conference; and that Bidder has received and understood all addenda to the BIDDING DOCUMENTS prior to the submission of its BID; and

3. That Bidder is able to furnish, if awarded a contract, PERFORMANCE AND MAINTENANCE BOND and PAYMENT BOND as required by the BIDDING DOCUMENTS and a Certificate of Insurance evidencing the coverages required in the BIDDING DOCUMENTS which names the OWNER and the ENGINEER as Additional Insureds where required; and

4. That Bidder is duly qualified to carry on its business in the state where the Work is situated; possesses or has the ability to possess all licenses, permits, and certificates of authority necessary to commence and to complete the Work in accordance with the BIDDING DOCUMENTS; is fully qualified and has experience in performing work of the same type as the Work covered by the BIDDING DOCUMENTS; and will provide all necessary labor, superintendence, machinery, equipment, tools, materials, services, and other means of construction to complete all work upon which he bids and complete the said work within the time stated and for maintaining same as required for the following prices:

Section 1 - Surface Water Supply Project – Re-Pump Station					
Item No.	**Item Description[4]**	**Unit**	**Unit Quantity**	**Unit Price[1]**	**Total**
1.	For construction of the Re-Pump Station completely as shown in the Plans and described in the Specifications, except such items as are listed below	LS	1	$_____	$_____
2.	Drilled Shafts				
2a.	18-inch Drilled Shafts	VLF	???	$_____	$_____
2b.	24-inch Drilled Shafts	VLF	???	$_____	$_____
2c.	30-inch Drilled Shafts	VLF	???	$_____	$_____
2d.	36-inch Drilled Shafts	VLF	???	$_____	$_____
2e.	42-inch Drilled Shafts	VLF	???	$_____	$_____
3.	Trench Safety [3]	LF		$_____	$_____
	SECTION 1 – SWSP – RE-PUMP STATION SUB-TOTAL				$_____
Section 2 – Extra Unit Price Work					
Item No.	**Item Description[4]**	**Unit**	**Unit Quantity**	**Unit Price[1]**	**Total**
4.	Additional daily expense to maintain pumps, motors, valves, and electrical equipment prior to substantial completion due to delay of startup and 30-day testing of pumps, motors, and VFD's as detailed in Specification Section 01 23 10 – Alternates and Allowances	Day	120	$_____	$_____
	SECTION 2 – EXTRA UNIT PRICE WORK SUB-TOTAL				$_____

Section 3 – Additive and Deductive Alternates					
Item No.	**Item Description[4]**	**Unit**	**Unit Quantity**	**Unit Price[1]**	**Total**
5.	Deductive Alternate for deleting pump lineup No. 1, including pump, motor, pump control valve, piping, electrical, controls, instrumentation and variable frequency drive as detailed in Specification Section 01 23 10 – Alternates and Allowances	LS	1	$_____	$_____
	SECTION 3 – ADDITIVE AND DEDUCTIVE ALTERNATE SUB-TOTAL				$_____
Section 4 – Cash Allowances					
Item No.	**Item Description[4]**	**Unit**	**Unit Quantity**	**Unit Price[1]**	**Total**
6.	Cash Allowance for providing furnishings for Operations Center and Pump Station as detailed in Specification Section 01 23 10 – Alternates and Allowances	Allow	1	$100,000.00[2]	$_____
7.	Cash Allowance for payment to CenterPoint Energy for Construction and provision of primary electrical service to the Re-Pump Station as detailed in Specification Section 01 23 10 – Alternates and Allowances	Allow	1	$100,000.00[2]	$_____
	SECTION 4 – CASH ALLOWANCES SUB-TOTAL				$_____

Re-Pump Station
Pump Alternate Proposal

Pump Supplier: _____

Motor Supplier: _____

Bidder shall complete this from for each pre-approved pump supplier he wishes to propose for the Re-Pump Station. Bidder is not required to fill in totals for a pump supplier he does not wish to propose as an alternate offering. The pump and motor combination will be evaluated by the Owner and the lowest cost may or may not reflect the lowest evaluated offering chosen by the Owner. Evaluation of the pump and motor offerings will take place in accordance with the procedures defined in Specification Section 01 23 10 – Alternates and Allowances.

Section 5 – Pump Alternate Proposals					
Item No.	**Item Description[4]**	**Unit**	**Unit Quantity**	**Unit Price[1]**	**Total**
8.	Furnish, test, deliver, and provide competent service technician for five horizontal split case pumping units, each with a rated capacity of 40.0 MGD at 163 feet TDH; a guaranteed wire-to-water efficiency of _____% at 170 feet TDH; a guaranteed wire-to-water efficiency of _____% at 140 feet TDH, complete as specified herein.	EA	5	$_____	$_____
9.	Additional Costs for witnessed tests for five Re-Pump Station pumps by representatives of the Owner.	EA	5	$_____	$_____
10.	Additional Costs for witnessed tests for five Re-Pump Station motors by representatives of the Owner.	EA	5	$_____	$_____
	SECTION 5 – PUMP ALTERNATE PROPOSAL SUB-TOTAL				$_____

Total Amount Bid

RE-PUMP STATION

Subtotal Section 1 – Surface Water Supply Project – Re-Pump Station	**$**_____
TOTAL BASE BID (SUM OF ITEMS ABOVE)	**$**_____
Subtotal Section 2 – Extra Unit Price Work	**$**_____
Subtotal Section 3 – Additive and Deductive Alternates	**$**_____
Subtotal Section 4 – Cash Allowances Items	**$**_____
Subtotal Section 5 – Pump Alternate Proposals – Lowest Cost Offering [5]	**$**_____
TOTAL AMOUNT BID: BASE BID PLUS SUBTOTAL EXTRA UNIT PRICE ITEMS, ADDITIVE AND DEDUCTIVE ALTERNATES, CASH ALLOWANCES & LOWEST COST PUMP PROPOSAL	**$**_____

Notes:

(1) In the event of a discrepancy, this column shall govern.

(2) Fixed Price determined prior to Bid. Cannot be adjusted by the Bidder.

(3) Contractor shall estimate the quantity of required for Trench Safety and include in the space provided.

(4) The intent of the Contract Documents is for the Contractor to include all items necessary for the proper execution and completion of the Work described in the Contract Documents. No separate measurement and payment shall be made for any work unless identified as a pay item in the BID. Include the cost of work not identified as a separate pay item in Contract price bid for items of which this work is a component. In case of discrepancy between measurement and payment within the BID and Technical Specification Section, the BID shall govern.

(5) The Bidder shall write-in the Sub-Total for the lowest bid price from among his proposed alternate pump suppliers. This Sub-Total does not represent the evaluated pricing – only the lowest bid price. The efficiency evaluation and subsequent pump evaluation may change the selected product.

The total amount bid equals the total of the following items, each of which shall be billed separately by CONTRACTOR to OWNER for the Re-Pump Station:

a. $_____ Incorporated Material

b. $_____ Non-Incorporated Material

c. $_____ All other costs and fees

The amounts set forth above are current estimates by CONTRACTOR of the amounts that will be determined during the progress of the Work. The separated Final Progress billing from CONTRACTOR to OWNER shall reflect the actual amounts expended for the items enumerated in (a), (b), and (c) above.

The undersigned agrees to begin work within **10 calendar days** after written Notice to Commence Work has been given him by ENGINEER. The undersigned also agrees to complete the work within **730 calendar days** after the date of the written Notice to Commence Work.

Receipt and acknowledgement of the following Addenda to the BIDDING DOCUMENTS are hereby made:

Addendum No. _____ Dated _____

Addendum No. _____ Dated _____

Enclosed with this BID is a Cashier's Check or Bid Bond in the amount of $_____. The undersigned agrees that this amount is the measure of liquidated damages which OWNER will sustain by the failure of the undersigned to timely execute and deliver the above-named Contract and Bonds, and further agrees that this check or bid bond shall be retained and/or collected by OWNER as liquidated damages in the event this BID is accepted by OWNER within **60 calendar days** after the date of the opening of bids and the undersigned fails to execute the Contract and the required Bonds, and provide the required insurance certificates, all within **7 calendar days** after the date CONTRACT DOCUMENTS are received by the undersigned, otherwise said check or Bid Bond shall be returned to the undersigned in accordance with the provisions of the INVITATION TO BIDDERS.

_____ ATTEST:_____

Name of Bidder (SEAL, if Bidder is a Corporation)

By _____ Address _____

Name _____ _____

Title _____ _____

Date _____ Telephone _____

Insurance Carrier _____

State of incorporation _____

Local agent _____

Agent's address _____

_____

Agent's telephone _____

Surety Company _____

State of incorporation _____

Local agent _____

Agent's address _____

_____

Agent's telephone _____

00740 SPECIAL CONDITIONS FOR TEXAS WATER DEVELOPMENT BOARD (TWDB) FUNDING

ARTICLE 1 – FUNDING AGENCY REQUIREMENTS

1.01 This Project is funded in whole or in part by Texas Water Development Board (Funding Agency). The Funding Agency requires specific conditions and reporting as a condition for providing this funding. The conditions and reporting forms of the Funding Agency are included in the Contract Documents. The Funding Agency requirements govern in the event of any conflict between the Funding Agency requirements and any other provision of the Contract Documents.

1.02 The applicable Funding Agency conditions and reporting forms are as follows:

Specification Section	Title	Funding Agency Document No.
00741	TWDB Supplemental Contract Conditions and Instructions for Construction Services for Projects Funded through State Programs	TWDB-0552
00742	Vendor Compliance with Reciprocity on Non-Resident Bidders	TWDB-0459
00743	Site Certificate	TWDB-ED-101
00744	Contractors Act of Assurance	TWDB-ED-103
00745	Contractors Act of Assurance Resolution	TWDB-ED-104

END OF SECTION

Texas Water Development Board

Supplemental Contract Conditions and Instructions

For Construction Services for

Projects Funded through State Programs

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Forms and Guidance:

The Texas Water Development Board (TWDB) forms and guidance documents noted in this instruction document may be accessed through the TWDB's Financial Assistance web site at: http://www.twdb.texas.gov/financial/instructions/index.asp

Search by either the document number or name.

I. INSTRUCTIONS TO APPLICANT

1. Applicability

These Supplemental Conditions contain provisions that are worded to comply with certain statutes and regulations which specifically relate to projects receiving state funds only. Except as noted, these supplemental conditions apply to projects funded by the following financial assistance programs:

- ✓ Agricultural Water Conservation Fund (AWCF)
- ✓ Economically Distressed Areas Program (EDAP)
- ✓ Rural Water Assistance Fund (RWAF)
- ✓ State Participation (SP)
- ✓ State Water Implementation Fund for Texas (SWIFT)
- ✓ Texas Water Development Fund II (WDF)

Provisions that are applicable to the project's funding source or dollar value of the contract are so noted within these provisions.

NOTES:

- Per Section 17.183(c)(4), Texas Water Code (TWC), U.S. Iron and Steel requirements do not apply to SWIFT projects funded prior to May 1, 2019.

- Effective September 1, 2017, TWC §17.183 eliminated the requirement for *Manufactured Goods*. Thus, projects approved for funding after September 1, 2013 and which are not currently under construction, will only need to meet the requirements of TWC §17.183 as amended by S.B. 1289, 85th Legislative Session, and as outlined in these Contract Conditions.

- Texas Water Code § 17.183 does not apply to the Agricultural Water Conservation Fund; however, the US I&S provisions in Texas Government Code, Chapter 2252, Subchapter F may apply to certain conservation projects funded through the Agricultural Water Conservation Fund. See Attachment 1 for supplemental guidance regarding Agricultural Water Conservation Fund projects.

2. Use of Conditions

The language and conditions listed under ***Section II: Instructions to Bidders*** are to be included in the instructions to bidders for construction services. The provisions listed under ***Section III: Supplemental Contract Conditions*** shall be included in their entirety with the other general and special conditions that are typically included in the construction contract documents by the design engineer.

3. Modifications to Provisions

These provisions shall be included as a stand-alone section in the contract documents. The Applicant and the consulting engineer (Engineer) should carefully study these provisions before incorporating them into the construction contract documents. In particular, Water Districts and other types of districts should be aware of statutes relating to their creation and operation which may affect the application of these conditions. **The TWDB Project Engineer/Reviewer should be consulted if the Applicant thinks there is a need to modify parts of these provisions.**

Supplemental Condition #13 (Archeological Discoveries and Cultural Resources) and #14 (Endangered Species) may be superseded or modified by project specific conditions established during the environmental review process.

These documents may confer certain duties and responsibilities on the Engineer that are beyond, or short of, what the Applicant intends to delegate. The Applicant should ensure that the contractual agreement with the Engineer provides for the appropriate services. Otherwise the Applicant should revise the wording in these special conditions to agree with actually delegated functions.

4. Good Business Practices

There are other contract provisions that the Applicant (Owner) and Engineer should include as a matter of good business practices. It is recommended that provisions addressing the following matters be included in the construction contract.

(a) Specifying the time frame for accomplishing the construction of the project, and the consequences of not completing on time, including liquidation damages.
(b) Specifying the type, dollar value, and documentation of insurance the contractor is to carry. At a minimum the contractor should carry worker's compensation, liability and builder's risk insurance.
(c) Identifying the responsibility of the contractor – Responsibility and Warranty of Work.
(d) Price reduction for defective pricing of negotiated costs.
(e) Differing site conditions - notice and claims regarding site conditions differing from indicated conditions.
(f) Covenants against contingent fees - prohibit contingent fees for securing business.
(g) Gratuities - prohibitions against offering and accepting gratuities.
(h) Audit and access to records.
(i) Suspension of work - conditions under which the Owner may suspend work.
(j) Termination - conditions under which the Owner may terminate the contract.
(k) Remedies - procedures for resolving disputes.

5. Other Requirements

There may be other local government requirements and applicable Federal and State statutes and regulations that are not accommodated by these conditions. It is the Applicant's responsibility to ensure that the project and all contract provisions are consistent with the relevant statutes and regulations.

6. Advertisements for Bids

State procurement statutes require advertising a contract for bids for at least two (2) consecutive weeks. By not following this requirement, the project may need to be re-advertised. The official advertisement for bids that is published in newspapers shall include certain information such as, but not limited to, the following:

(a) A clear description of what is being procured.
(b) How to obtain plans and specifications (P&S) and necessary forms and information.
(c) The date and time by which bids are to be submitted (deadline).
(d) The address where bids are to be provided.
(e) This contract is contingent upon release of funds from the Texas Water Development Board (TWDB).
(f) Any contract(s) awarded under this Invitation for Bids is/are subject to the United States Iron and Steel (US I&S) requirements of Texas Water Code §17.183 and/or Texas Government Code, Chapter 2252, Subchapter F, as amended by SB 1289, 85th Legislative Session, as applicable. (NOTE: does not apply to SWIFT projects funded prior to May 1, 2019).
(g) Acknowledgement of any special requirements such as mandatory pre-bid conference.
(h) Right to reject any and all bids.
(i) General bond requirements.

Bid Proposal

The Bid Proposal form should account for the following:

(a) If lump sum bid, include a list of the materials used and associated costs.
(b) Distinguish eligible and ineligible items.
(c) Accommodate trench safety requirements with separate per unit pay item for trench excavation safety protection, Health and Safety Code Chapter 756, Subchapter C.
(d) Include space for the Contractor to acknowledge receipt of each Addendum issued during the bidding process.

7. Bidding Process

The Plans and Specifications (P&S) should include an explanation of how the bids will be processed. The explanation should include the following components:

(a) Whether a pre-bid conference will be held, whether it is optional or mandatory, where and when it will be held.
(b) Specify the criteria and process for determining responsiveness and responsibility of the bidder.
(c) Specify the method of determining the successful bidder and award (e.g., award to the lowest responsive, responsible bidder, accounting for any multiple parts to bids) and accounting for non-resident bidder reciprocity requirements.
(d) Allow for withdrawal of a bid due to a material mistake.
(e) Identify the time frame that the bids may be held by the Applicant before awarding a contract (e.g., typically for 60 or 90 days).
(f) Acknowledge right of the Applicant to reject any and all bids.

8. Release of Funds

(a) Submittal of Bid Documents to TWDB Project Engineer/Reviewer to allow contingent award of contract:

    (1) Advertisement and affidavit of advertisement.
    (2) Bid tabulation.
    (3) All addenda submitted and approved for the contract.
    (4) Bid proposal of apparent low bidder (or chosen bidder, with explanation) with bid bond.
    (5) Site certificate (ED-101).
    (6) Consulting engineer's recommendation to award letter.
    (7) A description of any bidding irregularities.
    (8) Construction inspection proposal.
    (9) Vendor Compliance with Reciprocity of Non-Resident Bidders Form (TWDB-0459).

(b) Following contingent award of the contract, TWDB Project Engineer/Reviewer should receive a bound copy of the executed contract documents (including specifications). This document should include:

(1) Executed agreement.
(2) Contractor's act of assurance (ED-103).
(3) Contractor's act of assurance resolution (ED-104).
(4) Payment and Performance bond (must be executed on or after the date of execution of the contract).
(5) Contractor's Certificate of Insurance.
(6) Sufficiency of funds letter (if the project is not 100% funded with TWDB funds).

After reviewing and approving the executed bid documents, the TWDB will issue an authorization for the Applicant to issue a notice to proceed. At this time, TWDB staff can begin releasing construction funds, in accordance with program specific requirements.

For any questions or proposed modifications to these conditions, please contact your TWDB Project Engineer/Reviewer.

II. INSTRUCTIONS TO BIDDERS

The language and conditions listed in this section shall be included in the "Instructions to Bidders" section of the construction contract document.

1. Contingent Award of Contract

This contract is contingent upon release of funds from the Texas Water Development Board. Any contract or contracts awarded under this Invitation for Bids is/are expected to be funded in part by a loan or grant from the Texas Water Development Board. Neither the state of Texas, nor any of its departments, agencies, or employees are or will be a party to this Invitation for Bids or any resulting contract.

2. U.S. Iron and Steel (Does not apply to SWIFT Projects funded prior to May 1, 2019)

Any contract(s) awarded under this Invitation for Bids is/are subject to the United States Iron and Steel requirements of Texas Water Code §17.183 and/or Texas Government Code, Chapter 2252, Subchapter F, as amended by SB 1289, 85th Legislative Session. The contractor must complete the statement of understanding regarding this requirement, found in the Supplemental Contract Conditions, Item No. 9. Refer to TWDB-1105 – United States Iron and Steel (US I&S) Guidance.

3. Bid Guarantee

Each bidder shall furnish a bid guarantee equivalent to five percent of the bid price (Water Code §17.183). If a bid bond is provided, the Contractor shall utilize a surety company which is authorized to do business in Texas in accordance with Surety Bonds and Related Instruments, Chapter 3503 of the Insurance Code.

4. Award of Contract to Nonresident Bidder

A governmental entity may not award a governmental contract to a nonresident bidder unless the nonresident underbids the lowest bid submitted by a responsible resident bidder by an amount that is not less than the amount by which a resident bidder would be required to underbid the nonresident bidder to obtain a comparable contract in the state in which the nonresident's principal place of business is located. A non-resident bidder is a Contractor whose corporate offices or principal place of business is outside of the state of Texas (Source: Texas Government Code, Chapter 2252, Subchapter A, Nonresident Bidders, §2252.002).

The bidder will complete form TWDB-0459, Vendor Compliance with Reciprocity on Non-Resident Bidders, **which must be submitted with the bid.**

III. SUPPLEMENTAL CONTRACT CONDITIONS

1. Supersession

The Owner and the Contractor agree that the TWDB Supplemental Conditions apply to the work eligible for Texas Water Development Board assistance to be performed under this contract and these clauses supersede any conflicting provisions of this contract.

2. Privity of Contract

Funding for this project is expected to be provided in part by a loan or grant from the Texas Water Development Board. Neither the state of Texas, nor any of its departments, agencies or employees is, or will be, a party to this contract or any lower tier contract. This contract is subject to applicable provisions in 31 TAC Chapter 363 in effect on the date of the assistance award for this project.

3. Definitions

(a) The term "Owner" means the local entity contracting for the construction services.
(b) The term "TWDB" means the Executive Administrator of the Texas Water Development Board, or other person who may be at the time acting in the capacity or authorized to perform the functions of such Executive Administrator, or the authorized representative thereof.
(c) The term "Engineer" means the Owner's authorized consulting engineer for the project.

4. Laws to be Observed

In the execution of the contract, the Contractor must comply with all applicable local, state and federal laws, including but not limited to laws concerned with labor, safety, minimum wages, and the environment. The Contractor shall be familiar with and at all times shall observe and comply with all federal, state, and local laws, ordinances and regulations which in any manner affect the conduct of the work, and shall indemnify and save harmless the Owner, Texas Water Development Board, and their representatives against any claim arising from violation of any such law, ordinance or regulation by the Contractor, their Subcontractor or their employees.

5. Review by Owner and TWDB

(a) The Owner, authorized representatives and agents of the Owner, and the TWDB shall, at all times have access to and be permitted to observe and review all work, materials, equipment, payrolls, personnel records, employment conditions, material invoices, and other relevant data and records pertaining to this contract, provided, however that all instructions and approval with respect to the work will be given to the Contractor only by the Owner through authorized representatives or agents.

(b) Any such inspection or review by the TWDB shall not subject the state of Texas, or its representatives, to any action for damages.

6. Performance and Payment Bonds

Each Contractor awarded a construction contract must furnish performance and payment bonds:

(a) the performance bond shall include without limitation guarantees that work done under the contract will be completed and performed according to approved plans and specifications and in accordance with sound construction principles and practices;

(b) the performance and payment bonds shall be in a penal sum of not less than 100 percent of the contract price and remain in effect for one year beyond the date of approval by the Engineer of the political subdivision; and

(c) the Contractor shall utilize a surety company that is authorized to do business in Texas in accordance with Surety Bonds and Related Instruments, Chapter 3503 of the Insurance Code.

7. Payments Schedule and Cost Breakdown

(a) The Contractor shall submit for approval immediately after execution of the Agreement, a carefully prepared Progress Schedule, showing the proposed dates of starting and completing each of the various sections of the work, the anticipated monthly payments to become due to the Contractor, and the accumulated percent of progress each month.

(b) The following paragraph applies only to contracts awarded on a lump sum contract price:

COST BREAKDOWN - The Contractor shall submit to the Owner a detailed breakdown of the estimated cost of all work to be accomplished under the contract, so arranged and itemized as to meet the approval of the Owner or funding agencies. This breakdown shall be submitted promptly after execution of the agreement and before any payment is made to the Contractor for the work performed under the contract. After approval by the Owner the unit prices established in the breakdown shall be used in estimating the amount of partial payments to be made to the Contractor.

8. Workers' Compensation Insurance Coverage (as applicable, consistent with Texas Labor Code § 406.096)

(a) The Contractor shall certify in writing that they provide workers' compensation insurance coverage for each employee of the Contractor employed on the public project.
(b) Each Subcontractor on the public project shall provide such a certificate relating to coverage of the Subcontractor's employees to the general Contractor, who shall provide the Subcontractor's certificate to the governmental entity.
(c) A Contractor who has a contract that requires workers' compensation insurance coverage may provide the coverage through a group plan or other method satisfactory to the governing body of the governmental entity.
(d) The employment of a maintenance employee by an employer who is not engaging in building or construction as the employer's primary business does not constitute engaging in building or construction.

(e) In this section:

(1) "Building or construction" includes:

i. erecting or preparing to erect a structure, including a building, bridge, roadway, public utility facility, or related appurtenance;

ii. remodeling, extending, repairing, or demolishing a structure; or

iii. otherwise improving real property or an appurtenance to real property through similar activities.

(2) "Governmental entity" means this state or a political subdivision of this state. The term includes a municipality.

9. U.S. Iron and Steel (Does not apply to SWIFT Projects funded prior to May 1, 2019)

The following statement must be completed by the Contractor and made a part of the agreement between the Owner and the Contractor.

The Contractor acknowledges to and for the benefit of the Applicant ("Purchaser") and the Texas Water Development Board ("TWDB") that it understands the goods and services under this Agreement are being funded with monies made available by the Water Development Fund, Rural Water Assistance Fund, Economically Distressed Areas, State Participation Fund and/or Agricultural Water Conservation Fund. That these funds have statutory requirements commonly known as "United States Iron and Steel" that requires all of the iron and steel products used in the project to be produced in the United States ("United States Iron and Steel Requirement") including iron and steel products provided by the Contactor pursuant to this Agreement. The Contractor hereby represents and warrants to and for the benefit of the Purchaser and the TWDB that (a) the Contractor has reviewed and understands the United States Iron and Steel Requirement, (b) all of the iron and steel products used in the project will be and/or have been produced in the United States in a manner that complies with the United States Iron and Steel Requirement, unless a waiver of the requirement is approved, and (c) the Contractor will provide any further verified information, certification or assurance of compliance with this paragraph, or information necessary to support a waiver of the United States Iron and Steel Requirement, as may be requested by the Purchaser or the TWDB. Notwithstanding any other provision of this Agreement, any failure to comply with this paragraph by the Contractor shall permit the Purchaser to enforce this Agreement and recover as damages against the Contractor any loss, expense, or cost (including without limitation attorney's fees) incurred by the Purchaser resulting from any such failure (including without limitation any impairment or loss of funding, whether in whole or in part, from the TWDB or any damages owed to the TWDB by the Purchaser). Neither this paragraph (nor any other provision of this Agreement necessary to give this paragraph force or effect) shall be amended or waived without the prior written consent of the TWDB.

In the execution of the Contract, the Contractor shall be familiar with and at all times shall observe and comply with all applicable federal, state, and local laws, ordinances and regulations concerned with the use of iron and steel made in the United States which in any manner affect the conduct of the work, and shall indemnify and save harmless the Texas Water Development Board against any claim arising from violation of any such law, ordinance or regulation by the Contractor or by their Subcontractor or their employees.

Additional information on the United States Iron and Steel (US I&S) and its applicability to this contract can be found in the TWDB-11005 guidance.

It is recommended the Owner receive and maintain files documenting the Contractor's use of US I&S. Compliance with US I&S will be verified by the Owner through the submittal of the TWDB form TWDB-1105-A.

10. Prevailing Wage Rates

This contract is subject to Government Code Chapter 2258 concerning payment of Prevailing Wage Rates. The Owner will determine what the general prevailing rates are in accordance with the statute. The applicable provisions include, but are not limited to the following:

§2258.021. Right to be Paid Prevailing Wage Rates

(a) A worker employed on a public work by or on behalf of the state or a political subdivision of the state shall be paid:
   (1) not less than the general prevailing rate of per diem wages for work of a similar character in the locality in which the work is performed; and
   (2) not less than the general prevailing rate of per diem wages for legal holiday and overtime work.

(b) Subsection (a) does not apply to maintenance work.

(c) A worker is employed on a public work for the purposes of this section if the worker is employed by a Contractor or Subcontractor in the execution of a contract for the public work with the state, a political subdivision of the state, or any officer or public body of the state or a political subdivision of the state.

§2258.023. Prevailing Wage Rates to be Paid by Contractor and Subcontractor; Penalty

(a) The Contractor who is awarded a contract by a public body or a Subcontractor of the Contractor shall pay not less than the rates determined under Section 2258.022 to a worker employed by it in the execution of the contract.

(b) A Contractor or Subcontractor who violates this section shall pay to the state or a political subdivision of the state on whose behalf the contract is made, $60 for each worker employed for each calendar day or part of the day that the worker is paid less than the wage rates stipulated in the contract. A public body awarding a contract shall specify this penalty in the contract.

(c) A Contractor or Subcontractor does not violate this section if a public body awarding a contract does not determine the prevailing wage rates and specify the rates in the contract as provided by Section 2258.022.

(d) The public body shall use any money collected under this section to offset the costs incurred in the administration of this chapter.

(e) A municipality is entitled to collect a penalty under this section only if the municipality has a population of more than 10,000.

§2258. 024. Records

(a) A Contractor and Subcontractor shall keep a record showing:
  (1) the name and occupation of each worker employed by the Contractor or Subcontractor in the construction of the public work; and
  (2) the actual per diem wages paid to each worker.

(b) The record shall be open at all reasonable hours to inspection by the officers and agents of the public body.

§2258. 025. Payment Greater Than Prevailing Rate Not Prohibited

This chapter does not prohibit the payment to a worker employed on a public work an amount greater than the general prevailing rate of per diem wages.

11. Employment of Local Labor (only applicable to projects funded by EDAP)

The Contractor shall, to the maximum feasible extent, employ local labor for construction of the project. The Contractor and every Subcontractor undertaking to do work on the project which is, or reasonably may be done as on-site work, shall employ qualified persons who regularly reside within the political subdivision boundary of the Owner and the economically distressed area where the project is located (Texas Water Code, Section 17.183).

12. Payments

(a) Progress Payments:
  (1) The Contractor shall prepare their requisition for progress payment as of the last day of the month and submit it, with the required number of copies, to the Engineer for review. Except as provided in paragraph (3) of this subsection, the amount of the payment due the Contractor shall be determined by adding to the total value of work completed to date, the value of materials properly stored on the site and deducting: (1) five percent (5%) minimum of the total amount, as a retainage and (2) the amount of all previous payments. The total value of work completed to date shall be based on the actual or estimated quantities of work completed and on the unit prices contained in the agreement (or cost breakdown approved pursuant to section 7b relating to lump sum bids) and adjusted by approved change orders. The value of materials properly stored on the site shall be based upon the estimated quantities of such materials and the invoice prices. Copies of all invoices shall be available for inspection by the Engineer.

  (2) The Contractor shall be responsible for the care and protection of all materials and work upon which payments have been made until final acceptance of such work and materials by the Owner. Such payments shall not constitute a waiver of the right of the Owner to require the fulfillment of all terms of the Contract and the delivery of all improvements embraced in this contract complete and satisfactory to the Owner in all details.

(3) This clause applies to contracts when the Owner is a District or Authority. The retainage shall be ten percent of the amount otherwise due until at least fifty percent of the work has been completed. After the project is fifty percent completed, and if the District or Authority's Board finds that satisfactory progress is being made, then the District may authorize any of the remaining progress payments to be made in full. The District is not obligated to pay interest earned on the first 50% of work completed (Texas Water Code Sec. 49.276(d)).

(4) The five percent (5%) retainage of the progress payments due to the Contractor may not be reduced until the building of the project is substantially complete and a reduction in the retainage has been authorized by the TWDB.

(b) Withholding Payments. The Owner may withhold from any payment otherwise due the Contractor so much as may be necessary to protect the Owner and if so elects may also withhold any amounts due from the Contractor to any Subcontractors or material dealers, for work performed or material furnished by them. The foregoing provisions shall be construed solely for the benefit of the Owner and will not require the Owner to determine or adjust any claims or disputes between the Contractor and their Subcontractors or Material dealers, or to withhold any monies for their protection unless the Owner elects to do so. The failure or refusal of the Owner to withhold any monies from the Contractor shall in no way impair the obligations of any surety or sureties under any bond or bonds furnished under this contract.

(c) Payments Subject to Submission of Certificates. Each payment to the Contractor by the Owner shall be made subject to submission by the Contractor of all written certifications required of the Contractor, their Subcontractors and other general and special conditions elsewhere in this contract.

(d) Final Payment.

(1) Upon satisfactory completion of the work performed under this contract, as a condition before final payment under this contract or as a termination settlement under this contract the Contractor shall execute and deliver to the Owner a release of all claims against the Owner arising under, or by virtue of, this contract, except claims which are specifically exempted by the Contractor to be set forth therein. Unless otherwise provided in this contract, by state law or otherwise expressly agreed to by the parties to this contract, final payment under this contract or settlement upon termination of this contract shall not constitute a waiver of the Owner' s claims against the Contractor or their sureties under this contract or applicable performance and payment bonds.

(2) After final inspection and acceptance by the Owner of all work under the Contract, the Contractor shall prepare their requisition for final payment which shall be based upon the carefully measured or computed quantity of each item of work at the applicable unit prices stipulated in the Agreement or cost breakdown (if lump sum), as adjusted by approved change orders. The total amount of the final payment due to the Contractor under this contract shall be the amount computed as described above less all previous payments.

(3) The retainage and its interest earnings, if any, shall not be paid to the Contractor until the TWDB has authorized a reduction in, or release of, retainage on the contract work.

(4) Withholding of any amount due to the Owner, under general and/or special conditions regarding "Liquidated Damages" shall be deducted from the final payment due the Contractor.

13. Archaeological Discoveries and Cultural Resources

No activity which may affect properties listed or properties eligible for listing in the National Register of Historic Places or eligible for designation as a State Archeological Landmark is authorized until the Owner has complied with the provisions of the National Historic Preservation Act and the Antiquities Code of Texas. The Owner has previously coordinated with the appropriate agencies and impacts to known cultural or archeological deposits have been avoided or mitigated. However, the Contractor may encounter unanticipated cultural or archeological deposits during construction.

If archeological sites or historic structures which may qualify for designation as a State Archeological Landmark according to the criteria in 13 TAC Chapter 26, or that may be eligible for listing on the National Register of Historic Places in accordance with 36 CFR Part 800, are discovered after construction operations are begun, the Contractor shall immediately cease operations in that particular area and notify the Owner, the TWDB, and the Texas Historical Commission, 1511 N. Colorado St. , P. O. Box 12276, Capitol Station, Austin, Texas 78711-2276. The Contractor shall take reasonable steps to protect and preserve the discoveries until they have been inspected by the Owner's representative and the TWDB. The Owner will promptly coordinate with the State Historic Preservation Officer and any other appropriate agencies to obtain any necessary approvals or permits to enable the work to continue. The Contractor shall not resume work in the area of the discovery until authorized to do so by the Owner.

14. Endangered Species

No activity is authorized that is likely to jeopardize the continued existence of a threatened or endangered species as listed or proposed for listing under the Federal Endangered Species Act (ESA), and/or the State of Texas Parks and Wildlife Code on Endangered Species, or to destroy or adversely modify the habitat of such species.

If a threatened or endangered species is encountered during construction, the Contractor shall immediately cease work in the area of the encounter and notify the Owner, who will immediately implement actions in accordance with the ESA and applicable State statutes. These actions shall include reporting the encounter to the TWDB, the U.S. Fish and Wildlife Service, and the Texas Parks and Wildlife Department, obtaining any necessary approvals or permits to enable the work to continue, or implement other mitigation actions. The Contractor shall not resume construction in the area of the encounter until authorized to do so by the Owner.

15. Hazardous Materials

Materials utilized in the project shall be free of any hazardous materials, except as may be specifically provided for in the specifications.

If the Contractor encounters existing material on sites owned or controlled by the Owner or in material sources that are suspected by visual observation or smell to contain hazardous materials, the Contractor shall immediately notify the Engineer and the Owner. The Owner will be responsible for the testing and removal or disposal of hazardous materials on sites owned or controlled by the Owner. The Owner may suspend the work, wholly or in part during the testing, removal or disposal of hazardous materials on sites owned or controlled by the Owner.

16. Changes

*Provisions identified with an asterisk below are consistent with Local Government Code 271.060. Counties and Municipalities may modify the identified provisions, when applicable, to conform to Local Government Code 262.031 (Counties) or 252.048 (Municipalities).

(a) The Owner may at any time, without notice to any surety, by written order designated or indicated to be a change order, make changes in the work within the general scope of the contract, including but not limited to changes:
  (1) In the specifications (including drawings and designs);
  (2) In the time, method or manner of performance of the work;
  (3) To decrease or increase the quantity of work to be performed or materials, equipment or supplies to be furnished;

(b) *The total price of a contract may not be increased by a change order unless provision has been made for the payment of the added cost by the appropriation of current funds or bond funds for that purpose, by the authorization of the issuance of certificates, or by a combination of those procedures.

(c) *A contract with an original contract price of $1 million or more may not be increased by more than 25 percent. If a change order for a contract, with an original contract price of less than $1 million, increases the contract amount to $1 million or more, subsequent change orders may not increase the revised contract amount by more than 25 percent.

(d) *A governing body may grant authority to an official or employee responsible for purchasing or for administering a contract to approve a change order that involves an increase or decrease of $50,000 or less.

(e) Changes that involve an increase in price will be supported by documentation of the cost components. For projects funded through the EDAP program, or with grant proceeds, TWDB staff may request this information to be provided in a format equivalent to the Cost and Pricing Information form (No. WRD-277).

(f) Any change orders involving a change in the project requiring a relocation of project components, sizing, or process may require additional environmental approval. A map and description of the proposed changes should be sent to the TWDB Environmental

Reviewer for coordination and approval as soon as possible to avoid any delay.

17. Operation and Maintenance Manuals and Training

(a) The Contractor shall obtain installation, operation, and maintenance manuals from manufacturers and suppliers for equipment furnished under the contract. The Contractor shall submit three copies of each complete manual to the Engineer within 90 days after approval of shop drawings, product data, and samples, and not later than the date of shipment of each item of equipment to the project site or storage location.

(b) The Owner shall require the Engineer to promptly review each manual submitted, noting necessary corrections and revisions. If the Engineer rejects the manual, the Contractor shall correct and resubmit the manual until it is acceptable to the Engineer as being in conformance with the design concept of the project and for compliance with information given in the contract documents. Owner may assess Contractor a charge for reviews of same items in excess of three (3) times. Such procedure shall not be considered cause for delay.

(c) Acceptance of manuals by Engineer does not relieve Contractor of any requirements of terms of Contract.

(d) The Contractor shall provide the services of trained, qualified technicians to check final equipment installation, to assist as required in placing same in operation, and to instruct operating personnel in the proper manner of performing routine operation and maintenance of the equipment.

(e) Operations and maintenance manuals specified hereinafter are in addition to any operation, maintenance, or installation instructions required by the Contractor to install, test, and start-up the equipment.

(f) Each manual is to be bound in a folder and labeled to identify the contents and project to which it applies. The manual shall contain the following applicable items:
   (1) A listing of the manufacturer's identification, including order number, model, serial number, and location of parts and service centers.
   (2) A list of recommended stock of parts, including part number and quantity.
   (3) Complete replacement parts list.
   (4) Performance data and rating tables.
   (5) Specific instructions for installation, operation, adjustment, and maintenance.
   (6) Exploded view drawings for major equipment items.
   (7) Lubrication requirements.
   (8) Complete equipment wiring diagrams and control schematics with terminal identification.

18. As-built Dimensions and Drawings

(a) Contractor shall make appropriate daily measurements of facilities constructed and keep accurate records of location (horizontal and vertical) of all facilities.

(b) Upon completion of each facility, the Contractor shall furnish the Owner with one set of direct prints, marked with red pencil, to show as-built dimensions and locations of all work constructed. As a minimum, the final drawings shall include the following:
   (1) Horizontal and vertical locations of work.
   (2) Changes in equipment and dimensions due to substitutions.
   (3) "Nameplate" data on all installed equipment.
   (4) Deletions, additions, and changes to scope of work.
   (5) Any other changes made.

19. Close-Out Procedures

To close-out the contract and release final retainage, the following steps must be completed:

(a) TWDB Staff must conduct a construction contract final inspection (CCFI).

(b) The following submittals must be received, reviewed, and accepted by TWDB:
   (1) The final change order, adjustment of quantities, or a statement that all change orders have previously been submitted and there will be no more change orders;
   (2) The final pay request from the Contractor;
   (3) An affidavit by the Contractor that all bills have been paid;
   (4) Certification by the consulting Engineer that the work has been completed and was constructed in accordance with the approved plans and specifications and sound engineering principles and construction practices;
   (5) Acceptance of the project by the Owner in the form of a written resolution or other formal action;
   (6) Notification of the beginning date of the warranty period for the contract; and
   (7) Confirmation that the Owner has received as-built drawings from the Contractor.
   (8) Certificate of Compliance with U.S. Iron and Steel Requirements (TWDB-1105A)

(c) TWDB will issue a Certificate of Approval allowing the release of retainage.

IV. FORMS AND GUIDANCE LIST

The following documents, mentioned throughout this guidance are available on the TWDB website at: http://www.twdb.texas.gov/financial/instructions/index.asp

Forms:

The following forms must be included in the bid documents:

- Contractor' s Act of Assurance (ED-103)
- Contractor' s Act of Assurance Resolution (ED-104)
- Certificate of Compliance with U.S. Iron and Steel Requirements (TWDB-1105A)
- Site Certificate (ED-101)
- Vendor Compliance with Reciprocity of Non-Resident Bidders (TWDB-0459).

Guidance Document:

- United States Iron and Steel Guidance (TWDB-1105)

TWDB-0459
Rev 01/17

VENDOR COMPLIANCE WITH RECIPROCITY ON NON- RESIDENT BIDDERS

Texas Government Code Section 2252.002 provides that in order for nonresident bidders to be awarded a governmental contract, the bidder must bid projects for construction, improvements, supplies, or services in Texas at an amount lower than the lowest Texas resident bidder by the same amount that a Texas resident bidder would be required to underbid the nonresident bidder in order to obtain a comparable contract in the nonresident bidder's state. A nonresident bidder is a person, including a contractor, whose principal place of business or corporate office is outside of the state of Texas. This requirement does not apply to a contract involving Federal funds. The appropriate blanks in Section A must be filled out by all nonresident bidders in order for your bid to meet specifications. The failure of a nonresident bidder to do so will automatically disqualify that bidder. Resident bidders must check the blank in Section B.

A. Non-resident vendors in _____(give state), our principal place of business, are required to be _____percent lower than resident bidders by state law. A copy of the statute is attached.

   Non-resident vendors in _____ (give state), our principal place of business, are not required to underbid resident bidders.

B. Our principal place of business or corporate office is in the state of Texas:_____.

BIDDER:

_____
Company

_____
City State Zip

_____
By (print name)

_____
Signature

_____
Title (print)

THIS FORM MUST BE RETURNED WITH THE BID

STATE OF TEXAS §
§
COUNTY OF _____ §

SITE
CERTIFICATE

Before me, the undersigned notary, on this day personally appeared _____, a person whose identity is known to me or who has presented to me a satisfactory proof of identity. After I administered an oath, this person swore to the following:

(1) My name is_____. I am over 18 years of age and I am of sound mind, and capable of swearing to the facts contained in this Site Certificate. The facts stated in this certificate are within my personal knowledge and are true and correct.

(2) I am an authorized representative of _____, an entity that has filed an application for financial assistance with the Texas Water Development Board for a (water) (wastewater) project.

Please complete only those sections that apply to your project:

LEGAL CERTIFICATION – LEASE/CONTRACT

I certify that: _____
(Legal Name of Applicant, i.e., City, District, etc.)

has executed a written lease or other contractual agreement to use the property needed for this (water)(wastewater) project that extends through _____(date), the life of the Texas Water Development Board loan or grant that will be used to finance this project, either in whole or in part. A copy of this lease or agreement is attached hereto.

LEGAL CERTIFICATION – PROPERTY EASEMENT

I certify that: _____
(Legal Name of Applicant, i.e., City, District, etc.)

has executed an express easement to use the property needed for this (water) (wastewater) project that extends through the life of the Texas Water Development Board loan or grant that will be used to finance this project, either in whole or in part. The express easement to use the property needed for this (water) (wastewater) project extends through _____ (date). A copy of the express easement agreement is attached hereto.

LEGAL CERTIFICATION – OWNERSHIP INTEREST

I certify that_____
(Legal Name of Applicant, e.g. City, District, etc.)

◯ Option A: has acquired the necessary real property interest, as evidenced by fee simple purchase, deed, fully executed earnest money contracts, or completion of eminent domain proceedings; that such acquisition will guarantee access and egress; and such interest will contain the necessary easements, rights of way, or unrestricted use as is required for the project being financed by the Texas Water Development Board. The legal description is referenced below.

◯ Option B: is in the process of acquiring the necessary real property interest, as evidenced by earnest money contracts, contracts for sale, firm option agreements to purchase the subject property, or the initiation of eminent domain procedures; that such acquisition will guarantee access and egress; and such interest will contain the necessary easements, rights of way, or unrestricted use as is required for the project being financed by the Texas Water Development Board. The legal description is referenced below. The anticipated date of acquisition is: _____.

The property has been/will be acquired with the use of eminent domain: ◯ True ◯ False

Location and Description of Property Interests acquired for Project:

Any deeds or other instruments required to be recorded to protect the title(s) held by _____ (Legal Name of Applicant) have been recorded or filed for the record in the County deed records or other required location. The following documents are attached hereto:

Description of documents that were used or will be used to acquire the property:

EXECUTED this_____day of _____, 20_____.

_____ (Signature)

_____ (Print Name)

_____ (Title)

Sworn to and subscribed before me by _____ on this _____ day of_____,20_____.

_____(Notary Public in and for the State of Texas)

[SEAL]

CONTRACTOR'S ACT OF ASSURANCE

STATE OF TEXAS §
§
COUNTY OF_____§

BEFORE ME _____, a Notary Public duly commissioned and qualified in and for the County of _____ in the State of Texas came and appeared _____, as represented by _____, the Corporation's _____, who declares he/she is authorized to represent _____ pursuant to provisions of a resolution adopted by said Corporation on the _____ day of _____, 20_____(a duly certified copy of such resolution is attached to and is hereby made a part of this document).

_____, as the representative of, _____declares that _____ assures the Texas Water Development Board that it will construct _____ project at _____, Texas, in accordance with sound construction practice, all laws of the State of Texas, and the rules of the Texas Water Development Board.

GIVEN UNDER MY HAND and seal of office this _____ day of _____, 20_____.

_____ (Notary Public in and for the State of Texas)

_____ (Print Name)

[SEAL]

CONTRACTOR'S ACT OF ASSURANCE RESOLUTION

I hereby certify that it was RESOLVED by a quorum of the directors of the _____(Name of Corporation), meeting on the_____day of _____ 20_____, that:

Authorized Representative(s):

be, and hereby is/are authorized to act on behalf of _____ (Name of Corporation), as its representative in all business transactions conducted in the State of Texas, and;

That all above resolution was unanimously ratified by the Board of Directors at said meeting and that the resolution has not been rescinded or amended and is now in full forces and effect; and;

In authentication of the adoption of this resolution, I subscribe my name and affix the seal of the Corporation this _____ day of _____, 20_____.

_____(Secretary)

[SEAL]

DIVISION 1

GENERAL REQUIREMENTS

01 11 00 SUMMARY OF WORK

PART 1 - GENERAL

1.01 SUMMARY

A. Construct Work as described in the Contract Documents.

1. Provide the materials, equipment, and incidentals required to make the Project completely and fully operable.
2. Provide the labor, equipment, tools, and consumable supplies required for a complete Project.
3. Provide the civil, architectural, structural, mechanical, electrical, instrumentation, and all other Work required for a complete and operable Project.
4. Test and place the completed Project in operation.
5. Provide the special tools, spare parts, lubricants, supplies, or other materials as indicated in the Contract Documents for the operation and maintenance of the Project.
6. The Contract Documents do not indicate or describe all Work required to complete the Project. Additional details required for the correct installation of selected products are to be provided by the Contractor and coordinated with the Construction Manager.

1.02 DESCRIPTION OF WORK

A. Work is described in general, non-inclusive terms as:

1. Clearing of the pump station property to the limits shown on the drawings
2. Excavation, earthwork, compacted fill placement and site grading
3. Construction of pump station foundation and building superstructure
4. Construction of Operations Center
5. Construction of two (2) 10-million-gallon pre-stressed concrete tanks, tank foundations and associated excavation and backfill
6. Installation of pump station equipment and piping, including but not limited to pumps, motors, variable frequency drives, pump control ball valves, pump room traveling crane, interior piping and valves, floor drains, plumbing systems, 5kV switchgear and motor control centers, other general electrical work, instrumentation and control, HVAC systems, and miscellaneous work associated with above and as shown on the Drawings or as specified
7. Construction of yard piping and associated appurtenances, including but not limited to air valves, blow-off valves, and butterfly valves
8. Installation of pump station utilities, including but not limited to telephone, sewer, water and electricity
9. Construction of access roads, parking areas, fences, gates, and other site modifications as shown on the Drawings

10. Making tie-ins and as required to connect the new pump station yard piping to proposed piping by others
11. Coordination and interface with the power company who will be providing service to the site
12. Coordination and interface with third party on-site generation contractor
13. Construction of a transformer yard, equipment pads, power poles and other appurtenances for primary power; Provide and install two (2) 34.5kV to 4160V, 10-MVA transformers.
14. Construction of electrical duct banks
15. Construction of all on-site power and instrumentation
16. Construction of site and building electronic surveillance and security
17. Coordinate with others performing fiber optic installation and SCADA activities
18. Restoring the project area upon completion of the pump station construction

1.03 WORK UNDER OTHER CONTRACTS

A. The following items of work are not included in this Contract, but may impact construction scheduling, testing, and startup:

Owner	Description
City of Houston	Northeast Water Treatment Plant Expansion
WHCRWA	Segment A1 Waterline Package
WHCRWA	Segment A2 Waterline Package
WHCRWA	Segment B1 Waterline Package
WHCRWA	Segment B2 Waterline Package
WHCRWA	Segment B3 Waterline Package
WHCRWA	Segment C1 Waterline Package
WHCRWA	Segment C2 Waterline Package
WHCRWA	Central Pump Station Project
WHCRWA	Fiber Optic Installation and Termination Project
WHCRWA	System-Wide SCADA Network and upgrades
WHCRWA	NEWTP Valve Delivery Station
CenterPoint	Power Company Permanent Service to Re-Pump Station

B. Bring any discrepancies in the list to the attention of the Construction Manager. It will be deemed that the Contractor included the more expensive listing in the Contract Price if the Contractor fails to bring any discrepancies to the attention of the Construction Manager prior to executing the Agreement.

C. Completion of the Work described in this Contract may impact the construction and testing of the items listed above.

1. Coordinate construction activities through the Construction Manager.
2. Pay claims for damages which result from the late completion of the Project or any specified Milestones.

1.04 WORK BY OWNER

A. The Owner has no knowledge of work, other than the Work included in this Contract that may impact construction scheduling, testing, and startup.

B. The Owner plans to perform the following items of work which are not included in this Contract, but may impact construction scheduling, testing, and startup:

Owner	Description
WHCRWA	Based on Completion of other projects, availability of water for final 30-day testing may be limited or delayed.

C. Bring any discrepancies between the projects listed above and those specified elsewhere in the Contract Documents to the attention of the Construction Manager. It will be deemed that the Contractor included the more expensive listing in the Contract Price if the Contractor fails to bring any discrepancies to the attention of the Construction Manager prior to executing the Agreement.

D. Completion of the Work described in this Contract may impact the construction and testing of the items listed above.

1. Coordinate construction activities through the Construction Manager.

2. Pay claims for damages which result from the late completion of the Project or any specified Milestones.

E. Owner will provide normal operation and maintenance of the existing facilities during construction, unless otherwise stated.

1.05 CONSTRUCTION OF UTILITIES

A. Utility companies or their contractors will provide new or enhanced utilities for this Project. Coordinate with others performing Work associated with this Project.

B. Power and Electrical Services:

1. Provide permanent power connections for the Site through the power utility unless indicated otherwise in the Contract Documents.

2. Pay for permits and for providing permanent power.

3. Coordinate and cooperate with others performing this Work.

4. Power utility will provide the construction to the point shown on the Drawings.

5. Provide conduit, conductors, pull boxes, manholes, and other appurtenances for the installation of power cable between the property line and the transformer and between the transformer and the main power switch unless the Contract Documents indicate otherwise.

6. Test conductors in accordance with the Specifications and requirements of the power utility and coordinate with the power utility to energize the system when ready.

7. Pay for temporary power including construction cost, meter connection, fees, and permits.

8. Contractor may use the permanent power source in lieu of temporary power source when permanent power is available at the Site.
    a. Notify Construction Manager and Owner of intent to use the permanent power source.
    b. Arrange with the power utility and pay the charges for connections and monthly charges for use of this power.
9. Pay for the power consumed until the Project has been accepted as Substantially Complete unless noted otherwise.

C. Telephone Services:

1. Provide permanent telephone service for the Site through the telephone utility.
2. Pay for providing permanent telephone service.
3. Coordinate and cooperate with others performing this Work.
4. Telephone utility will provide construction to the property line.
5. Provide conduit, cable, pull boxes, manholes, and other appurtenances for the installation of telephone cable between the property line and the main telephone terminal board.
6. Test all cable and connections in accordance with Specifications and telephone utility requirements and coordinate with the telephone utility to ring out all lines on the system when ready.
7. Pay for temporary service including construction cost, telephones, internet and equipment, connection fees, and permit.
8. Contractor may use the permanent telephone lines in lieu of temporary lines when permanent lines are available at the Site.
9. Notify Construction Manager and Owner of intent to use the permanent telephone system.
10. Arrange with the telephone utility and pay the charges for connections and monthly charges for use of this service.
11. Pay for the service until the Project has been accepted as Substantially Complete. Provide separate service for Owner, Contractor, and Construction Manager.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

01 14 50 USE OF PREMISES

1.00 GENERAL

1.01 SECTION INCLUDES

A. General use of the site including properties inside and outside of rights-of-way, work affecting road, ramps, streets and driveways and notification to adjacent occupants.

1.02 RIGHTS-OF-WAY

A. Confine access, and operations and storage areas to rights-of-way provided by the Authority as stipulated in Document 00700 - General Conditions; trespassing on abutting lands or other lands in the area is not allowed.

B. Make arrangements, at no cost to the Authority for temporary use of private properties. Contractor and Surety shall indemnify and hold harmless the Authority against claims or demands arising from such use of properties outside of rights-of-way. Submit a copy of agreements between private property owners and Contractor prior to use of the area. Agreements between private property owners and Contractor shall be notarized or bear the signatures of two witnesses.

C. Restrict total length of distributed materials along the route of construction to 1,000 linear feet unless otherwise approved in writing by Engineer.

D. Maintain TxDOT and Harris County Right-Of-Way at all times, including keeping pavement clean and preventing erosion to roadside ditches and other areas. Regularly mow grass lined ditches and other Right-Of-Way areas which receive discharged water from construction activities. No separate pay.

1.03 PROPERTIES OUTSIDE OF RIGHTS-OF-WAY

A. Do not alter the condition of properties adjacent to and along rights-of-way.

B. Do not use ways, means, methods, techniques, sequences, or procedures that result in damage to properties or improvements.

C. Restore damaged properties outside of rights-of-ways at no cost to the Authority.

1.04 USE OF SITE

A. Obtain approvals from governing authorities prior to impeding or closing public roads and streets. Do not close more than two consecutive intersections at one time.

B. Notify Engineer and COH Public Works and Engineering Traffic Management Branch at least five working days prior to closing a street or street crossing. Obtain permits for street closures in advance.

C. Maintain 10-foot-wide minimum access lanes for emergency vehicles including access to fire hydrants.

D. Avoid obstructing drainage ditches or inlets. When obstruction is unavoidable due to requirements of the Work, provide grading and temporary drainage structures to maintain unimpeded flow.

E. Locate and protect private lawn sprinkler systems that may exist within the site. Repair or replace damaged systems to condition existing at start of the Work, or better. Test irrigation system prior to construction.

F. Perform daily clean up in affected construction areas in order to restore site to existing or better conditions. Areas should be free of debris, scrap material, dirt, mud, and other items identified by Engineer. Do not leave buildings, roads, streets, and other construction areas unclean.

G. Restore damaged landscaping, other than landscaping designated for removal, to condition existing at start of Work, or better

H. Beware of overhead power lines existing in area and in close proximity of the Project. When 10 feet of clearance between energized overhead power line and construction-related activity cannot be maintained, request Center Point Energy (CPE) de-energize or move conflicting overhead power line. Contact CPE representatives at (713) 207-2222. Schedule, coordinate and pay costs associated with de-energizing or moving conflicting overhead power lines. When there is no separate pay item for this effort, include these costs in various items of bid that make such work necessary.

I. Accessibility to easement along Project alignment is limited after rainfall events. Provide necessary means to maintain access at all times. No separate pay. No extra days will be granted for inaccessibility to the site.

J. Maintain access to all Metro bus stops. Replace Metro bus sign (Stop) and temporary pedestrian pad/shelter along routed road for Metro passenger pick-up/drop-off if required.

K. Protect and maintain existing fences within construction limit and in near vicinity as necessary.

L. Restore drainage swale and channel to the original condition or better if damaged.

1.05 NOTIFICATION TO ADJACENT OCCUPANTS

A. Notify individual occupants in areas to be effected by the Work of proposed construction and time schedule. Notify not less than 72 hours or more than two weeks prior to work performed within 200 feet of homes or businesses. Follow form and content of sample door hanger provided by Engineer.

B. Include in notification nature of the Work, and names and telephone numbers of two company representatives for resident contact available on 24-hour call.

C. Submit proposed notification to Engineer for approval. Consider ethnicity of the neighborhood where English is not the dominant language. Provide notice in an understandable language.

1.06 PUBLIC, TEMPORARY, AND CONSTRUCTION ROADS AND RAMPS

A. Construct and maintain temporary detours, ramps, and roads to provide for normal public traffic flow when it is necessary to close public roads or streets.

B. Provide mats or other means to prevent overloading or damage to existing roadways from tracked equipment, large tandem axle trucks or equipment that will damage the existing roadway surfaces.

C. Construct and maintain access roads and parking areas as specified in Section 01 50 40 - Temporary Facilities and Controls.

1.07 EXCAVATION IN STREETS AND DRIVEWAYS

A. Avoid hindering or inconveniencing public travel on streets or intersecting alleys for more than two blocks at any one time, except by permission of the Engineer.

B. Obtain Traffic Management Branch and Project Manger’s approval when nature of the Work requires closure of an entire street. Permits required for street closure are Contractor's responsibility. Avoid unnecessary inconvenience to abutting property owners.

C. Remove surplus materials and debris and open each block for public use, as work in that block is complete.

D. Acceptance of any portion of the Work will not be based on return of street to public use.

E. Avoid obstructing driveways or entrances to private property.

F. Provide temporary crossings or complete excavation and backfill in one continuous operation to minimize duration of obstruction when excavation is required across drives or entrances.

G. Provide barricades and signs in accordance with Section VI of the State of Texas Manual on Uniform Traffic Control Devices.

1.08 TRAFFIC CONTROL

A. Comply with traffic regulation as specified in Section 01555 - Traffic Control and Regulation.

1.09 SURFACE RESTORATION

A. Restore the site including landscaping to the condition existing before construction, or better.

B. Repair paved areas per the requirements of Harris County.

C. Repair damaged turf areas, level with topsoil conforming to Section 32 91 19.13 – Topsoil Placement and Grading. Where indicated, reseed in accordance with Section 31 25 13.13 – Seeding for Erosion Control.

1.10 LIMITS OF CONSTRUCTION

A. Confine operations to lands within construction work limits shown on Drawings. Unless otherwise noted on Drawings adhere to the following:

1. Where utility alignment is within esplanade, and construction limits are shown on Drawings to extend to edge of esplanade, keep equipment, materials, stockpiles a minimum of five feet from back of curb.

2. Where construction limits shown on Drawings extend to property line, keep sidewalks free of equipment, materials, and stockpiles.

1.11 EQUIPMENT AND MATERIAL SALVAGE

A. Upon completion of the Work, carefully remove salvageable equipment and material. Deliver them to Authority as directed by Engineer. Dispose of equipment offsite at no additional cost to the Authority when Engineer deems equipment unfit for further use.

1.12 COORDINATE WITH OTHER AGENCIES

A. Coordinate work with adjacent contractors on access to the site. Avoid obstructing the other agencies' work.

B. Refer to Section 01 11 00 for additional information.

2.00 PRODUCTS - NOT USED

3.00 EXECUTION - NOT USED

END OF SECTION

01 23 10 ALTERNATES AND ALLOWANCES

PART 1 - GENERAL

1.01 SUMMARY

A. Alternates:

1. This Section describes each alternate by number and describes the basic changes to be incorporated into the Work when this alternate is made a part of the Work in the Agreement.
2. The Drawings and Specifications will outline the extent of Work to be included in the alternate Contract Price.
3. Coordinate related Work and modify surrounding Work as required to properly integrate the Work under each alternate, and provide a complete and functional Project as required by the Contract Documents.
4. Alternate Bids or Proposals may be accepted or rejected at the option of the Owner.
5. Owner may incorporate these alternates in the Contract when executed, or may issue a Change Order to incorporate these alternates within 120 days of the opening of Contractor's Bid or Proposal at the prices offered in the Contractor's Bid or Proposal, unless noted otherwise. A Request for a Change Proposal may be issued after 120 days or other designated time period to negotiate a new price for incorporating the Work into the Project.

B. Cash Allowances:

1. Include the specified cash allowance amounts in the Contract Price.
2. The amount of each cash allowance includes:
    a. The cost of the product to the Contractor less any applicable trade discounts;
    b. Delivery to the Site; and
    c. Applicable taxes.
    d. No other costs will be covered
3. Include in the Stipulated Contract Price (Pay Item No. 1) all costs for:
    a. Handling at the Site, including unloading, uncrating, and storage per Section 01 31 00 "Project Management and Coordination."
    b. Cost for labor and equipment for installation and finishing.
    c. Cost for related products not specifically listed in the allowance required for installation, including consumable supplies and materials.
    d. All overhead, profit, and related costs.
4. Assist Owner in the selection of products.
    a. Identify qualified Suppliers.
    b. Obtain bids or proposals from qualified Suppliers.

c. Present available alternates to the Owner through the Construction Manager. Notify Construction Manager of:

1) Any objections to a particular Supplier or product.

2) Effect on the construction schedule anticipated by the selection of each option.

3) Cost of each option.

5. Upon selection of the product:

a. Purchase and install the product.

b. Contractor's responsibilities for products will be the same as for products selected by the Contractor.

6. Submit a Change Proposal per Section 01 26 00 "Change Order Procedures" to adjust the Contract Price if the net cost of the product is more or less than the specified amount.

a. Adjust the unit cost applied to the quantities installed per the method of payment described in Section 01 29 01 "Measurement and Payment" for products specified as Unit Price Work.

b. Do not perform Work until selection of alternate has been approved by the Owner.

c. Provide actual invoices for the materials.

1.02 DOCUMENTATION

A. Provide documents for materials furnished as part of each alternate in accordance with Section 01 33 00 "Submittal Procedures."

1.03 DESCRIPTION OF CASH ALLOWANCES

A. Pay Item No. 6: Cash Allowance for providing furnishings for Operations Center and Pump Station

1. This cash allowance shall cover the actual invoice cost for purchase and delivery of furnishings to the Re-Pump Station facilities. The Owner shall be allowed to make choices of furnishings to outfit the Operations Center and Re-Pump Station Facility. This allowance only covers unspecified general office furnishings such as chairs, tables, desks, etc. Any specified product will not be covered by this allowance and will paid under the Lump Sum bid for Pay Item No 1.

2. The following items will not be allowed under the Cash Allowance but instead should be included under the Lump Sum bid for Pay Item No. 1.

a. Labor, installation, or consumables necessary to unload, assemble, install and place furnishings.

b. Overhead markup of any kind.

3. Reimbursement for this cash allowance will be only for the actual invoice amount for the furnishings and delivery to the site.

B. Pay Item No. 7: Cash Allowance for Payment to CenterPoint Energy

1. Contractor will directly pay any invoices issued by CenterPoint Energy for provision of permanent, electrical service to the Re-Pump Station site. This will include but not be limited to construction costs or service charges required to initiate service.

2. The following items will not be allowed under the Cash Allowance but instead should be included under the Lump Sum bid for Pay Item No. 1.

    a. Costs for Contractor to manage and coordinate the permanent electrical service for the site.

    b. Any work required by the contract documents, regardless of ownership. This includes construction of improvements to be owned by CenterPoint where called for under the scope of the contract work.

    c. Any temporary construction power, including improvements or electrical usage.

    d. Additional invoicing from CenterPoint due to damage, rework or additional costs required due to actions or negligence of the Contractor.

    e. Overhead markup of any kind.

3. Permanent power will be in the name of the Owner. Owner will assume monthly payments for service once permanent power is available to run facilities.

4. Reimbursement for this cash allowance will be only for allowed, actual invoice amounts issued by CenterPoint Energy specifically for provision of permanent electrical service to the Re-Pump Station site.

1.04 DESCRIPTION OF ALTERNATES

A. Pay Item No. 5 – Deductive Alternate for deleting pump lineup No. 1, including but not limited to pump, motor, pump control valve, piping, electrical, controls, instrumentation, variable frequency drive

1. Owner may elect to deduct the pump train and equipment lineup for pump No. 1 at the Re-Pump Station, along with other associated equipment and ancillary components. The contract value will be reduced by the deductive alternate lump sum value shown for Pay Item No. 5, if this alternate is elected.

2. The following components will be deleted from the scope of work under Pay Item No. 5:

    a. RPS-P1 Pump and Motor, RPS-P1 Variable Frequency Drive, Pump Control Valve and motor operator (RPS-P1-PCVB), Pump Control Bypass Valves (RPS-P1-BPGV1, RPS-P1-PCVB, RPS-P1-BPGV2), Flow Meter (RPS-P1-FM), Local Eurotherm T2750 PAC unit associated with Pump RPS-P1.

    b. Above grade suction and discharge piping between RPS-P1 Suction Isolation Butterfly Valve (RPS-P1-BFV1) and Discharge Isolation Butterfly Valve (RPS-P1-BFV2) and all ancillary items associated with deleted piping and equipment including adjustable pipe supports, floor stands, Instrumentation and instrumentation cabling.

c. Power cabling running from switchgear to VFD and to pump motor. Power cabling running from panelboard to flow meter, pump control valve motor operator, field instrumentation and all associated conduit run above grade.

3. The following items will remain as a part of the contract if Pay Item No. 5 is exercised:

   a. RPS-P1 Suction Isolation Butterfly Valve (RPS-P1-BFV1), Discharge Isolation Butterfly Valve (RPS-P1-BFV2) and limit switches for both valves.

   b. All concrete pipe supports as well as concrete pump pad.

   c. Below grade conduit and cable tray.

   d. HVAC associated with Pump Lineup No. 1.

4. If this deductive alternate is exercised the price for Pay Item No. 5 shall be adjusted as necessary to include the addition of the following items:

   a. Provide and install blind flanges on RPS-P1-BFV1 (suction isolation butterfly valve) and RPS-P1-BFV2(discharge butterfly valve.

B. Pay Item No. 8, 9 and 10 – Section 5 - Pump Alternate Proposals

1. The Owner will select the Pumping Units (pump and motor) for the project from among alternates proposed by Bidder. The selection will be that pumping unit, which provides the best value to the Owner based upon the published selection criteria and evaluation weighting shown below. The highest ranked evaluated offering selected by the Owner may or may not be the lowest cost offering.

2. Bidder shall complete the Pump Alternate Proposal Form in the Bid Proposal for each pre-approved pump supplier he wishes to propose as an alternate offering. Each Bidder is encouraged but not required to include with his proposal, multiple, alternate offerings from approved suppliers for Pumping Units. Bidder is not required to submit an offering for a pump supplier he does not wish to propose.

3. The evaluated bid price of any alternate offering will be the sum of the capital cost (Pay Items 8, 9 and 10) and the calculated efficiency penalty for the equipment. The evaluated bid price will then be applied to the bid price of the Bidder under Section 5 (Pay Items 8, 9 and 10) of the Bid to establish the Total Amount Bid for the project for the purposes of establishing the lowest Total Amount Bid.

4. The contract will be awarded on the condition that the proposed Pumping Units specifically selected by the Owner will be provided by the Bidder without exception and that only by written consent from the Owner will any substitution be allowed. The Bidder agrees that by submitting a proposal from a manufacturer for consideration by the Owner, that the Bidder agrees to provide the equipment and services of that manufacturer, as if he had selected that manufacturer himself. The pumping unit manufacturer shall be a subcontractor of the Contractor (successful Bidder).

5. EVALUATION AND SELECTION PROCESS FOR PUMPING EQUIPMENT (PUMPS AND MOTORS):

   a. The Bidder shall provide alternate Pumping Unit selections for the Owner's Evaluation. Pumps and Motors proposed shall be from the list of acceptable manufacturers shown in Specification Section 43 23 2.13 – Horizontal Split-Case Centrifugal Pumping Units, Paragraph 1.02. Manufacturers not listed, will not be

considered. The Pump Manufacturer shall provide the motor for the project. The following information shall be submitted by the Bidder with his proposal at the time and place called for, for an offer from prospective pump and motor manufacturers to be considered in the evaluation:

b. The pump and motor alternate forms contained in the Proposal Submittal Form section shall be completely filled out by each of the prospective pump / motor manufacturers being proposed as alternates by the Bidder. Pricing for each line item shall be included. All blanks within the submittal form including guaranteed wire-to-water efficiencies for rated points shall be completed. Incomplete forms for any manufacturer shall be cause for rejection of that manufacturer's offering.

c. The data sheets Attachment A and Attachment B and the qualifications statement Attachment C provided at the end of specification section 043 23 21.13 - Horizontal Split-Case Centrifugal Pumping Units, shall be completely filled out by each prospective pump / motor supplier. Incomplete forms for any manufacturer shall be cause for rejection of that manufacturer's offering.

d. Submit complete information required per Specification Section 43 23 21.13 - Horizontal Split-Case Centrifugal Pumping Units, Paragraph 1.04.A. Incomplete submittals for any manufacturer shall be cause for rejection of that manufacturer's offering.

e. Each pump manufacturer's package will be evaluated for acceptability. The offerings will be assessed for compliance with the specifications and should there be any deviations, the Owner shall reserve the right to reject the alternate proposal for that pump manufacturer from being considered. Where deviations are noted, the Owner may accept the deviations if minor. The Owner shall also reserve the right to reject an offering for any reason, including evidence of problems with installation and service by the manufacturer; or evidence of inability or refusal of the manufacturer to abide by the schedule or specification requirements. An evaluated bid price will be calculated for each Pump Manufacturer with acceptable offerings. The evaluated bid price shall be the sum of the equipment price plus the calculated efficiency penalties for a manufacturer added to the sum of the Pump, Motor and Witness Test pricing (Sum of Pay Items 8, 9 and 10 shown on the Pump Alternate Proposal Form). In comparing offerings, the calculated efficiency penalty allows the Owner to take into consideration the guaranteed efficiencies of the pumps at the specified rated head and flow conditions as stated in the bid proposal. For the purposes of evaluation, the overall efficiency of the pumping units shall be the average of the efficiency at the first rated condition and the efficiency at the second rated condition.

f. A hypothetical example explaining how the evaluated bid price is derived is shown in Specification Section 43 23 21.13 - Horizontal Split-Case Centrifugal Pumping Units, Paragraph 1.09.C. Evaluators will independently review and score each pump manufacturer's offering in accordance with the evaluation criteria and weighting listed below. The committee will meet, during which time the Committee Chairperson will total the individual scores. If the individual scores are similar, the Chairperson will average the scores then ranks pump manufacturer's offerings accordingly. If the scores are significantly diverse, the

Chairperson will initiate and moderate discussion to determine the reasons for the differences and ensure that all evaluators are fully knowledgeable of all aspects of the proposals. Scores may then be adjusted by the committee based on committee discussion. Please note that manufacturer's with higher qualifications scores could be ranked higher than manufacturers with slightly better price (evaluated bid) scores. The evaluated bid price of the highest ranked manufacturer submitted by the Bidder will be used in the overall price evaluation for assessing Bidder proposals (i.e. highest ranked manufacturer's bid price will be added to the Bidder's Base Bid). The successful Bidder shall agree to provide the equipment and services of the highest ranked manufacturer submitted and selected by the Owner.

6. EVALUATION AND SELECTION CRITERIA AND WEIGHTING FOR PROPOSALS FOR PUMPING EQUIPMENT (PUMPS AND MOTORS):

   a. 60% EVALUATED BID PRICE: The quality of a manufacturer is not judged solely by a low initial evaluated bid price or, conversely, eliminated solely because of a high initial evaluated bid price. The following is the formula used when determining evaluated bid price as a factor for selecting the pumping unit manufacturer. The lowest evaluated bid price of all the manufacturer offerings becomes the standard by which all evaluated bid prices are evaluated. One at a time, each evaluated bid price is evaluated by taking the lowest evaluated bid price and dividing it by the evaluated bid price being evaluated. That fraction is then multiplied by the maximum point value multiplied by the weight of the price factor for the price score. For Example: (Lowest evaluated bid price/Current evaluated bid price) X Maximum Point Value X Weight Factor (60%) = Price Score

   b. 20% MANUFACTURER QUALIFICATIONS: When evaluating a manufacturer's qualifications, the Owner uses the bid submittal information required by Specification Section 43 23 21.13 - Horizontal Split-Case Centrifugal Pumping Units and past experience with the manufacturer. This criterion is subjectively evaluated, and the formula is as follows: (Points X Weight = Score) with a maximum of 20 points allowable. Each evaluator assigns points based upon the responses the Bidder provides in the **Pump and Motor Manufacturer Qualifications Statement** and any past experience with the Bidder. The Qualifications Statement is a minimum, and Bidder may provide additional pertinent information relevant to the project. Key items to be considered will include, but are not limited to the following: history of manufacturer in producing the size and type of equipment required, delivery schedule history, previous pumping units of the size and type proposed with references, proximity and location of service facilities, availability and qualifications of local field service personnel, process and ease of securing spare parts, relative quality and completeness of the bid submittal, and resumes of key individuals such as the project manager.

   c. 20% EQUIPMENT EVALUATION: This criterion is a measure of the relative performance characteristics of the pumps and motors. The evaluation formula is as follows: (Points X Weight = Score) with a maximum of 20 points allowable. Each pump and motor offering which is considered acceptable, is evaluated on its performance in relation to other offerings. Though a pump and motor may meet

the specification requirements, there are certain characteristics which are preferable among competitive offerings. These include but are not limited to: higher efficiencies across the allowable operating range of the pump (including full and reduced speeds), better coverage of system curves by pump preferred operating range and allowable operating range (including full and reduced speeds), lower turndown coverage of pump, lower NPSHR within allowable operating range (including runout), lower driver speed, and appropriate margin between maximum brake horsepower of pump and motor nameplate rating.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

01 26 00 CHANGE ORDER PROCEDURES

1.00 GENERAL

1.01 SECTION INCLUDES

A. Procedures for processing Change Orders, including:

1. Assignment of a responsible individual for approval and communication of changes in the Work;
2. Documentation of change in Contract Price and Contract Time;
3. Change procedures, using proposals and Modifications;
4. Execution of Change Orders;
5. Correlation of Contractor submittals.

1.02 REFERENCES

A. Blue Book is defined as the Rental Rate Blue Book for Construction Equipment (a.k.a. Data Quest Blue Book).

B. Rental Rate is defined as the full-unadjusted base rental rate for the appropriate item of construction equipment.

1.03 RESPONSIBLE INDIVIDUAL

A. Provide a letter indicating the name and address of the individual authorized to execute Modifications, and who will be responsible for informing others in Contractor's employ and Subcontractors of changes to the Work. Provide this information at the pre-construction meeting.

1.04 DOCUMENTATION OF CHANGE IN CONTRACT PRICE AND CONTRACT TIME

A. Maintain detailed records of changes in the Work. Provide full information required for identification and evaluation of proposed changes, and substantiate costs of changes in the Work.

B. Document each proposal for change in Contract Price or Contract Time with sufficient data to allow evaluation of proposal

C. Include the following minimum information on proposals:

1. Quantities of items in original Bid Form with additions, reductions, deletions, and substitutions.
2. Quantities and cost of items in original Schedule of Values with additions, reductions, deletions and substitutions.
3. Provide Unit Prices for new items, with supporting information, for inclusion in Schedule of Unit Price Work.
4. Justification for changes in Contract Time.
5. Additional data upon request.

D. Documents are to be submitted electronically in *PDF format. No printed copies will be accepted for review unless original signature is required and the document has been input to the WHCRWA FTP site.

E. For changes in the Work performed on a time-and-material basis, provide the following additional information:

1. Quantities and description of Products.
2. Taxes, insurance and Bonds.
3. Overhead and profit as noted in Document 00700 - General Conditions.
4. Dates, times and by who work was performed.
5. Time records and certified copies of applicable payrolls.
6. Invoices and receipts for Products, rental equipment, and subcontracts, similarly documented.

F. For changes in the Work performed on a time-and-materials basis, rental equipment is paid as follows:

1. Actual invoice cost for duration of time required to complete extra work without markup for overhead and profit. When extra work comprises only a portion of a rental invoice where equipment would otherwise be on site, compute hourly equipment rate by dividing the actual monthly invoice by 176. One day equals eight hours and one week equals 40 hours.
2. Do not exceed estimated operating costs given in Blue Book for items of equipment. Overhead and profit will be allowed on the operating cost.

G. For changes in the Work performed on a time-and-materials basis using Contractor-owned equipment, use Blue Book rates as follows:

1. Contractor-owned equipment will be paid at the Blue Book Rental Rate for the duration of time required to complete extra work without markup for overhead and profit. Utilize lowest cost combination of hourly, daily, weekly or monthly rates. Use 150 percent of Rental Rate for double shifts, one extra shift per day, and 200 percent of Rental Rate for more than two shifts per day. Standby rates shall be 50 percent of the appropriate Rental Rate shown in Blue Book. No other rate adjustments apply.
2. Do not exceed estimated operating costs given in Blue Book. Overhead and profit will be allowed on operating costs. Operating costs will not be allowed for equipment on standby.

1.05 CHANGE PROCEDURES

A. Changes to Contract Price or Contract Time can only be made by issuance of Change Order. Issuance of Work Change Directive will be formalized into a Change Order. Changes will be in accordance with requirements of Document 00700 - General Conditions.

B. Engineer will advise of Minor Changes in the Work as authorized by the Document 00700 - General Conditions by issuing supplemental instructions.

C. Request clarification of Drawings, Specifications, Contract documents or other information by using Request for Information. Response by Engineer to Requests for Information does not authorize Contractor to perform tasks outside scope of the Work. Changes must be authorized as described in this Section.

1.06 PROPOSALS AND CONTRACT MODIFICATIONS

A. Engineer may issue Request for Proposal, which includes a detailed description of the proposed change with supplementary or revised Drawings and Specifications. Engineer may also request a proposal in response to a Request for Information. Prepare and submit the proposal within seven days or as specified in request.

B. Submit requests for Contract changes to Engineer describing proposed change and its full effect on the Work, with a statement describing reason for change and effect on Contract Price and Contract Time including full documentation.

C. DPOR may review Change Orders.

1.07 WORK CHANGE DIRECTIVE

A. Engineer may issue a signed Work Change Directive instructing Contractor to proceed with a change in the Work. Work Change Directive will subsequently be incorporated into a Change Order.

B. Work Change Directives will describe changes in the Work and designate the method of determining change in Contract Price or Contract Time.

C. Proceed promptly to execute changes in the Work in accordance with the Work Change Directive.

1.08 STIPULATED PRICE CHANGE ORDER

A. A Stipulated Price Change Order will be based on an accepted proposal.

1.09 UNIT PRICE CHANGE ORDER

A. Where Unit Prices for affected items of the Work are included in Document 00300 – Bid Form, the Change Order will be based on Unit Prices, of Document 00700 - General Conditions.

B. Where Unit Prices of the Work are not pre-determined in Document 00300- Bid Form, the Work Change Directive or accepted proposal will specify the Unit Prices to be used.

1.10 TIME-AND-MATERIAL CHANGE ORDER

A. Provide itemized account and supporting data after completion of change, within time limits indicated for claims in Document 00700 - General Conditions.

B. Engineer will determine the change allowable in Contract Price and Contract Time as provided in Document 00700 - General Conditions.

C. Maintain detailed records for work done on time-and-material basis as specified in Paragraph 1.4 above.

D. Provide full information required for evaluation of changes and substantiate costs for changes in the Work.

1.11 EXECUTION OF CHANGE DOCUMENTATION

A. Engineer will issue Change Orders, Work Change Directives, or Minor Change in the Work for signatures of Parties as described in Document 00700 - General Conditions.

1.12 CORRELATION OF CONTRACTOR SUBMITTALS

A. For Stipulated Price Contracts, promptly revise Schedule of Values and Application for Payment forms to record authorized Change Orders as separate line item.

B. For Unit Price Contracts, the next monthly estimate of the Work after acceptance of a Change Order will be revised to include new items not previously included with appropriate Unit Prices.

C. Promptly revise progress schedules to reflect change in Contract Time, and to adjust time for other items of work affected by the change, and resubmit for review.

D. Promptly enter changes to on-site and record copies of Drawings, Specifications or Contract documents.

2.00 PRODUCTS -NOT USED

3.00 EXECUTION - NOT USED

END OF SECTION

01 29 01 MEASUREMENT AND PAYMENT

1.00 GENERAL

1.01 SECTION INCLUDES

A. Procedures for measurement and payment plus conditions for nonconformance assessment and nonpayment for rejected Products.

1.02 AUTHORITY

A. Measurement methods delineated in Specification sections are intended to complement criteria of this Section. In event of conflict, requirements of the Specification section shall govern.

B. Engineer will take all measurements and compute quantities accordingly.

C. Assist by providing necessary equipment, workers, and survey personnel.

D. Measurement and Payment paragraphs are included only in those Specification sections of Division 01 where direct payment will be made. Include costs in the total bid price for those Specification sections in Division 01 that do not contain Measurement and Payment paragraphs.

1.03 UNIT QUANTITIES SPECIFIED

A. Quantity and measurement estimates stated in the Agreement are for contract purposes only. Quantities and measurements supplied or placed in the Work and verified by Engineer will determine payment as stated in Article 9 of Document 00700 - General Conditions.

1. -When actual work requires greater or lesser quantities than those quantities indicated in Document 00300 – Bid Form, provide required quantities at Unit Prices contracted, except as otherwise stated in Article 9 of Document 00700 General Conditions.

1.04 MEASUREMENT OF QUANTITIES

A. Measurement by Weight: Reinforcing steel, rolled or formed steel or other metal shapes are measured by CRSI or AISC Manual of Steel Construction weights. Welded assemblies are measured by CRSI or AISC Manual of Steel Construction or scale weights.

B. Measurement by Volume:

1. Stockpiles: Measured by cubic dimension using mean length, width, and height or thickness.

2. Excavation and Embankment Materials: Measured by cubic dimension using average end area method.

C. Measurement by Area: Measured by square dimension using mean length and width or radius.

D. Linear Measurement: Measured by linear dimension, at item’s horizontal centerline or mean chord.

E. Stipulated Price Measurement: By unit designated in the Agreement.

F. Other: Items measured by weight, volume, area, or linear means or combination, as appropriate, as completed item or unit of the Work.

G. Measurement by Each: Measured by each instance or item provided.

H. Measurement by Lump Sum: Measure includes all associated work.

1.05 PAYMENT

A. Payment includes full compensation for all required supervision, labor, Products, tools, equipment, plant, transportation, services, and incidentals; and erection, application or Installation of an item of the Work; and Contractor's overhead and profit.

B. Total compensation for required Unit Price work shall be included in Unit Price bid in Document 00300 – Bid Form. Claims for payment as Unit Price work, but not specifically covered in the list of Unit Prices contained in Document 00300 – Bid Form, will not be accepted.

C. Interim payments for stored materials will be made only for materials to be incorporated under items covered in Unit Prices, unless disallowed in Document 00500 - Supplementary Conditions.

D. Progress payments will be based on Engineer's observations and evaluations of quantities incorporated in the Work multiplied by Unit Price.

E. Final payment for work governed by Unit Prices will be made on the basis of actual measurements and quantities determined by Engineer multiplied by the Unit Price for work which is incorporated in or made necessary by the Work.

1.06 NONCONFORMANCE ASSESSMENT

A. Remove and replace work, or portions of the Work, not conforming to the Contract documents.

B. When not practical to remove and replace work, Engineer will direct one of the following remedies:

1. Nonconforming work will remain as is, but Unit Price will be adjusted lower at discretion of Engineer.

2. Nonconforming work will be modified as authorized by Engineer, and the Unit Price will be adjusted lower at the discretion of Engineer when modified work is deemed less suitable than specified.

C. Specification sections may modify the above remedies or may identify a specific formula or percentage price reduction.

D. Authority of Engineer to assess nonconforming work and identify payment adjustment is final.

1.07 NONPAYMENT FOR REJECTED PRODUCTS

A. Payment will not be made for any of the following:

1. Products wasted or disposed of in an unacceptable manner.

2. Products determined as nonconforming before or after placement.
3. Products not completely unloaded from transporting vehicles.
4. Products placed beyond lines and levels of required work.
5. Products remaining on hand after completion of the Work, unless specified otherwise.
6. Loading, hauling, and disposing of rejected Products.

1.08 MEASUREMENT AND BASIS FOR PAYMENT FOR BID ITEMS

A. Section 1

1. Pay Item No. 1 – For construction of the Re-Pump Station completely as shown in the Plans and described in the Specifications, except such items as are listed below:

   The lump sum amount bid for the construction of the Pump Station shall be full compensation for the construction of the project as described in the Contract Documents except for those items specifically described in the paragraphs to follow. All incidental cost for the construction of the project in conformance with contract documents not specifically included in one of the following items is to be included in Pay Item No. 1.

2. Pay Item No. 2 – Drilled Shafts; Pay Item No 2.a – 18-inch Drilled Shafts; Pay Item No 2.b – 24-inch Drilled Shafts; Pay Item No 2.c – 30-inch Drilled Shafts; Pay Item No 2.d – 36-inch Drilled Shafts; Pay Item No 2.e – 42-inch Drilled Shafts:

   Measurement and payment for drilled shafts shall be per vertical linear foot of shaft as measured in a vertical line from the bottom of the shaft to the top of the shaft (bottom of beam or cap) and shall be paid at the unit price bid per vertical linear foot. Payment for drilled shafts required for fences, light standards, cameras, gates, bollards and other installations not specifically detailed as separate pay items, shall be paid under the lump sum price for the pump station construction.

3. Pay Item No. 3 – Trench Safety:

   The price bid per linear foot for this item shall be full compensation for trench safety as outlined in the Project Specifications. Measurement shall be along the centerline of the pipe or structure. Partial payment for trench safety shall be based on the total linear footage of pipe installed and backfilled or for trench conditions created by structural excavations. Contractor is to provide the length of trench that will be required by their selected means, methods, sequences and procedures for construction and include this quantity in the amount bid. Payment for trench safety in excess of this estimated quantity will only be paid by the Owner if an increase in the length of trench is the result of an Owner initiated contract modification as approved by Change Order. The increase in contract amount for this additional trench safety will in included in the Change Order.

4. Pay Item No. 4 – Additional daily expense to maintain pumps, motors, valves, and electrical equipment prior to substantial completion due to delay of startup and 30-day testing of pumps, motors, and VFD's as detailed in Specification Section 01 23 10 – Alternates and Allowances:

   a. This line item is to compensate the Contractor for daily maintenance activities required to maintain pumps, motors, valves and electrical gear in accordance with

manufacturer Operation and Maintenance recommendations in the event there is a delay between the preliminary operational tests for equipment and the 30-day test.

b. This line item is intended only for compensation to the Contractor when it can be demonstrated that delays in completion of construction by others (as listed specifically below) directly results in additional time delay and cost to the Contractor. Only the following delays will be considered by the Owner in paying for Standby Time:

   1). Delay in Permanent Power Availability at the Re-Pump Station attributable solely to delays by CenterPoint Energy. Contractor will not be compensated where delays are due to Contractor's failure to adequately coordinate the service with CenterPoint Energy or failure of Contractor to make timely payment to CenterPoint Energy for service.

   2). Delay in completion of other Contracts which specifically affects Owners ability to provide water for 30-day testing.

   3). Under no circumstances will compensation be considered if it cannot be documented that pump station pump testing and the 30-day test by the Contractor is unduly delayed by one of the listed delays in work by others. A written request for delay payment shall be made immediately by the Contractor upon notice by the Owner that a delay is foreseen. The Contractor shall include with his request the following information:

      a). Documentation that control system check-out, power system check-out, pump-valve-piping check-out has been completed and the pumps are ready for full capacity testing.

      b). If approved, Delay payment shall begin to accrue on the date agreed to by the Owner and Contractor that a true delay to the Contractor is established. Payment for Standby Time shall be for every calendar day accrued and end the date that the delay is rectified, the Owner provides other means for continuance of the project, the Contractor is released, or some other alternative is agreed to between Owner and Contractor. The Owner shall reserve the right to minimize the extent of delay paid, by undertaking efforts to limit startup or testing work or by pursuing other alternatives.

5. Pay Item No. 5 – Deductive Alternate for deleting pump lineup No. 1, including pump, motor, pump control valve, piping, electrical, controls, instrumentation and variable frequency drive as detailed in Specification Section 01 23 10 – Alternates and Allowances:

   a. If elected by the Owner, Pay Item No.5 will be deducted from the contract value. Credit for the deduct will be applied proportionally to individual line items in Schedule of Values.

   b. Additional requirements and provisions are included in Specification Section 01 23 10 – Alternates and Allowances.

6. Pay Item No. 6 – Cash Allowance for providing furnishings for Operations Center and Pump Station as detailed in Specification Section 01 23 10 – Alternates and Allowances:

a. Cash Allowance will be paid on the actual invoice amount paid for Owner selected furnishings. The Contractor shall not markup the cost of the invoice under the allowance line item, but instead shall include such administrative costs as a part of the line item for the Pay Item No 1. The Contractor shall be allowed full payment of the amount invoiced but shall not be required to pay in excess of the allowance amount.

b. Additional requirements and provisions are included in Specification Section 01 23 10 – Alternates and Allowances.

7. Pay Item No. 7 – Cash Allowance for payment to CenterPoint Energy for Construction and provision of primary electrical service to the Re-Pump Station as detailed in Specification Section 01 23 10 – Alternates and Allowances:

   a. Cash Allowance will be paid on the actual invoice amount paid for Owner selected furnishings. The Contractor shall not markup the cost of the invoice under the allowance line item, but instead shall include such administrative costs as a part of the line item for the Pay Item No 1. The Contractor shall be allowed full payment of the amount invoiced but shall not be required to pay in excess of the allowance amount.

   b. Additional requirements and provisions are included in Specification Section 01 23 10 – Alternates and Allowances.

8. Pay Item No. 8 – Furnish, test, deliver, and provide competent service technician for five horizontal split case pumping units, each with a rated capacity of 40.0 MGD at 163 feet TDH; a guaranteed wire-to-water efficiency of _____% at 170 feet TDH; a guaranteed wire-to-water efficiency of _____% at 140 feet TDH, complete as specified herein:

   a. Pay Item No. 8 will be paid on the basis of milestone completions by pump and motor vendors, less any applicable retainages or setoffs. The following milestone payments will be applied:

Milestone	Milestone Description	Total Cumulative Percent of Contract Eligible for Payment
1	Approval of a complete shop drawing package by the Engineer.	10
2	Delivery of Pre-installation Materials to the Project Site including horizontal pump anchor bolts and horizontal pump anchor bolt template.	15
3	Approval of testing for all castings (casing, impellers, elbows and other fabrications) and approval of submergence tests for motors.	50
4	Approval of factory performance tests	60

5	Delivery of equipment and approved preliminary Operation and Maintenance Manuals	80
6	Final acceptance of the installed and tested equipment, and final Operation and Maintenance Manuals and other required information approved.	100

b. Additional requirements and provisions are included in Specification Section 01 23 10 – Alternates and Allowances.

9. Pay Item No. 9 – Additional Costs for witnessed tests for five Re-Pump Station pumps by representatives of the Owner:

   a. The Owner may elect to witness pump factory performance tests. If the Owner exercises this option, the Contractor will be paid for each test performed upon successful completion of a witnessed factory test. If Owner elects not to perform factory witness testing, then Pay Item No. 9 will not be paid.

   b. Additional requirements and provisions are included in Specification Section 01 23 10 – Alternates and Allowances.

10. Pay Item No. 10 – Additional Costs for witnessed tests for five Re-Pump Station motors by representatives of the Owner:

    a. The Owner may elect to witness motor factory performance tests. If the Owner exercises this option, the Contractor will be paid for each test performed upon successful completion of a witnessed factory test. If Owner elects not to perform factory witness testing, then Pay Item No. 10 will not be paid.

    b. Additional requirements and provisions are included in Specification Section 01 23 10 – Alternates and Allowances.

2.00 PRODUCTS -NOT USED

3.00 EXECUTION - NOT USED

END OF SECTION

01 29 20 SCHEDULE OF VALUES

1.00 GENERAL

1.01 SECTION INCLUDES

A. Preparation and submittal of Schedule of Values for Stipulated Price Contracts or for Major Unit Price Work on Unit Price Contracts.

1.02 PREPARATION

A. For Stipulated Price Contracts, subdivide the Schedule of Values into logical portions of the Work, such as major work items or work in contiguous construction areas. Use Section 01 32 50 - Construction Schedule as a guide to subdivision of work items. Directly correlate Items in the Schedule of Values with tasks in the Construction Schedule. Organize each portion using the Project Manual Table of Contents as an outline for listing value of the Work by Sections. A pro rata share of mobilization, Bonds, and insurance may be listed as separate items for each portion of the Work.

B. For Unit Price Contracts, items should include a proportional share of Contractor's overhead and profit so that total of all items will equal Contract Price.

C. For lump sum equipment items, where submittal of operation and maintenance data and testing are required, include separate items for equipment operation and maintenance data where:

1. submittal of maintenance data is valued at five percent of the lump sum amount for each equipment item and

2. submittal for testing and adjusting is valued at five percent of the lump sum amount for each equipment item.

Round off figures for each item listed to the nearest $100. Set the value of one item, when necessary, to make total of all values equal the Contract Price for Stipulated Price Contracts or the lump sum amount for Unit Price Work.

D. Divide the Contract Price into an adequate number of line items to allow more accurate determination of the earned value for each line item when evaluating progress payments. Submit a detailed Schedule of Values for the Project at least 10 days prior to submitting the first Application for Payment using forms provided by the Construction Manager.

E. Do not apply for payment until the Schedule of Values has been approved by the Construction Manager.

F. Divide the cost associated with each line item in the Schedule of Values into installation and materials components.

1. Installation cost is to include all cost associated with the line item except materials cost.

2. Materials cost is the direct cost (as verified by invoice values) for products, materials, and equipment to be permanently incorporated into the Project associated with the line item.

3. Installation cost is to include all direct costs and a proportionate amount of the indirect costs for the Work associated with each line item. Include costs not specifically set forth as an individual payment item but required to provide a complete and functional system.

4. The sum of materials and installation costs for all line items must equal the Contract Price.

G. Use each unit price line item in the Agreement as a line item in the Schedule of Values. The sum of materials and installation costs for each line item for unit price contracts must equal the value of the line item in the Agreement. Installation costs for unit price items are to include costs for waste and overages.

   1. Installation and materials cost may be left as a single installation component if:

      a. Contractor does not intend to request payment for stored materials for that line item; or

      b. Work in the line item will be completed within a single payment period.

   2. Provide adequate detail to allow a more accurate determination of the earned value for installation costs, expressed as a decimal fraction of Work completed, for each line item.

   3. Installation cost line items may not exceed $50,000.00. Items that are not subdivided into smaller units may only be included in the Application for Payment when Work on the entire unit is complete.

   4. Lump sum items may be divided into an estimated number of units to estimate earned value. The estimated number of units times the cost per unit must equal the lump sum amount for that line item.

   5. Include Contractor's overhead and profit in the installation costs each line item in proportion to the value of the line item to the Contract Price.

   6. Include cost not specifically set forth as an individual payment item but required to provide a complete and functional system in the Contract Price for each item.

   7. Line items may be used to establish the value of Work to be added or deleted from the Project.

H. Submit Schedule of Values electronically using WHCRWA FTP site in approved electronic file or *.PDF.

1.03 ADJUSTMENTS TO THE SCHEDULE OF VALUES IN THE APPLICATION FOR PAYMENT

A. Submit a Change Proposal to request any changes to the Schedule of Values incorporated into the Application for Payment once approved. A Field Order will be issued by the Construction Manager to modify the Application for Payment form if approved.

B. Payment for materials and equipment shown in the Application for Payment will be made for the total of associated invoice amounts, up to the value shown for materials in the Application for Payment for that line item.

1. If the total amount for invoices for materials and equipment for a line item are less than the amount shown for the materials component of that line item in the Application for Payment, and it can be demonstrated that no additional materials or equipment are required to complete Work described in that item, the difference between the total invoice for materials and equipment and the materials component for that line item can be added to the installation component of that Work item.

2. Costs for material and equipment in excess of the value shown in the Schedule of Values may not be paid for under other line items.

1.04 SUBMITTAL

A. Submit the Schedule of Values, in accordance with requirements of Section 01 33 00 - Submittal Procedures, at least 10 days prior to submitting first application for progress payment.

B. Submit the Schedule of Values in an approved electronic spreadsheet file and an 8 1/2 - inch by 11 - inch print on white bond paper.

C. Revise Schedule of Values for items affected by Contract Modifications. After Engineer has reviewed changes, resubmit at least 10 days prior to the next application for progress payment.

2.00 PRODUCTS -NOT USED

3.00 EXECUTION - NOT USED

END OF SECTION

01 31 00 PROJECT MANAGEMENT AND COORDINATION

Note to Specifier: Verify all references to: (1) paragraphs within this Section; (2) other Sections of the Specifications; and (3) any other applicable standards or sources of information.

1.00 GENERAL

1.01 SUMMARY

A. Furnish resources required to complete the Project in accordance with the Contract Documents and within the Contract Times.

B. Construct Project in accordance with current safety practices.

C. Manage Site to allow access to Site and control construction operations.

D. Construct temporary facilities to provide and maintain control over environmental conditions at the Site. Remove temporary facilities when no longer needed.

E. Provide temporary controls for pollution, management of water, and management of excess earth as required in Section 01 57 00 “Temporary Controls.”

1.02 STANDARDS

A. Perform Work to comply with:

1. Requirements of the Contract Documents;

2. Laws and Regulations; and

3. Specified industry standards.

1.03 DOCUMENTATION

A. Provide documents in accordance with Section 01 33 00 “Document Management.”

B. Provide copies of Supplier’s printed storage instructions prior to furnishing materials or products and installation instructions prior to beginning the installation.

C. Incorporate field notes, sketches, recordings, and computations made by the Contractor in Record Drawings per Section 01 31 13 “Project Coordination.”

1.04 PERMITS

A. Obtain building permits for the Project from the local authorities having jurisdiction. [**Building permit fees will be waived by the Owner.] [Pay building permit fees and include these costs in the Contract Price.]**

B. Obtain environmental permits required for construction at the Site.

C. Provide required permits for transporting heavy or oversized loads.

D. Provide other permits required to conduct any part of the Work.

E. Arrange for inspections and certification by agencies having jurisdiction over the Work and include the cost for these inspections and certifications in the Contract Price.

F. Make arrangements with private utility companies and pay fees associated with obtaining services or inspections.

G. Retain copies of permits and licenses at the Site and comply with all regulations and conditions of the permit or license.

1.05 SAFETY REQUIREMENTS

A. Manage safety to protect the safety and welfare of persons at the Site.

B. Provide safe access to move through the Site. Provide protective devices to warn and protect from hazards at the Site.

C. Provide safe access for those performing tests and inspections.

D. Maintain a supply of personal protective equipment for visitors to the Site.

E. Comply with latest provisions of the Occupational Health and Safety Administration (OSHA) and other Laws and Regulations.

F. Cooperate with accident investigations. Provide two copies of all reports, including insurance company reports, prepared concerning accidents, injuries, or deaths related to the Project to the Construction Manager as Record Data per Section 01 31 13 “Project Coordination.”

1.06 ACCESS TO THE SITE

A. Maintain access to the facilities at all times. Do not obstruct roads, pedestrian walks, or access to the various buildings, structures, stairways, or entrances. Provide safe access for normal operations during construction.

B. Provide adequate and safe access for inspections. Leave ladders, bridges, scaffolding, and protective equipment in place until inspections have been completed. Construct additional safe access if required for inspections.

C. Use roadways for construction traffic only with written approval of the appropriate representatives of each entity. Roadways may not be approved for construction traffic. Obtain written approval to use roads to deliver heavy or oversized loads to the Site. Furnish copies of the written approvals to the Construction Manager as Record Data per Section 01 31 13 “Project Coordination.”

1.07 CONTRACTOR’S USE OF THE SITE

A. Limit the use of Site for Work and storage to those areas designated on the Drawings or approved by the Construction Manager. Coordinate the use of the Site with the Construction Manager.

B. Provide security at the Site as necessary to protect against vandalism and loss by theft.

C. Park construction equipment in designated areas only and provide spill control measures as discussed in Section 01 57 00 “Temporary Controls.”

D. Park employees’ vehicles in designated areas only.

E. Obtain written permission of the property owner before entering privately-owned land outside of the Owner’s property, rights-of-way, or easements.

Note to Specifier: Modify the paragraph below to include the applicable 811 and 1-800 numbers for the state one-call notification system and the applicable notice requirements as necessary for each project.

F. Cooperate with public and private agencies with facilities operating within the limits of the Project. Provide 48 hours' notice to any applicable agency when Work is anticipated to proceed in the vicinity of any facility by using **[specify state one-call notification system contact information]**.

G. Conduct of Contractor's or Subcontractor's Employees:

1. Do not permit alcoholic beverages or illegal substances on the Site. Do not allow persons under the influence of alcoholic beverages or illegal substances to enter or remain on the Site at any time. Persons on Site under the influence of alcoholic beverages or illegal substances will be permanently prohibited from returning to the Site. Criminal or civil penalties may also apply.

2. Do not allow the use of offensive language or sexual harassment in any form. These actions will cause immediate and permanent removal of the offender from the premises. Criminal or civil penalties may apply.

3. Require Workers to wear clothing that is inoffensive and meets safety requirements. Do not allow sleeveless shirts, shorts, or any exceedingly torn, ripped, or soiled clothing to be worn on the Site.

4. Do not allow the use, possession, concealment, transportation, promotion, or sale of the following prohibited items anywhere on the Site:

a. Firearms (including air rifles and pistols and BB or pellet guns) and ammunition;

b. Bows, crossbows, arrows, bolts, or any other projectile weapons;

c. Explosives of any kind, including fireworks;

d. Illegal knives;

e. Other weapons prohibited by state Laws and Regulations; and

f. Any other item that has been designed or intended to be used as a weapon.

No exceptions will be made for the possession of a firearm by a person that has a valid state-issued license to carry a firearm. Remove any of the prohibited items listed above from the Site immediately and permanently. Any person found to be in possession of any prohibited item must also be removed from the Site and may be reported to local law enforcement.

1.08 PROTECTION OF EXISTING STRUCTURES AND UTILITIES

A. Examine the Site and review the available information concerning the Site. Locate utilities, underground facilities, and existing structures. Verify the elevations of the structures adjacent to excavations. Report any discrepancies from information in the Contract Documents to the Construction Manager before beginning construction.

B. Determine if existing structures, poles, piping, or other utilities at excavations will require relocation or replacement. Prepare a Plan of Action per Section 01 31 13 "Project

Coordination." Coordinate Work with local utility company and others for the relocation or replacement.

C. Protect utilities, underground facilities and existing structures unless they are shown to be replaced or relocated on the Drawings. Restore damaged items to the satisfaction of the Owner and utility or property owner.

D. Carefully support and protect all structures and/or utilities so that there will be no failure or settlement where excavation or demolition endangers adjacent structures and utilities. Do not take existing utilities out of service unless required by the Contract Documents or approved by the Construction Manager. Notify and cooperate with the utility owner if it is necessary to move services, poles, guy wires, pipelines, or other obstructions.

E. Protect existing trees and landscaping at the Site. Mark trees that may be removed during construction and review with the Construction Manager for approval before removing. Protect trees to remain from damage limiting activity, including stockpiling of materials within the drip line of the tree.

F. Protect buildings from damage when handling material or equipment. Protect finished surfaces, including floors, doors, and jambs. Remove doors and install temporary wood protective coverings over jambs, if needed.

1.09 DISRUPTION TO SERVICES/CONTINUED OPERATIONS

A. Owner's facilities are to continue in service as usual during the construction unless noted otherwise. Owner or utilities must be able to operate and maintain the facilities. Keep disruptions to existing utilities, piping, process piping, or electrical services to a minimum.

1. Do not restrict access to critical valves, operators, or electrical panels.

2. Do not store material or products inside structures unless authorized by the Construction Manager.

3. Limit operations to the minimum amount of space needed to complete the specified Work.

4. Maintain storm sewers and sanitary sewers in service at all times. Provide temporary service around the construction or otherwise construct the Work in a manner that flow is not restricted.

B. Provide a Plan of Action in accordance with Section 01 35 00 "Special Procedures" if facilities must be taken out of operation.

1.10 FIELD VERIFICATION

A. Perform complete field measurements prior to purchasing products or beginning construction for products required to fit existing conditions.

B. Verify property lines, control lines, grades, and levels indicated on the Drawings.

C. Verify pipe class, equipment capacities, existing electrical systems, and power sources for existing conditions.

D. Check Shop Drawings and indicate the actual dimensions available where products are to be installed.

E. Include field measurements in Record Documents as required in Section 01 31 13 “Project Coordination.”

1.11 REFERENCE DATA AND CONTROL POINTS

A. The Construction Manager will provide the following control points:

1. Base line or grid reference points for horizontal control.

2. Benchmarks for vertical control.

B. Locate and protect control points prior to starting the Work and preserve permanent reference points during construction. Designated control points may be on an existing structure or monument. Do not change or relocate points without prior approval of the Construction Manager. Notify Construction Manager when a reference point is lost, destroyed, or requires relocation. Replace Project control points on the basis of the original survey. Control points or benchmarks damaged, disturbed or destroyed as a result of the Contractor’s negligence will be restored by the Construction Manager. Owner will impose a set-off as compensation for the effort required.

C. Provide complete engineering layout of the Work needed for construction.

1. Provide competent personnel. Provide equipment including accurate surveying instruments, stakes, platforms, tools, and materials.

Note to Specifier: Include the applicable reference for surveying accuracy in the subparagraph below.

2. Provide surveying with accuracy meeting the requirements established for **[specify surveying standard]**.

3. Provide Record Data per Section 01 31 13 “Project Coordination” and measurements per standards.

1.12 DELIVERY AND STORAGE

A. Deliver products and materials to the Site in time to prevent delays in construction.

B. Deliver packaged products to Site in original undamaged containers with identifying labels attached. Open cartons as necessary to check for damage and to verify invoices. Reseal cartons and store properly until used. Leave products in original packages or other containers until installed. If original packages or containers are damaged, repackage in containers and include packing slips, labels and other information from the original packaging.

C. Deliver products that are too large to fit through openings to the Site in advance of the time enclosing walls and roofs are erected. Set in place, raised above floor on cribs or pallets.

D. Assume full responsibility for the protection and safekeeping of products stored at the Site.

E. Store products at locations acceptable to the Construction Manager and to allow Owner access to maintain and operate existing facilities.

F. Store products in accordance with the Supplier’s storage instructions immediately upon delivery. Leave seals and labels intact. Arrange storage to allow access for maintenance of

stored items and for inspection. Store unpacked and loose products on shelves, in bins, or in neat groups of like items.

G. Provide additional storage areas as needed for construction. Store products subject to damage by elements in substantial weather-tight enclosures or storage sheds. Provide and maintain storage sheds as required for the protection of products. Provide temperature, humidity control, and ventilation within the ranges stated in the Supplier's instructions. Remove storage facilities at the completion of the Project.

H. Protect the pipe interior. Keep all foreign materials such as dirt, debris, animals, or other objects out of the pipe during the Work.

I. Provide adequate exterior storage for products that may be stored out-of-doors.

1. Provide substantial platforms, blocking, or skids to support materials and products above ground which has been sloped to provide drainage. Protect products from soiling or staining.

2. Cover products subject to discoloration or deterioration from exposure to the elements, with impervious sheet materials. Provide ventilation to prevent condensation below covering.

3. Store loose, granular materials on clean, solid surfaces, or on rigid sheet materials, to prevent mixing with foreign matter.

4. Provide surface drainage to prevent erosion and ponding of water.

5. Prevent mixing of refuse or chemically injurious materials or liquids with stored materials.

6. Pipes and conduits stored outdoors are to have open ends sealed to prevent the entrance of dirt, moisture, and other injurious materials. Protect PVC pipe from ultraviolet light exposure.

7. Store products to prevent wind damage.

J. Protect and maintain mechanical and electrical equipment in storage.

1. Provide Supplier's service instructions on the exterior of the package.

2. Service equipment on a regular basis as recommended by the Supplier. Maintain a log of maintenance services. Submit the log as Record Data per Section 01 31 13 "Project Coordination" when Owner assumes responsibility for maintenance and operation.

3. Provide power to and energize space heaters for all equipment for which these devices are provided.

4. Provide temporary enclosures for all electrical equipment, including electrical systems on mechanical devices. Provide and maintain heat in the enclosures until equipment is energized.

K. Maintain storage facilities. Inspect stored products on a weekly basis and after periods of severe weather to verify that:

1. Storage facilities continue to meet specified requirements;

2. Supplier's required environmental conditions are continually maintained; and

3. Products that can be damaged by exposure to the elements are not adversely affected.

L. Replace any stored item damaged by inadequate protection or environmental controls.

M. Payment may be withheld for any products not properly stored.

1.13 CLEANING DURING CONSTRUCTION

A. Provide positive methods to minimize raising dust from construction operations and provide positive means to prevent air-borne dust from disbursing into the atmosphere. Control dust and dirt from demolition, cutting, and patching operations.

B. Clean the Site as Work progresses and dispose of waste materials, keeping the Site free from accumulations of waste or rubbish. Provide containers at the Site for waste collection. Do not allow waste materials or debris to blow around or off of the Site. Control dust from waste materials. Transport waste materials with as few handlings as possible.

C. Comply with Laws and Regulations. Do not burn or bury waste materials. Remove waste materials, rubbish, and debris from the Site and legally dispose of these at public or private disposal facilities.

1.14 MAINTENANCE OF ROADS, DRIVEWAYS, AND ACCESS

A. Maintain roads and streets in a manner that is suitable for safe operations of public vehicle during all phases of construction unless the Owner approves a street closing. Do not close public roads overnight. Coordinate and arrange for emergency vehicle access when streets are to be closed.

B. Submit a Notification by Contractor for Owner's approval of a street closing. The request must state:

1. The reason for closing the street.

2. How long the street will remain closed.

3. Procedures to be taken to maintain the flow of traffic.

C. Obtain permits and permissions of the entity that owns the road prior to any Work and provide a copy of the permit or permission Record Data per Section 01 31 13 "Project Coordination."

D. Construct temporary detours, including by-pass roads around construction, with adequately clear width to maintain the free flow of traffic at all times. Maintain barricades, signs, and safety features around the detour and excavations. Maintain barricades, signs, and safety features around the Work in accordance with all provisions of the latest edition of the Manual on Uniform Traffic Control Devices (MUTCD).

E. Assume responsibility for any damage resulting from construction along roads or drives.

1.15 BLASTING

A. Blasting is not allowed for any purpose.

1.16 ARCHAEOLOGICAL REQUIREMENTS

A. Cease operations immediately and contact the Owner for instructions if historical or archaeological artifacts are found during construction.

B. Conduct all construction activities to avoid adverse impact of the sites where significant historical or archaeological artifacts are found or identified as an area where other artifacts could be found.

1. Obtain details for working in these areas from regulatory agencies.

2. Maintain confidentiality regarding the site(s) of artifacts.

3. Adhere to the requirements of applicable local, state, and federal Laws and Regulations.

4. Notify the Construction Manager and any local, state, or federal agency as required by applicable Laws and Regulations.

C. Do not disturb archaeological sites.

1. Obtain the services of a qualified archaeological specialist to instruct construction personnel on how to identify and protect archaeological finds on an emergency basis.

2. Coordinate activities to permit archaeological work to take place within the area.

a. Attempt to archaeologically clear areas needed for construction as soon as possible.

b. Provide a determination of priority for such areas.

D. Assume responsibility for any unauthorized destruction that might result to such sites by construction personnel, and pay all penalties assessed by state or federal agencies for non-compliance with these requirements.

E. Contract Times will be modified to compensate for delays caused by such archaeological finds. No additional compensation will be paid for delays.

1.17 ENDANGERED SPECIES RESOURCES

A. Do not perform any activity that is likely to destroy or adversely modify the habitat or jeopardize the continued existence of a threatened or endangered species as listed or proposed for listing under the Federal Endangered Species Act (ESA) or applicable state Laws and Regulations.

B. Cease Work immediately in the area of the encounter and notify the Construction Manager if a threatened or endangered species is encountered during construction. Construction Manager will implement actions in accordance with the ESA and applicable state statutes. Resume construction in the area of the encounter when authorized to do so by the Construction Manager.

Note to Specifier: The "Coordination", "Cutting and Patching", and "Preliminary Occupancy" Articles should be included for projects with buildings. Delete these if the Project does not have buildings or a particular Article does not apply.

1.18 COORDINATION

A. Coordinate the efforts of various trades having interdependent responsibilities for Work.

B. Conceal ducts, pipes, wiring, and other non-finish items in finished areas, except as otherwise shown. Coordinate locations of concealed items with finish elements. Install access panel or doors where units requiring access for maintenance or operation are concealed behind finished surfaces.

C. Coordinate architectural reflected ceiling plans with the exact location of items installed in suspended ceilings. Request clarification from the Construction Manager prior to proceeding with fabrication or installation of an item if it appears that a conflict exists.

D. Coordinate the installation of items to be installed later, including:

1. Accepted alternates.
2. Products purchased using allowances.
3. Work by others.
4. Owner-supplied, Contractor-installed items.

E. Sequence, coordinate, and integrate the various elements of mechanical, electrical, and other systems, materials, and equipment. Comply with the following requirements:

1. Coordinate mechanical and electrical systems, equipment, and materials installation with other building components.
2. Verify all dimensions by field measurements.
3. Arrange for chases, slots, and openings in other building components during progress of construction.
4. Coordinate the installation of required supporting devices, sleeves, embedded items, and other structural components to be set in concrete before concrete is placed.
5. Install systems, materials, and equipment to provide the maximum headroom possible where mounting heights are not detailed or dimensioned.
6. Coordinate the connection of systems with exterior underground and overhead utilities and services. Comply with the Laws and Regulations and requirements of franchise service companies. Provide required connection for each service.
7. Install systems, materials, and equipment to conform with approved Shop Drawings, Product Data, and Operation and Maintenance Data. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Adjust routing of piping, ductwork, utilities, and location of equipment as needed to resolve spatial conflicts between the various trades. Document changes in the indicated routings in the Record Documents per Section 01 31 13 "Project Coordination."

8. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components.
9. Install systems, materials, and equipment to facilitate servicing, maintenance, and repair or replacement of components.
10. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

1.19 CUTTING AND PATCHING

A. Perform cutting, fitting, and patching required to complete the Work or to:
   1. Uncover Work to provide for installation of new Work or the correction of Defective Work.
   2. Provide routine penetrations of non-structural surfaces for installation of mechanical, electrical, and plumbing Work.
   3. Uncover Work that has been covered prior to observation by the Construction Manager.

B. Submit Notification by Contractor in accordance with Section 01 31 13 “Project Coordination” to the Construction Manager in advance of performing any cutting which affects:
   1. Work of any other contractor or the Owner;
   2. Structural integrity of any structure or system of the Project;
   3. Integrity or effectiveness of weather exposed or moisture resistant structure or systems;
   4. Efficiency, operational life, maintenance, or safety of any structure or system; or
   5. Appearance of any structure or surfaces exposed occasionally or constantly to view.

C. Include in request:
   1. Location and description of affected Work;
   2. Reason for cutting, alteration, or excavation;
   3. Effect on the Work of any separate contractor or Owner;
   4. Effect on the structural or weatherproof integrity of the Work;
   5. Description of proposed Work, including:
      a. Scope of cutting, patching, or alteration;
      b. Trades that will perform the Work;
      c. Products proposed for use; and
      d. Extent of refinishing to be performed.
   6. Alternatives to cutting and patching;
   7. Written authorization from any separate Contractor whose Work would be affected; and

8. Date and time Work will be uncovered or altered.

D. Inspect existing conditions prior to starting the Work, including elements subject to damage or movement during cutting and patching. Uncover elements where required for an adequate inspection. Notify the Construction Manager of any conditions that negatively impact the ability to perform cutting and patching. Contractor is deemed to have accepted the existing conditions and assumed the risk associated with completing the Work when cutting or patching is started after the inspection.

E. Provide adequate support to maintain the structural integrity of facilities, structures, or elements that could be affected by cutting, patching or installing new Work. Provide devices and methods to protect facilities, structures, or elements from damage that could be affected by Contractor's efforts. Provide protection from the weather for portions of the Project that may be exposed by cutting and patching.

F. Make cuts or penetrations using methods that prevent damage to other Work and provide proper surfaces for patching and repairs.

G. Fit and adjust installed products to comply with specified products, functions, tolerances, and finishes.

H. Patch or repair facilities, structures or elements to provide completed Work per the Contract Documents.

I. Fit Work air-tight to pipes, sleeves, ducts, conduit, and other penetrations through the surfaces. Where fire rated separations are penetrated, fill the space around the pipe with materials with physical characteristics equivalent to fire resistance requirements of penetrated surface. Provide firestop inserts inside pipes, sleeves, ducts, conduit, and other penetrations when required by fire resistance requirements.

J. Patch finished surfaces and building components using new products specified for the original installation. Refinish entire surfaces as necessary to provide an even finish to match adjacent finishes:

1. For continuous surfaces, refinish to the nearest intersection.

2. For an assembly, refinish the entire unit.

1.20 PRELIMINARY OCCUPANCY

A. Owner may deliver, install, and connect equipment, furnishings, or other apparatus in buildings or other structures. These actions do not indicate acceptance of any part of the building or structure and does not affect the start of warranties or correction periods.

B. Protect the Owner's property after installation is complete.

C. Owner may use any product for testing or to determine that the product meets the requirements of the Contract Documents. This use does not constitute acceptance by OPT. These actions do not indicate acceptance of any part of the product and does not affect the start of warranties or correction periods.

1.21 OCCUPANCY

A. Owner has the right to occupy or operate any portion of the Project that is ready for use after notifying the Contractor of its intent to do so.

B. Testing of equipment and appurtenances including specified test periods, training, and startup does not constitute acceptance for operation.

C. Owner may accept the facility for continued use after startup and testing at the option of the Owner. If acceptance is delayed at the option of the Owner, shut down facilities per approved operation and maintenance procedures.

D. The execution of bonds is understood to indicate the consent of the surety to these provisions for occupancy of the structures and use of equipment.

E. Provide an endorsement from the insurance carrier permitting occupancy of the structures and use of equipment during the remaining period of construction.

F. Conduct operations to ensure the least inconvenience to the Owner and general public.

2.00 PRODUCTS (NOT USED)

3.00 EXECUTION (NOT USED)

END OF SECTION

01 31 20 COORDINATION AND MEETINGS

1.00 GENERAL

1.01 SECTION INCLUDES

A. General coordination including pre-construction meeting, site mobilization conference, and progress meetings.

1.02 COORDINATION OF DOCUMENTS

A. Coordination is required throughout documents. Refer to Contract documents and coordinate as necessary.

1.03 CONTRACTOR COORDINATION

A. Coordinate scheduling, submittals, and work of various Specification sections to assure efficient and orderly sequence of Installation of interdependent construction elements.

B. Coordinate completion and clean up of the Work prior to the Date of Substantial Completion and for portions of the Work designated for Authority's partial occupancy.

C. Coordinate access to the site for correction of nonconforming work to minimize disruption of the Authority's activities where the Authority is in partial occupancy.

D. Coordination shall be tracked using WHCRWA FTP site.

1.04 PRE-CONSTRUCTION MEETING

A. Engineer will schedule pre-construction meeting.

B. Attendance Required: Authority representatives, Design Professional of Record, special consultants as required by Engineer, Contractor, and major Subcontractors and Suppliers.

C. Agenda:

1. Distribution of Contract documents.

2. Designation of personnel representing the Parties and Design Professional of Record.

3. Review of insurance.

4. Discussion of formats for Schedule of Values and Construction Schedule.

5. Procedures and processing of Shop Drawings, substitutions, pay estimates or Applications for Payment, Requests for Information, Requests for Proposal, Modifications, and the Contract closeout, other submittals.

6. Scheduling of the Work and coordination with other contractors.

7. Review of Subcontractors and Suppliers.

8. Appropriate agenda items listed for the site mobilization conference, Paragraph 1.5.C, when pre-construction meeting and site mobilization conference are combined.

9. Procedures for testing.

10. Procedures for maintaining record documents.

1.05 SITE MOBILIZATION CONFERENCE

A. When required by Contract documents, Engineer will schedule a conference at the Project site prior to Contractor mobilization.

B. Attendance Required: Authority representatives, Design Professional of Record, special consultants, Superintendent, and major Subcontractors.

C. Agenda:

1. Use of premises by the Authority and Contractor.

2. Safety and first aid procedures.

3. Construction controls provided by the Authority.

4. Temporary utilities.

5. Survey and layout.

6. Security and housekeeping procedures.

7. Field office requirements

1.06 PROGRESS MEETINGS

A. Hold meetings at Project field office or other location designated by Engineer. Hold meetings at monthly intervals, or more frequently when directed by Engineer.

B. Attendance Required: Superintendent, major Subcontractors and Suppliers, Authority representatives, Design Professional of Record and its subconsultants as appropriate for agenda topics for each meeting.

C. Engineer will make arrangements for meetings, and for recording minutes.

D. Engineer will prepare the agenda and preside at meetings.

E. Provide required information and be prepared to discuss each agenda item.

F. Agenda:

1. Review minutes of previous meetings.
2. Review of construction schedule, pay estimates, cash flow curve, payroll and compliance submittals.
3. Field observations, problems, and necessary decisions.
4. Identification of problems that impede planned progress.
5. Review of submittal schedule and status of submittals.
6. Review of RFI and RFP status.
7. Modification status.
8. Review of off-site fabrication and delivery schedules.
9. Maintenance of Construction Schedule.
10. Corrective measures to regain Construction Schedule.
11. Planned progress during the succeeding work period.
12. Coordination of projected progress.
13. Maintenance of quality and work standard
14. Effect of proposed Modifications on Construction Schedule and coordination.
15. Review Project Record Contract Drawings.
16. Other item relating to the Work.

2.00 PRODUCTS– NOT USED

3.00 EXECUTION – NOT USED

END OF SECTION

01 32 10 CONSTRUCTION PHOTOGRAPHS

1.00 GENERAL

1.01 SECTION INCLUDES

A. Photographic requirements for construction photographs and submittals.

1.02 DEFINITIONS

A. Pre-construction Photographs: Photographs taken, in sufficient numbers and detail, prior to Date of Commencement of the Work, to show original construction site conditions.

B. Progress Photographs: Photographs, taken throughout the duration of construction at regular intervals and from fixed vantage points, pre-approved by the Authority, that document progress of the Work.

C. Finished Photographs: Photographs, taken by a professional photographer near Date of Substantial Completion and before the Authority Council's acceptance of the Work, that are suitable for framing and for use in brochures or on the Internet

1.03 SUBMITTALS

A. Refer to Section 01 33 00, Submittal Procedures, for submittal requirements.

B. Format and Media. Film or digital photography may be used. Submit color photographs, unless otherwise specified.

1. Prints. Submit each Progress or Pre-construction Photograph print in a three-hole plastic pocket or sleeve, bound in a three-ring notebook or in digital format. Produce prints on photographic-quality paper approved by Engineer. Minimum size for Pre-construction Photograph prints shall be 3-inches by 5-inches. Progress Photograph prints shall be 8-inches by 10-inches.

2. Film. Use 35mm or larger color film. Submit negatives used to make submitted photographs, in 3-hole 8-1/2 inch by 11-inch plastic sheets with sleeves for negatives.

3. Digital Photography. Use 10.0 megapixel density or greater for photographs. Scanned photographs must equal or exceed 400 dots per inch when scanned from 8-inch by 10-inch prints. Submit digital photographic files in digital format. Format in JPEG (Joint Photographic Experts Group) format.

C. Submittal Quantities and Frequencies.

1. Pre-construction Photographs:

a. For Stipulated Price Contracts, submit two sets of Pre-construction Photographs, if required, prior to first Application for Payment.

b. For Unit Price Contracts, submit two sets of Pre-construction Photographs prior to start of construction operations.

2. Progress Photographs:

a. For Stipulated Price Contracts, submit three sets of Progress Photographs with each Application for Payment at the times established for submittal of Applications for Payment. Monthly Applications for Payment shall be deemed incomplete if not accompanied by the required Progress Photographs. Contractor's failure or election to not submit a monthly Application for Payment shall not affect the requirement for monthly Progress Photographs.

b. Progress Photographs are not required for Unit Price Contracts unless otherwise specified.

3. Finished Photographs: For Stipulated Price Contracts submit two sets of Finished Photographs, if required, after Date of Substantial Completion and prior to final payment. Each set shall contain one 11-inch by 14-inch matte finish color photographic print from each of the two vantage points pre-approved by the Authority. Vantage points for Finished Photographs will be approved separately from vantage points approved for Progress Photographs. Finished Photographs are not required for Unit Price Contracts unless otherwise specified.

D. Labeling. Place a label on the back of each photographic print, applied so as to not to show through on the front. Labels shall contain the following information:

1. Name of Project, address of Project and GFS Number.

2. Name and address of Contractor.

3. Date photograph was taken.

4. Location photo was taken from and short description of photo subject.

5. Name and address of professional photographer who took the photograph, if applicable.

E. Hand deliver or transmit prints in standard photographic mailers marked "Photographs - Do Not Bend".

F. Photographic prints, negatives, photographic files and disks become the property of the Authority. Do not be publish photographs without written consent by the Authority.

1.04 QUALITY ASSURANCE

A. Contractor shall be responsible for the quality of and timely execution and submittal of photographs.

B. For Finished Photographs, Contractor shall use a professional photographer, with five years minimum professional experience in the Houston area. Contractor shall submit name, address and credentials of professional photographer for Engineer's review and approval.

2.00 PRODUCTS - NOT USED

3.00 EXECUTION

3.01 PRE-CONSTRUCTION PHOTOGRAPHS

A. Prior to commencement of construction operations, photograph the site to include initial construction corridor, detour routes, and staging or storage areas.

1. For Stipulated Price Contracts, unless specified as a requirement in other Sections, these photographs are optional for Contractor, but are highly recommended for areas bounded by other property owners.

2. Pre-construction photographs are required for Unit Price Contracts. For line projects with scheduled construction segments, take Pre- construction Photographs prior to commencement of work on each segment.

B. Prepare Pre-construction Photographs as follows:

1. Show the following information on a non-reflective chalkboard placed within the picture frame:

a. Job number.

b. Project Number.

c. Date and time photographs were taken (Automatic date/time in negative is acceptable).

d. Baseline station, direction of view (i.e. N, S, NW, etc.) and house number or street address and street name.

2. Pre-construction Photographs shall indicate condition of the following:

a. Esplanades and boulevards.

b. Yards (near side and far side of street).

c. House walks and sidewalks.

d. Curbs.

e. Areas between walks and curbs.

f. Particular features (e.g. yard lights, shrubs, fences, trees).

3. Show date photographs were taken on negatives.

C. Show the location of vantage points and direction of shots on a key plan of the site.

3.02 PROGRESS PHOTOGRAPHS

A. Progress Photographs document monthly advancement of the Work. Select vantage points for each shot so as to best show status of construction and progress since last photograph submittal. Select camera stations that will require little or no movement or adjustment over the duration of construction.

B. Take monthly Progress Photographs at regular intervals to coincide with cutoff dates associated with each Application for Payment.

3.03 FINISHED PHOTOGRAPHS

A. Finished Photographs shall be “staged” and taken by a professional photographer to depict the most flattering images of a finished facility. Two vantage points, from which Finished Photographs will be taken, shall be agreed to in advance by the Authority. Photographer shall consider lighting, time of day, height of eye, landscaping and placement of vehicles, people and other props in each picture. Filters and post-photography processing may be utilized to achieve a finished product acceptable to the Authority.

3.04 LOCATION

A. Vantage points, times and conditions for camera stations and photography for Progress and Finished Photographs shall be mutually agreed upon by the Authority, Contractor and Photographer. Progress Photograph vantage points may be changed by mutual agreement as the Work progresses, at no additional cost to the Authority.

END OF SECTION

01 32 50 CONSTRUCTION SCHEDULE

1.00 GENERAL

1.1 GENERAL

A. Provide Construction Schedules for the Work included in this Contract in accordance with requirements in this Section. Create Construction Schedule using Critical Path Method (CPM) computer software capable of mathematical analysis of Precedence Diagramming Method (PDM) plan. Provide printed activity listings and bar charts in formats described in this Section.

B. Combine activity listings and bar charts with narrative report to form Construction Schedule submittal for Engineer.

1.02 SCHEDULING STAFF

A. Employ or retain services of individual experienced in CPM scheduling for duration of the Contract. Individual shall cooperate with Engineer and update schedule monthly as required to indicate current status of the Work.

1.03 SUBMITTALS

A. Conform to requirements of Section 01 33 00 - Submittal Procedures. Submit electronic schedule (in *.PDF format) using WHCRWA FTP site.

B. During preconstruction meeting, as described in Section 01 31 20 - Coordination and Meetings, provide sample bar charts and activity listings produced from scheduling software proposed. Scheduling software is subject to review by Engineer and must meet requirements provided in this Section. Engineer will provide review of samples within seven days of submittal.

C. Within 21 days of receipt of approval of Contractor's format, or 30 days of Notice to Proceed, whichever is later, submit proposed Construction Schedule for review. Base Construction Schedule submittal on the following:

1. Level of detail and number of activities required in schedule are dependent on project type.

    a. For wastewater projects, categorize work type and area code in schedule.

        1). For wastewater rehabilitation projects, there are six work-type categories. An area code will be assigned for each Meter Service Area or Basin. Include at least one activity for each unique combination of work type and area code. Normal schedules of wastewater rehabilitation projects contain between 35 and 100

activities, depending on number of basins and work types involved in each basin.

2). For wastewater relief projects (line work), area codes will be assigned geographically.

3). For wastewater plant or facility work, other criteria may apply to assignment of area codes, such as a combination of geographical and craft categories.

b. For projects with multiple types of tasks within scope, indicate types of work separately within schedule.

c. For projects with work at different physical locations or service areas, or different facilities within a site, indicate each location or facility separately within schedule. Show work on each floor of multi-story building as separate tasks.

d. For projects with multiple crafts or significant Subcontractor components, indicate elements separately within schedule. Unless permitted by Engineer, tasks shall consist of work covered by only one division of Project Manual.

2. Unless permitted by Engineer, each scheduled task shall be same as Schedule of Values line item, and vice versa.

3. For projects with Major Unit Price Work, indicate Shop Drawing submittal and review, purchase, delivery, and Installation dates on Project schedule. Include activities for testing, adjustment, and delivering O&M manuals.

4. No task except the acquisition of Major Unit Price Work shall represent more than one percent of Original Contract Price for facility projects and three percent of Original Contract Price for other projects. Duration of tasks may not exceed 40 calendar days.

5. For projects where operating facilities are involved, identify each period of work that will impact any process or operation in the schedule and that must be agreed to by Engineer and facility operator prior to starting work in the area.

D. Construction Schedule submittals shall include:

1. printed bar charts that meet criteria outlined in this Section and are produced by Contractor's approved scheduling software;

2. activity listings that meet criteria outlined in this Section and are produced by Contractor's approved scheduling software; and

3. A predecessor/successor listing sorted by Activity ID that meets criteria outlined in this Section and is produced by Contractor's scheduling software.

4. A logic network diagram is required with the first Construction Schedule submittal for facilities projects.

5. Prepare and submit graphic or tabular display of estimated monthly billings (i.e. a cash flow curve for the Work) with the first schedule submittal. This information is not required in monthly updates, unless significant changes in work require re-submittal of schedule for review. Display shall allocate units indicated in bid schedule or Schedule of Values to Construction Schedule activities. Weighted allocations are acceptable, where appropriate. Dollar value associated with each allocated unit will be spread across the duration of that activity on a monthly basis. Total for each month and cumulative total will be indicated. These monthly forecasts are only for Engineer's planning purposes. Monthly payments for actual work completed will be made in accordance with Document 00700 - General Conditions.

6. Narrative Report that provides the information outlined in this Section.

E. No payment will be made until Engineer approves Construction Schedule and billing forecast.

F. If Contractor desires to make changes in its method of operating and scheduling, after Engineer has reviewed original schedule, notify Engineer in writing, stating reasons for changes. When Engineer considers these changes to be significant, Contractor may be required to revise and resubmit for review all or affected portion of Contractor's Construction Schedule to show effect on the Work.

G. Upon written request from Engineer, revise and submit for review all or any part of Construction Schedule submittal to reflect changed conditions in the Work or deviations made from original schedule.

H. Updated Construction Schedule with actual start and actual finish dates, percent complete, and remaining duration of each activity shall be submitted monthly. Data date used in updating monthly Construction Schedule shall be the same date as used in monthly Payment Application. Monthly update of Construction Schedule is required for monthly Payment Application to be processed for payment.

1.04 SCHEDULING COMPUTER SOFTWARE REQUIREMENTS

A. Contractor's scheduling software shall be capable of creating bar charts and activity listings, which can be sorted by various fields (i.e. Activity ID, Early Start, Total Float, Area Code, Specification Section number, and Subcontractor). Use software capable of producing logic network diagram.

B. Use scheduling software capable of producing activity listings and bar charts with the following information for each activity in the schedule:

1. Activity ID
2. Activity Description
3. Estimated (Original) Duration
4. Remaining Duration
5. Actual Duration
6. Early Start Date
7. Late Start Date
8. Early Finish Date
9. Late Finish Date
10. Free Float
11. Total Float
12. Activity Codes (such as Area Code, Work Type, Specification Section, Subcontractor)

C. Use scheduling software capable of printing calendars using mathematical analysis of schedule, indicating standard workdays of week and scheduled holidays.

D. Use scheduling software capable of printing activity listing that indicates predecessors and successors, lag factors and lag relationships used in creating logic of the schedule.

E. Use scheduling software to provide monthly time in Bar Chart format and scale with 12 month scale not to exceed one page width. Bar charts may be printed or plotted on 8½ by 11-inch, 8½ by 14-inch or 11 by 17-inch sheet sizes. Over-size plots are not acceptable.

1.05 NARRATIVE SCHEDULE REPORT

A. Narrative schedule report shall list activities started this month, activities completed this month, activities continued this month, activities scheduled to start or complete next month, problems encountered this month, and actions taken to solve these problems.

B. Narrative schedule report shall describe changes made to Construction Schedule logic (i.e. changes in predecessors and lags), activities added to schedule, activities deleted from schedule, any other changes made to the schedule other than addition of actual start dates and actual finish dates and changes of data date and remaining durations for re-calculation of mathematical analysis.

C. Submit electronic Narrative Schedule Report (in the form of approved word processor or *.PDF format) using WHCRWA FTP site.

2.00 PRODUCTS NOT USED

3.00 EXECUTION NOT USED

END OF SECTION

01 33 00 SUBMITTAL PROCEDURES

1.00 GENERAL

1.01 SECTION INCLUDES

A. Submittal procedures for:

1. Schedule of Values
2. Construction Schedules and Cash Flow Curve (billing forecast).
3. Shop Drawings, Product Data and Samples
4. Operations and Maintenance (O&M) Data
5. Manufacturer's Certificates
6. Construction Photographs
7. Project Record Documents and monthly certification.
8. Video Tapes
9. Design Mixes

1.02 SUBMITTAL PROCEDURES

A. Scheduling and Handling:

1. Submit shop drawings, data, and samples for related components electronically using WHCRWA FTP site as required by Engineer.

    a. Authority requires the use of WHCRWA FTP site to track the progress of West Harris County Regional Water Authority Contracts.

    b. All project documentation and correspondence, including Submittals, Request for Information (RFI), Request for Proposal (RFP), Change Orders, etc are to be transmitted electronically using WHCRWA FTP site or approved equal. Documents requiring original signature will be input into WHCRWA FTP site. The signed original are to be received by Engineer on the same day document is logged in electronically in WHCRWA FTP site. Documents received that are not input into WHCRWA FTP site may not be accepted by Engineer.

    c. Documents are to be submitted electronically in *.PDF format. No printed copies of submittal will be accepted for review unless original signature is required, submittal contains over fifty pages, or submittal page size is greater than 11" x 17".

d. Samples accompanying submittals and documentation are to be received by Engineer on the same day submittal is logged in electronically.

2. Schedule submittals well in advance of need for construction Products. Allow time for delivery of Products after submittal approval.

3. Develop submittal schedule that allows sufficient time for initial review, correction, resubmission and final review of all submittals. Allow a minimum of 30 days for initial review. Engineer will review and return submittals to Contractor as expeditiously as possible but time required for review will vary depending on complexity and quantity of data submitted.

4. Engineer's review of submittals covers only general conformity to Drawings, Specifications and dimensions that affect layout. Contractor is responsible for quantity determination. No quantities will be verified by Engineer. Contractor is responsible for errors, omissions or deviations from Contract requirements; review of submittals does not relieve Contractor from the obligation to furnish required items in accordance with Drawings and Specifications.

5. Submit all submittals electronically using WHCRWA FTP site unless otherwise specified in following paragraphs or Specifications.

6. Revise and resubmit submittals as required. Identify all changes made since previous submittal.

7. Assume risk for fabricated Products delivered prior to approval. Do not incorporate Products into the Work, or include payment for Products in periodic progress payments, until approved by Engineer.

B. Transmittal Form and Numbering:

1. Transmit each submittal to Engineer with Transmittal letter which includes:

a. Date and submittal number

b. Project title and number

c. Names of Contractor, Subcontractor, Supplier and manufacturer

d. Identification of Product being supplied

e. Location of where Product is to be Installed

f. Applicable Specification section number

2. Identify deviations from Contract documents clouding submittal drawings. Itemize and detail on separate 8-1/2 by 11-inch sheets entitled "DEVIATIONS FOR _____." When no deviations exist, submit a sheet stating no deviations exist.

3. Have design deviations signed and sealed by an appropriate design professional, registered in the State of Texas.

4. Sequentially number transmittal letters beginning with number one. Use original number for resubmittals with an alphabetic suffix (i.e., 2A for the first resubmittal of submittal 2, or 15C for third resubmittal of submittal 15, etc.). Show only one type of work or Product on each submittal. Mixed submittals will not be accepted.

C. Contractor's Stamp:

1. Apply Contractor's Stamp certifying that the items have been reviewed in detail by Contractor and that they comply with Contract requirements, except as noted by requested variances.

2. As a minimum, Contractor's Stamp shall include:

a. Contractor's name

b. Job number

c. Submittal number

d. Certification statement Contractor has reviewed submittal and it is in compliance with the Contract

e. Signature line for Contractor

D. Submittals will be returned with one of the following Responses:

1. "ACKNOWLEDGE RECEIPT" when no response and resubmittal is required.

2. "NO EXCEPTION" when sufficient information has supplied to determine that item described is accepted and that no resubmittal is required.

3. "EXCEPTIONS AS NOTED" when sufficient information has been supplied to determine that item will be acceptable subject to changes, or exceptions, which will be clearly stated. When exceptions require additional changes, the changes must be submitted for approval. Resubmittal is not required when exceptions require no further changes.

4. "REJECTED-RESUBMIT" when submittal does not contain sufficient information, or when information provided does not meet Contract requirements. Additional data or details requested by Engineer must be submitted to obtain approval.

1.03 MANUFACTURER'S CERTIFICATES

A. When required by Specification sections, submit manufacturers' certificate of compliance for review by Engineer.

B. Place Contractor's Stamp on front of certification.

C. Submit supporting reference data, affidavits, and certifications as appropriate.

D. Product certificates may be recent or from previous test results, but must be acceptable to Engineer.

1.04 DESIGN MIXES

A. When required by Specification sections, submit design mixes for review.

B. Place Contractor's Stamp, as specified in this section, on the front of each design mix.

C. Mark each mix to identify proportions, gradations, and additives for each class and type of mix submitted. Include applicable test results from samples for each mix. Perform tests and certifications within 12 months of the date of the submittal.

D. Maintain copies of approved mixes at mixing plant.

1.05 CHANGES TO CONTRACT

A. Changes to Contract may be initiated by completing a Request for Information form. Engineer will provide a response to Contractor by completing the form and returning it to Contractor.

1. If Contractor agrees that the response will result in no increase in cost or time, a Minor Change in the Work will be issued by Engineer.

2. If Contractor and Engineer agree that an increase in time or cost is warranted, Engineer will forward the Request for Proposal for negotiation of a Change Order.

2.00 PRODUCTS - NOT USED

3.00 EXECUTION - NOT USED

END OF SECTION

01 33 01 DOCUMENT REGISTER

Specification Section	Specification Description	Paragraph No.	Types of Documents Required		
			Product Information	Sample or Mockup	Operation Data

01 33 02 SHOP DRAWINGS

Note to Specifier: Verify all references to: (1) paragraphs within this Section; (2) other Sections of the Specifications; and (3) any other applicable standards or sources of information.

PART 1 - GENERAL

1.01 SUMMARY

A. Shop Drawings are required for those products that cannot adequately be described in the Contract Documents to allow fabrication, erection, or installation of the product without additional detailed information from the Supplier.

B. Submit Shop Drawings as required by the Contract Documents and as reasonably requested by the Construction Manager to:

1. Record the products incorporated into the Project;

2. Provide detailed information for the products proposed for the Project regarding their fabrication, installation, commissioning, and testing; and

3. Allow the Design Professional to advise the Owner if products proposed for the Project by the Contractor conform, in general, to the design concepts of the Contract Documents.

C. Contractor's responsibility for full compliance with the Contract Documents is not relieved by the review of Shop Drawings, Samples, or mockups.

D. Submit a Change Proposal per Section 01 26 00 "Change Management" to request modifications to the Contract Documents, including those for approval of "or equal" products when specifically allowed by the Contract Documents or as a substitution for specified products or procedures. Deviations from the Contract Documents can only be approved Change Order or Field Order.

1.02 QUALITY ASSURANCE

A. Submit legible, accurate, and complete documents presented in a clear, easily understood manner. Shop Drawings not meeting these criteria will not be approved.

B. Demonstrate that the proposed products are in full compliance with the design criteria and requirements of the Contract Documents, or will be if deviations requested per Paragraph **[1.11]** are approved.

C. Furnish and install products that fully comply with the information included in the Shop Drawings.

1.03 CONTRACTOR'S RESPONSIBILITIES

Note to Specifier: Use paragraph "A" below when there is an extensive list of products for which Shop Drawings are required. Use paragraph "B" below if there is a relatively small list of Shop Drawings required. Delete the paragraph not used.

A. Furnish Shop Drawings for products as indicated in Section 01 33 01 "Document Register" or in the individual Specification Sections.

B. Shop Drawings are required for the following items:

Specification Section	Shop Drawing Description

C. Include Shop Drawings in the Document Register required by Section 01 33 00 “Document Management” to indicate the Shop Drawings to be submitted, the dates on which Shop Drawings are to be sent to the Construction Manager for review, and proposed dates that the product will be incorporated into the Project.

D. Incorporate the dates for processing Shop Drawings into the Progress Schedule required by Section 01 33 05 “Construction Progress Schedule.”

1. Submit Shop Drawings in accordance with the schedule so construction of the Project is not delayed.
2. Submit Shop Drawings for interrelated Work at one time.
3. Allow adequate time for ordering, fabricating, delivering, and installing products so construction of the Project is not delayed.

E. Complete the following before submitting a Shop Drawing or Sample:

1. Prepare and review the Shop Drawing or Sample. Coordinate the Shop Drawing or Sample with other Shop Drawings and Samples, with the requirements of the Work, and the Contract Documents;
2. Determine and verify specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect to Shop Drawings and Samples;
3. Determine and verify the suitability of materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
4. Determine and verify information relative to Contractor’s responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.

F. Determine and verify:

1. Field measurements, quantities, and dimensions are shown on the Shop Drawing and are accurate;
2. Location of existing structures, utilities, and equipment related to the Shop Drawing have been shown and conflicts between the products, existing structures, utilities, and equipment have been identified;
3. Conflicts that impact the installation of the products have been brought to the attention of the Construction Manager;
4. Shop Drawing is complete for its intended purpose; and

5. Conflicts between the Shop Drawing related to the various Subcontractors and Suppliers have been resolved.

G. Review Shop Drawings prior to submitting to the Construction Manager. Certify that all Shop Drawings have been reviewed by the Contractor and are in strict conformance with the Contract Documents as modified by Addenda, Change Order, Field Order, or Contract Amendment when submitting Shop Drawings except for deviations specifically brought to the Construction Manager's attention on an attached Shop Drawing Deviation Request form in accordance with Paragraph **[1.11]**.

H. Fabrication or installation of any products prior to the approval of Shop Drawings is done at the Contractor's risk. Defective products may be rejected at the Owner's option.

I. Payment will not be made for products for which Shop Drawings or Samples are required until these are approved by the Construction Manager and Design Professional.

1.04 DOCUMENTATION

A. Provide adequate information in Shop Drawings and with Samples so the Design Professional can:

1. Assist the Owner in selecting colors, textures, or other aesthetic features.

2. Compare the proposed features of the product with the specified features and advise Owner that the product does, in general, conform to the Contract Documents.

3. Compare the performance features of the proposed product with those specified and advise the Owner that the product does, in general, conform to the performance criteria specified in the Contract Documents.

4. Review required certifications, guarantees, warranties, and service agreements for compliance with the Contract Documents.

B. Include a complete description of the material or equipment to be furnished, including:

1. Type, dimensions, size, arrangement, model number, and operational parameters of the components;

2. Weights, gauges, materials of construction, external connections, anchors, and supports required;

3. Performance characteristics, capacities, engineering data, motor curves, and other information necessary to allow a complete evaluation of mechanical components;

4. All applicable standards;

5. Fabrication and installation drawings, setting diagrams, manufacturing instructions, templates, patterns, and coordination drawings;

6. Wiring and piping diagrams and related controls;

7. Mix designs for concrete, asphalt, or other materials proportioned for the Project; and

8. Complete and accurate field measurements for products which must fit existing conditions. Indicate on the document that the measurements represent actual dimensions obtained at the Site.

C. Submit Shop Drawings that require coordination with other Shop Drawings for fabrication at the same time. Shop Drawings requiring coordination with other Shop Drawings will not be approved until a complete package is submitted, unless approved by the Construction Manager.

D. Submit information for all of the components and related equipment required for a complete and operational system in one Submittal.

1. Include electrical, mechanical, and other information required to indicate how the various components of the system function together as a system.

2. Provide certifications, warranties, and written guarantees and service contracts with the document package for review when these are required.

1.05 SPECIAL CERTIFICATIONS AND REPORTS

A. Provide all required special certifications, reports, and other documentation with the Shop Drawings as specified in the individual Specification Sections which may include:

1. Certified Test Reports (CTR): A report prepared by an approved testing agency giving results of tests performed on products to indicate their compliance with the Specifications. This report is to demonstrate that the product, when installed, will meet the requirements of the Contract Documents and is part of the Shop Drawing. Field tests may be performed by the Owner to determine that in place materials or products meet the same quality as indicated in the CTR submitted as part of the Shop Drawing.

2. Certification of Local Field Service (CLS): A certified letter stating that field service is available from a factory or supplier approved service organization located within a 300-mile radius of the Site. Include the names, addresses, and telephone numbers of approved service organizations with the certificate.

3. Certification of Adequacy of Design (CAD): A certified letter from the manufacturer of the equipment stating that the equipment has been designed to be structurally stable and to withstand all imposed loads without deformation, failure, or adverse effects to the performance and operational requirements of the unit. The letter must state that mechanical and electrical components have been adequately sized to be fully operational for the conditions specified or normally encountered by the product's intended use.

4. Certification of Applicator/Subcontractor (CSQ): A certified letter stating that the applicator or subcontractor proposed to perform a specified function is duly designated as factory authorized and trained for the application of the specified product.

Note to Specifier: Include the "Warranties and Service Agreements" Article and include Section 01 78 36 "Warranties and Service Agreements" when equipment or materials are pre-purchased or pre-selected, when service agreements are to be provided or extended, or when special warranties are required. If Section 01 78 36 is not used, delete this Article.

1.06 WARRANTIES AND SERVICE AGREEMENTS

A. Provide warranties and service agreements per Section 01 78 36 "Warranties and Service Agreements."

Note to Specifier: If the "Warranties and Service Agreements" Article and Section 01 78 36 are to be included, the "Warranties and Guarantees" and "Extended Service Agreements" Articles should be deleted.

1.07 WARRANTIES AND GUARANTEES

A. Provide all required warranties, guarantees, and related documents with the Shop Drawing. The effective date of warranties and guarantees will be the date of Substantial Completion.

B. Identify all extended warranties which are defined as any guarantee of performance for the product or system beyond the one-year correction period described in the General Conditions. Issue the warranty certificate in the name of the Owner. Provide a warranty bond for extended warranties if required by the individual Specification Sections.

C. Include an additional copy of equipment warranties in operation and maintenance manuals.

D. Provide a copy of all warranties in a separate document in accordance with Section 01 70 00 "Execution and Closeout Requirements."

1.08 EXTENDED SERVICE AGREEMENTS

A. Provide Extended Service Agreements and related documents with the Product Data. An Extended Service Agreement is a contract between the Owner and an approved Subcontractor or Supplier to provide service and or maintenance beyond that required to fulfill requirements for warranty repairs, or to perform routine maintenance for a definite period beyond the one-year correction period specified in the General Conditions.

B. An Extended Service Agreement does not relieve the Contractor from obligations under the one-year correction period or warranty provisions specified in the General Conditions

C. An Extended Service Agreement does not relieve the Contractor from obligations under the maintenance bond, if a maintenance bond is required by the Contract.

D. Requirements for the Extended Service Agreement are described in the Specification Sections for each piece of equipment or system requiring an Extended Service Agreement.

E. Enter into a contract with the service provider and assign the service contract to the Owner on the date Substantial Completion. Once assigned to the Owner, Contract requirements for the Extended Service Agreement will be complete and will not extend the Contract between the Owner and Contractor.

F. Owner may require that a performance bond be provided for the Extended Service Agreement. Provide a separate bond meeting the same requirements as those for the

Contractor's performance bond if required. The bond will be in the amount of the Extended Service Agreement.

G. Include an additional copy of Extended Service Agreements in operation and maintenance manuals.

H. Provide a copy of Extended Service Agreements in a separate document in accordance with Section 01 70 00 "Execution and Closeout Requirements."

1.09 SHOP DRAWING SUBMITTAL PROCEDURES

A. Submit Shop Drawings to the Construction Manager. Send all documents in digital format for processing.

1. Provide all information requested. Do not leave any blanks incomplete. If information is not applicable, enter NA in the space provided.

2. Submit all documents in Portable Document Format (PDF) as required by Section 01 33 00 "Document Management." Provide color PDF documents where color is required to interpret the Shop Drawing. Provide Samples and color charts per Paragraph **[1.10]**.

3. Submit each specific product, class of material, or equipment system separately so these can be tracked and processed independently. Do not submit Shop Drawings for more than one independent system in the same Submittal.

4. Submit items specified in different Specification Sections separately unless they are part of an integrated system.

5. Define abbreviations and symbols used in Shop Drawings.

a. Use terms and symbols in Shop Drawings consistent with the Contract Drawings.

b. Provide a list of abbreviations and their meaning as used in the Shop Drawings.

c. Provide a legend for symbols used on Shop Drawings.

6. Mark Shop Drawings to reference:

a. Related Specification Sections;

b. Drawing number and detail designation;

c. Equipment designation or name;

d. Schedule references;

e. System into which the product is incorporated; and

f. Location where the product is incorporated into the Project.

B. Use the following conventions to markup Shop Drawings for review:

1. Make comments and corrections in the color blue. Add explanatory comments to the markup.

2. Highlight items in black (redact) that are not being furnished when the Supplier's standard drawings or information sheets are provided so that only the products to be provided are in their original color.

3. Make comments in yellow where selections or decisions by the Design Professional are required, but such selections do not constitute a deviation from the Contract Documents. Add explanatory comments to the markup to indicate the action requested of the Design Professional.

4. Make comments in orange that are deviation requests. Include the deviation request number on the Shop Drawing that corresponds to the deviation request on the Shop Drawing Deviation Request form. Include explanatory comments in the Shop Drawing Deviation Request form.

5. Mark dimensions with the prefix “FD” to indicate field verified dimensions on the Shop Drawings.

C. Designate a document as requiring priority treatment to place the review of the Shop Drawing ahead of other Shop Drawings previously delivered. Shop Drawings are typically reviewed in the order received, unless Contractor requests that a different priority be assigned. Priority Shop Drawings will be reviewed before other Shop Drawings already received but not yet reviewed. Use of this priority designation for Shop Drawings may delay the review of Shop Drawings previously submitted. Contractor is responsible for delays resulting from the use of the priority designation status on Shop Drawings.

D. Complete the certification required by Paragraph **[1.03.G]**.

1.10 SAMPLE AND MOCKUP SUBMITTAL PROCEDURES

A. Submit color charts and Samples for every product requiring color, texture, or finish selection.

1. Submit color charts and Samples only after Shop Drawings for the products have been approved.

2. Deliver all color charts and Samples at one time.

3. Provide Samples of adequate size to clearly illustrate the functional characteristics of the product, with integrally related parts and attachment devices.

4. Indicate the full range of color, texture, and patterns.

5. Deliver color charts and Samples to the field office and store for the duration of the Project.

6. Notify the Construction Manager that color charts and Samples have been delivered for approval using the Notification by Contractor form.

7. Submit color charts and Samples not less than 30 days prior to when these products are to be ordered or released for fabrication to comply with the Project schedule.

8. Remove Samples that have not been approved. Submit new Samples following the same process as for the initial Sample until Samples are approved.

9. Dispose of Samples when related Work has been completed and approved and disposal is approved by the Construction Manager. At Owner’s option, Samples will become the property of the Owner.

B. Construct mockups for comparison with the Work being performed.

1. Construct mockups from the actual products to be used in construction per the detailed specifications.
2. Construct mockups of the size and in the area indicated in the Contract Documents.
3. Construct mockups complete with texture and finish to represent the finished product.
4. Notify the Construction Manager that mockups have been constructed and are ready for approval using the Notification by Contractor form. Allow 2 weeks for Construction Manager to approve of the mockup before beginning the Work represented by the mockup.
5. Remove mockups that have not been approved. Construct new mockups following the same process as for the initial mockup until mockup is approved.
6. Protect mockups until Work has been completed and accepted by the Construction Manager.
7. Dispose of mockups when related Work has been completed and disposal is approved by the Construction Manager.

1.11 REQUESTS FOR DEVIATION

A. Submit a Change Proposal per Section 01 26 00 “Change Management” to request modifications to the Contract Documents, including those for approval of “or equal” products when specifically allowed by the Contract Documents or as a substitution for specified products or procedures.

B. Provide a Shop Drawing with the Change Proposal that clearly identifies deviations for any product or component of the product that does not fully comply with the Contract Documents using the Shop Drawing Deviation Request form provided by the Construction Manager. Mark deviations on the Shop Drawing per Paragraph **[1.09.B]**

C. Include a description of why the deviation is required and the impact on Contract Price or Contract Times. Include the amount of any cost savings to the Owner for deviations that result in a reduction in cost.

D. Identify each deviation request as a separate item. Include all requested deviations that must be approved as a group together and identify them as a single item.

E. Construction Manager will issue a Field Order or Change Order to approve acceptable deviations. Approval of a requested Shop Drawing deviation by the Design Professional on the Shop Drawings Deviation Request form indicates approval of the requested deviation only on its technical merits as generally conforming to the Contract Documents. Deviations from the Contract Documents can only be approved by a Modification issued by the Construction Manager.

1.12 CONSTRUCTION MANAGER AND DESIGN PROFESSIONAL RESPONSIBILITIES

A. Shop Drawings will be received by the Construction Manager. Construction Manager will log the documents and forward to the Design Professional for review per this Section for general conformance with the Contract Documents.

1. Design Professional’s review and approval will be only to determine if the products described in the Shop Drawing or Sample will, after installation or incorporation in the

Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

2. Design Professional's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction or to safety precautions or programs incident thereto.

3. Design Professional's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

B. Comments will be made on items called to the attention of the Design Professional for review and comment. Any marks made by the Design Professional do not constitute a blanket review of the document or relieve the Contractor from responsibility for errors or deviations from the Contract requirements.

1. Design Professional will respond to Contractor's markups by either making markups directly in the Shop Drawing file using the color red or by attaching a Document Review Comments form with review comments keyed to the Drawings or Shop Drawing Deviation Request.

2. Shop Drawings that are reviewed will be returned with one or more of the following status designations:

a. Approved: Shop Drawing is found to be acceptable as submitted.

b. Approved as Noted: Shop Drawing is approved so long as corrections or notations made by Design Professional are incorporated into the Shop Drawing.

c. Not Approved: Shop Drawing or products described are not acceptable.

d. Cancelled: This action indicates that for some reason, the Shop Drawing is to be removed from consideration and all efforts regarding the processing of that document are to cease.

3. Shop Drawings will also be designated for one of the following actions:

a. Documents Filed: Shop Drawing is acceptable without further action and has been filed as a record document.

b. Shop Drawing Not Required: A Shop Drawing was not required by the Contract Documents. Resubmit the document per Section 01 33 03 "Product Data."

c. Cancelled: This action indicates that for some reason, the Shop Drawing is to be removed from consideration and all efforts regarding the processing of that document are to cease.

d. Revise and Resubmit: Shop Drawing has deviations from the Contract Documents, significant errors, or is inadequate and must be revised and resubmitted for subsequent review.

Actions "a" through "c" will close out the Shop Drawing review process and no further action is required as a Shop Drawing. Action "d" requires follow up action to close out the review process.

4. Drawings with a significant or substantial number of markings by the Contractor may be marked "Approved as Noted." These drawings are to be revised to provide a clean

record of the document. Proceed with ordering products as the documents are revised.

5. Dimensions or other data that do not appear to conform to the Contract Documents will be marked as “At Variance With” (AVW) the Contract Documents or other information provided. The Contractor is to make revisions as appropriate to comply with the Contract Documents.

C. Bring deviations to the Shop Drawings to the attention of the Design Professional for approval by using the Shop Drawing Deviation Request form. Use a single line for each requested deviation so the Status and Action for each deviation can be determined for that requested deviation. If approval or rejection of a requested deviation will impact other requested deviation, then all related deviations should be included in that requested deviation line so the status and action can be determined on the requested deviation as a whole.

D. Requested deviations will be reviewed as a possible Modification to the Contract Documents.

1. A requested deviation will be marked as “Not Approved” if the requested deviation is unacceptable. Contractor is to revise and resubmit the Shop Drawing with corrections for approval.

2. A Field Order will be issued by the Construction Manager for deviations approved by the Design Professional if the requested deviation is acceptable and if the requested deviation will not result in a change in Contract Price or Contract Times. Requested deviations from the Contract Documents may only be approved by Field Order.

3. A requested deviation will not be approved if the requested deviation is acceptable but the requested deviation will or should result in a change in Contract Price or Contract Times. Submit any requested deviation that requires a change in Contract Price or Contract Times as a Change Proposal for approval prior to resubmitting the Shop Drawing.

E. Contractor is to resubmit a complete Shop Drawing incorporating revisions until it is acceptable and marked “Approved” or “Approved as Noted” and is assigned an action per Paragraph **[1.12.B.3]** that indicates that the Shop Drawing process is closed.

F. Information that is submitted as a Shop Drawing that should be submitted as Product Data or other type of document, or is not required may be returned without review, or may be deleted. No further action is required and the Shop Drawing process for this document will be closed.

1.13 RESUBMISSION REQUIREMENTS

A. Make all corrections or changes required by the Design Professional in the document and resubmit to the Construction Manager until approved.

B. Resubmit a complete Shop Drawing for each resubmittal. The last approved Shop Drawing must not rely on previous submissions. The final Shop Drawing is to provide a complete record for the Owner’s records.

C. Revise initial drawings or data and resubmit as specified for the reviewed document.

1. Highlight or cloud in green those revisions which have been made in response to the previous reviews by the Design Professional. This will include changes previously highlighted or clouded in yellow to direct attention to Design Professional to items requiring selections, decisions by the Design Professional or highlighted or clouded in orange for a requested deviation from the Contract Documents, or comments in red made by the Construction Manager.

2. Highlight and cloud new items in yellow where selections or decisions by the Design Professional are required, but such selections do not constitute a deviation from the Contract Documents. Add explanatory comments to the markup to indicate the action to be taken by the Design Professional.

3. Highlight and cloud new items in orange that are deviation requests. Include the deviation request number on the Shop Drawing that corresponds to the deviation request on the Shop Drawing Deviation Request form. Numbering for these new items is to start with the next number following the last Shop Drawing deviation requested. Include explanatory comments in the Shop Drawing Deviation Request form.

D. Pay for excessive review of Shop Drawings.

1. Excessive review of Shop Drawings is defined as any review required after the original review has been made and the first resubmittal has been checked to see that corrections have been made.

2. Review of Shop Drawings or Samples will be an additional service requiring payment by the Contractor if the Contractor submits a substitution for a product for which a Shop Drawing or Sample has previously been approved, unless the need for such change is beyond the control of Contractor.

3. Cost for additional review time will be billed to the Owner by the Design Professional for the actual hours required for the review of Shop Drawings by Design Professional and in accordance with the rates listed in Section 00 73 00 “Supplementary Conditions.”

4. A set-off will be included in each Application for Payment to pay the cost for the additional review. The set-off will be based on invoices submitted to the Owner for these services.

5. Need for more than one resubmission or any other delay in obtaining Design Professional’s approval of Shop Drawings will not entitle the Contractor to an adjustment in Contract Price or an extension of Contract Times.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

01 33 03 PRODUCT DATA

Note to Specifier: Verify all references to: (1) paragraphs within this Section; (2) other Sections of the Specifications; and (3) any other applicable standards or sources of information.

PART 1 - GENERAL

1.01 SUMMARY

A. Submit Product Data as required by the Contract Documents and as reasonably requested by the Construction Manager. Provide Product Data for all products unless a Shop Drawing is required for the same item.

B. Submit Product Data to provide documents that allow the Owner to:

1. Record the products incorporated into the Project;

2. Record detailed information about products regarding their fabrication, installation, commissioning, and testing; and

3. Provide replacement or repair of products at some future date.

C. Contractor's responsibility for full compliance with the Contract Documents is not relieved by the receipt or cursory review of Product Data.

D. Submit a Change Proposal per Section 01 26 00 "Change Management" to request modifications to the Contract Documents, including those for approval of "or equal" products when specifically allowed by the Contract Documents or as a substitution for specified products or procedures. Deviations from the Contract Documents can only be made by an approved Change Order or Field Order.

1.02 QUALITY ASSURANCE

A. Submit legible, accurate, and complete documents presented in a clear, easily understood manner. Product Data not meeting these criteria will not be accepted and must be resubmitted.

1.03 CONTRACTOR'S RESPONSIBILITIES

Note to Specifier: Use paragraph "A" when there is an extensive list of products for which Product Data are required. Use paragraph "B" if there is a relatively small list of Product Data required. Delete the paragraph not used.

A. Furnish Product Data for products as indicated in Section 01 33 01 "Document Register" or in the individual Specification Sections.

B. Product Data is required for the following items:

Specification Section	Product Data Description

C. Include Product Data in the Document Register required by Section 01 33 00 “Document Management” to indicate the Product Data to be submitted, the dates on which documents are to be sent to the Construction Manager for review, and proposed dates that the product will be incorporated into the Project.

D. Complete the following before submitting Product Data:

1. Prepare Product Data and coordinate with Shop Drawings, Samples, Product Data for related products, and with the requirements of the Contract Documents;
2. Determine and verify specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information;
3. Determine and verify the suitability of materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
4. Determine and verify information relative to Contractor’s responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.

E. Determine and verify:

1. Field measurements, quantities, and dimensions are shown on the Product Data and are accurate;
2. Location of existing structures, utilities, and equipment related to the Product Data have been shown and conflicts between the products, existing structures, utilities, and equipment have been brought to the attention of the Construction Manager;
3. Conflicts that impact the installation of the products have been brought to the attention of the Construction Manager;
4. Product Data is complete for its intended purpose; and

5. Conflicts between the Product Data related to the various Subcontractors and Suppliers have been resolved.

F. Review Product Data prior to submitting to the Construction Manager. Certify that all Product Data has been reviewed by the Contractor and is in strict conformance with the Contract Documents as modified by Addenda, Change Order, Field Order, or Contract Amendment when submitting Product Data.

1.04 DOCUMENTATION

A. Include a complete description of the material or equipment to be furnished, including:

1. Type, dimensions, size, arrangement, model number, and operational parameters of the components;

2. Weights, gauges, materials of construction, external connections, anchors, and supports required;

3. Performance characteristics, capacities, engineering data, motor curves, and other information necessary to allow a complete evaluation of mechanical components;

4. All applicable standards;

5. Fabrication and installation drawings, setting diagrams, manufacturing instructions, templates, patterns, and coordination drawings;

6. Wiring and piping diagrams and related controls;

7. Mix designs for concrete, asphalt, or other materials proportioned for the Project; and

8. Complete and accurate field measurements for products which must fit existing conditions. Indicate on the document that the measurements represent actual dimensions obtained at the Site.

B. Submit information for all components and related equipment required for a complete and operational system in one submittal.

1. Include electrical, mechanical, and other information required to indicate how the various components of the system function together as a system.

2. Provide certifications, warranties, and written guarantees and service contracts with the document package for review when these are required.

1.05 SPECIAL CERTIFICATIONS AND REPORTS

A. Provide all required certifications with the Product Data as specified in the individual Specification Sections:

1. Certified Test Reports (CTR): A report prepared by an approved testing agency giving results of tests performed on products to indicate their compliance with the Specifications. This report is to demonstrate that the product when installed will meet the requirements of the Contract Documents and is part of the Product Data. Field tests may be performed by the Owner to determine that in place materials or products meet the same quality as indicated in the CTR submitted as part of the Product Data.

2. Certification of Local Field Service (CLS): A certified letter stating that field service is available from a factory or supplier approved service organization located within a

300-mile radius of the Site. Include the names, addresses, and telephone numbers of approved service organizations with the certificate.

3. Certification of Adequacy of Design (CAD): A certified letter from the manufacturer of the equipment stating that the equipment has been designed to be structurally stable and to withstand all imposed loads without deformation, failure, or adverse effects to the performance and operational requirements of the unit. The letter must state that mechanical and electrical components have been adequately sized to be fully operational for the conditions specified or normally encountered by the product's intended use.

4. Certification of Applicator/Subcontractor (CSQ): A certified letter stating that the applicator or subcontractor proposed to perform a specified function is duly designated as factory authorized and trained for the application of the specified product.

Note to Specifier: Include the "Warranties and Service Agreements" Article and include Section 01 78 36 "Warranties and Service Agreements" when equipment or materials are pre-purchased or pre-selected, when service agreements are to be provided or extended, or when special warranties are required. If Section 01 78 36 is not used, delete this Article.

1.06 WARRANTIES AND SERVICE AGREEMENTS

A. Provide warranties and service agreements per Section 01 78 36 "Warranties and Service Agreements."

Note to Specifier: If the "Warranties and Service Agreements" Article and Section 01 78 36 are to be included, the "Warranties and Guarantees" and "Extended Service Agreements" Articles should be deleted.

1.07 WARRANTIES AND GUARANTEES

A. Provide all required warranties, guarantees, and related documents with the Product Data. The effective date of warranties and guarantees will be the date of Substantial Completion.

B. Identify all Extended Warranties which are defined as any guarantee of performance for the product or system beyond the one-year correction period described in the General Conditions. Issue the warranty certificate in the name of the Owner. Provide a warranty bond for extended warranties if required by Specification Sections.

C. Include an additional copy of equipment warranties in operation and maintenance manuals.

D. Provide a copy of all warranties in a separate document in accordance with Section 01 70 00 "Execution and Closeout Requirements."

1.08 EXTENDED SERVICE AGREEMENTS

A. Provide Extended Service Agreements and related documents with the Product Data. An Extended Service Agreement is a contract between the Owner and an approved Subcontractor or Supplier to provide service and or maintenance beyond that required to fulfill requirements for warranty repairs, or to perform routine maintenance for a definite period beyond the one-year correction period specified in the General Conditions.

B. An Extended Service Agreement does not relieve the Contractor from obligations under the one-year correction period or Warranty provisions specified in the General Conditions

C. An Extended Service Agreement does not relieve the Contractor from obligations under the maintenance bond, if a maintenance bond is required by the Contract.

D. Requirements for the Extended Service Agreement are described in the Specification Sections for each piece of equipment or system requiring an Extended Service Agreement.

E. Enter into a contract with the service provider and assign the service contract to the Owner on the date of Substantial Completion. Once assigned to the Owner, Contract requirements for the Extended Service Agreement will be complete and will not extend the Contract between the Owner and Contractor.

F. Owner may require that a performance bond be provided for the Extended Service Agreement. Provide a separate bond meeting the same requirements as those for the Contractor's performance bond if required. The bond will be in the amount of the Extended Service Agreement.

G. Include an additional copy of Extended Service Agreements in operation and maintenance manuals.

H. Provide a copy of Extended Service Agreements in a separate document in accordance with Section 01 70 00 "Execution and Closeout Requirements."

1.09 PRODUCT DATA SUBMITTAL PROCEDURES

A. Submit Product Data to the Construction Manager. Send all documents in digital format for processing.

1. Provide all information requested. Do not leave any blanks incomplete. If information is not applicable, enter NA in the space provided.

2. Submit all documents in Portable Document Format (PDF) as required by Section 01 33 00 "Document Management." Provide color PDF documents where color is required to interpret the Product Data.

3. Submit each specific product, class of material, or equipment system separately so these can be tracked and processed independently. Do not submit Product Data for more than one system in the same Submittal.

4. Submit items specified in different Specification Sections separately unless they are part of an integrated system.

5. Define abbreviations and symbols used in Product Data.

a. Use terms and symbols in Product Data consistent with the Contract Drawings.

b. Provide a list of abbreviations and their meaning as used in the Product Data.

c. Provide a legend for symbols used on Product Data.

6. Mark Product Data to reference:

a. Related Specification Sections;

b. Drawing number and detail designation;

c. Equipment designation or name;

d. Schedule references;

e. System into which the product is incorporated; and

f. Location where the product is incorporated into the Project.

B. Complete the certification required by Paragraph **[1.03.F]**.

1.10 CONSTRUCTION MANAGER AND DESIGN PROFESSIONAL RESPONSIBILITIES

A. Product Data will be received by the Construction Manager, logged, and provided to Owner as the Project record.

1. Product Data may be reviewed to see that the information provided is adequate for the purpose intended. Product Data not meeting the requirements of Paragraph **[1.02]** may not be approved.

2. Product Data is not reviewed for compliance with the Contract Documents. Comments may be returned if deviations from the Contract Documents are noted during the cursory review performed to see that the information is adequate.

3. Contractor's responsibility for full compliance with the Contract Documents is not relieved by the review of Product Data. Contract modifications can only be approved by a Change Order or Field Order.

B. Construction Manager may take the following action in processing Product Data:

1. File Product Data as received if the cursory review indicates that the document meets the requirements of Paragraph **[1.02]**. Document will be marked "Filed as Received" and "Documents Filed." No further action is required on that Product Data.

2. Not approve the Product Data for one of the following reasons:

a. The documentation requirements of the Contract Documents indicate that the document submitted as Product Data should have been submitted as a Shop Drawing. The Product Data will be marked "Not Approved" and "Submit as Shop Drawing". No further action is required on this document as Product Data and the Product Data process will be closed. Resubmit the document as a Shop Drawing per Section 01 33 02 "Shop Drawings."

b. The cursory review indicates that the document does not meet the requirements of Paragraph **[1.02]**. The Product Data will be marked "Not Approved" and "Revise and Resubmit". Contractor is to resubmit the Product Data until it is acceptable and marked "Filed as Received". When Product Data is filed, no further action is required and the Product Data process will be closed.

c. The Product Data is not required by the Contract Documents nor is applicable to the Project. The Product Data will be marked "Not Approved" and "Cancelled." No further action is required and the Product Data process will be closed.

C. Contractor is to resubmit the Product Data until it is acceptable and marked "Filed as Received".

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

01 33 04 OPERATION AND MAINTENANCE DATA

Notes to Specifier:

1. **This Section has been renumbered from 01 78 23 to 01 33 04. Any references to Section 01 78 23 in the technical Specifications should be changed as necessary to reference this Section number.**
2. **Verify all references to: (1) paragraphs within this Section; (2) other Sections of the Specifications; and (3) any other applicable standards or sources of information.**

PART 1 - GENERAL

1.01 SUMMARY

A. Prepare a complete and detailed operation and maintenance manual (manual) for each type and model of equipment or product furnished and installed under this Contract.

B. Prepare manuals in the form of an instruction manual for the Owner. The manuals are to be suitable for use in providing the operation and maintenance instructions required by Section 01 79 00 “Training of Operation and Maintenance Personnel.”

C. Provide complete and detailed information specifically for the products or systems provided for this Project. Include the information required to operate and maintain the product or system.

D. Manuals are to be provided in addition to any information packed with or attached to the product when delivered. Remove information packed with or attached to the product and include this information as an attachment to the manual.

E. Include cost for manuals provided by Suppliers and Subcontractors as described in this Section in the Cost of Work for that equipment item.

1.02 DOCUMENTATION

A. Submit manuals in accordance with Section 01 33 00 “Document Management.” Attach a copy of the Operation and Maintenance Manual Review Report form provided by the Construction Manager to each manual with pertinent information completed.

B. Provide one preliminary electronic copy of the manual to the Construction Manager for review within 15 days after review of any equipment submittal by the OPT.

C. Provide one electronic copy and three printed copies of the final manual after:

1. Preliminary manuals have been approved;
2. Field test records have been incorporated into the manual; and
3. Record Documents per Section 01 31 13 “Project Coordination” have been approved and have been incorporated in the final manual.

D. Provide copies of the manufacturer’s warranties, guarantees, or service agreements in accordance with Section 01 70 00 “Execution and Closeout Requirements.”

PART 2 - PRODUCTS

2.01 MATERIALS

A. Provide digital files for each manual as specified in Paragraph **[2.02]**.

1. Use filenames that correspond to the equipment designation shown in the Contract Documents or other equipment designations provided by the OPT.

2. Submit a preliminary version of the electronic manual for review. Provide a final version of the manual incorporating OPT's comments.

B. Provide printed copies of each manual as specified in Paragraph **[2.03]**.

2.02 ELECTRONIC MANUAL FORMAT

A. Manual contents are to be submitted in electronic format to the Construction Manager.

B. Provide individual electronic files for each manual.

1. Maximum file size is 75 MB. If manual is greater than maximum allowable file size, provide individual files for each major section of manual.

2. Acceptable file types for written documents are Portable Document File (PDF) or provide manual text in Microsoft Word. Provide drawings in native format and PDF format. All files must be compatible with the latest software version available.

3. Filename must identify the equipment location, equipment manufacturer, and date equipment placed in service, e.g. JCC1-Pump Room-Manufacturer-200503.pdf.

4. Each electronic file must contain a table of contents at the beginning of the file which includes hypertext links or bookmarks to navigate the file contents per section/chapter.

5. Scanned images of written documents are not acceptable. Document must allow character selection. Text within a file must be transferable to other documents.

6. Drawing files must have the ability to turn on/off drawing layers within the file.

2.03 PRINTED MANUAL FORMAT

A. Printed copies of each manual are to be submitted as follows:

1. Print manuals on heavy, first quality 8-1/2 x 11 paper.

a. Reduce drawings and diagrams to 8-1/2 x 11 paper size.

b. When reduction is not practical, fold drawings and place each separately in a clear, super heavy weight, top loading polypropylene sheet protector designed for three-ring binder use. Provide a typed identification label on each sheet protector.

c. Punch paper for standard three-ring binders.

2. Place manuals in heavy duty presentation, d-ring binders with clear front, back, and spine covers.

3. Identify each manual by placing a printed cover sheet in the front cover of the binder and as the first page in the manual. The first page is to be placed in a clear polypropylene sheet protector. The information on first page and the cover page are to include:
    a. Name of Owner;
    b. Project name;
    c. Volume number; and
    d. Table of contents.
4. Insert the name of the Project and volume number into the spine covers.
5. Sheet lifters are to be provided.
6. Minimum size is 2-inch capacity. Maximum size is 3-inch capacity. Fill binders to only three-fourths of its indicated capacity to allow for addition of materials to each binder by the Owner.
7. Provide index tabs for each section of the manual. Indexes are to be constructed of heavy-duty paper with a reinforced binding edge. The designation on each index tab is to correspond to the number and letter assigned in the Table of Contents.
8. Manuals for several products or systems may be provided in the same binder. Correlate the data into related groups when multiple products or systems are included in the same binder.
    a. Sections for each product or system must be included in the same binder.
    b. Sections must be in numerical order from volume to volume.

PART 3 - EXECUTION

3.01 MANUAL ORGANIZATION AND CONTENTS

A. Provide a table of contents listing each section of the manual for each product or system.
    1. Assign a number and letter to each section in the manual.
        a. The number is to correspond to the Owner's equipment numbering system or other system designated in the Contract Documents.
        b. The letter assigned will represent the part of the manual, consistent with the manual contents as required by this Section.
    2. Identify each product or system using the nomenclature shown in the Contract Documents. Provide a cross reference to the Owner's numbering system and designations for equipment indicated in the Contract Documents if these are different.
B. Include only the information that pertains to the product described. Annotate each sheet to:
    1. Clearly identify the specific product or component installed;
    2. Clearly identify the data applicable to the installation; and
    3. Delete or strike through references to inapplicable information.

C. Supplement manual information with drawings as necessary to clearly illustrate relations of component parts of equipment and systems, and control and flow diagrams.

D. Manuals for several products or systems may be provided in the same binder.

E. Fill binders to only three-fourths of its indicated capacity to allow for addition of information by the Owner.

3.02 EQUIPMENT AND SYSTEMS MANUAL CONTENT

A. Provide the following information in the first tabbed section of each manual:

1. A description of the unit and component parts and how it functions.

2. Operating instructions for pre-startup, startup, normal operations, regulation, control, shutdown, emergency conditions, and limiting operating conditions.

3. The sequence of operation by the controls manufacturer. Provide control diagrams by the manufacturer, modified to reflect the as-built, as-installed condition.

4. Include general assembly contract drawings, sections, and photographic views as necessary to completely depict and properly identify the equipment. Indicate the dimensions, weight, capacity, and design conditions for the equipment.

B. Include detailed information to allow for the proper installation, calibration, testing, preventative, and corrective maintenance procedures in the second section of the manual or of each section of the manual information if the manual covers a multi-component equipment system. This information should include the following:

1. Maintenance instructions including assembly, installation, alignment, clearances, tolerances, and interfacing equipment requirements, adjustment, and checking instructions. Include any special rigging required to place the equipment into place, and any special test equipment required to place the equipment in service.

2. A safety subsection which addresses all safety and tag-out procedures necessary to safely operate and maintain the equipment.

3. Lubrication schedule and lubrication procedures. Include a cross reference for recommended lubrication products.

4. Troubleshooting guide.

5. A table showing the schedule of routine maintenance requirements and seasonal work which is not performed at a set frequency. Preventative maintenance tasking must address:

a. Daily/weekly inspections performed by operations personnel;

b. Routine preventative maintenance scheduled weekly, monthly, quarterly, semi-annually, or annually through major overhauls by maintenance personnel; and

c. Predictive maintenance work such as alignment, analysis of the equipment, vibration, flow, oil sampling, etc.

6. Description of sequence of operation by the control manufacturer.

7. Warnings for detrimental maintenance practices.

8. Detailed corrective maintenance procedures including:

    a. Detail equipment for complete disassembly and assembly;

    b. Cross-sectional drawings or exploded views with all parts numbered to correspond with the numbers in the parts list to permit identification of the various parts;

    c. A table of normal clearances, diameters, thickness of new parts, and limits permissible for wearing parts; and

    d. List torque settings for nuts, bolts, and fasteners when critical to the equipment's performance.

C. Include all necessary diagrammatic piping and wiring diagrams and miscellaneous contract drawings and equipment in the third section of the manual or of each section of the manual if the manual covers a multi-component equipment system.

D. Provide spare parts information in the fourth section of the manual including:

1. Part numbers for ordering new parts;

2. Assembly illustrations showing an exploded view of the complex parts of the product;

3. Predicted life of parts subject to wear;

4. List of the manufacturer's recommended spare parts, current prices with effective date, and number of parts recommended for storage;

5. Directory of a local source of supply for parts with company name, address, and telephone number;

6. Complete nomenclature and list of commercial replacement parts; and

7. Complete list of spare parts, spare equipment, tools, and materials that are turned over to the Owner.

E. Provide statistical information from the original equipment manufacturer as to performance such as pump curves, flow charts insulation resistance, calibration, or test data sheets in the fifth section of the manual, including all field testing records used to verify actual performance.

F. Provide equipment name plate data installed on equipment and valves and equipment data sheets as required and furnished by the Owner in the sixth section of the manual.

G. Provide a copy of warranties and the date the warranty expires for equipment in the seventh section of the manual.

3.03 ELECTRICAL AND ELECTRONICS SYSTEMS MANUAL

A. Provide all of the information listed in Paragraph **[3.02]** as appropriate and include the following information:

1. Control schematics and point to point wiring diagrams prepared for field installation;

2. Circuit directories of panel boards and terminal strips and as installed color coded wiring diagrams; and

3. Other information as may be required by the individual Specification Sections.

3.04 ARCHITECTURAL PRODUCTS MANUAL

A. Provide the following information:

1. Information required for ordering replacement products;
2. Instructions for care and maintenance;
3. List of the manufacturer's recommended lubricants;
4. The manufacturer's recommendations for types of cleaning agents and methods;
5. Cautions against cleaning agents and methods that are detrimental to the product; and
6. Recommended maintenance and cleaning schedule.

B. Final balancing reports for mechanical systems.

C. Other information as may be required by the individual Specification Sections.

3.05 LIST OF SERVICE ORGANIZATIONS

A. Provide a directory of authorized service organizations with company name, address, telephone number, email address, and the contact person for warranty repair.

END OF SECTION

01 35 00 SPECIAL PROCEDURES

Note to Specifier: Verify all references to: (1) paragraphs within this Section; (2) other Sections of the Specifications; and (3) any other applicable standards or sources of information.

PART 1 - GENERAL

Note to Specifier: The "Construction Sequence" Article is optional and should only be used if the Project must be completed in phases or part of the Project is to be accepted early under the Partial Utilization provisions of the General Conditions. Delete or revise this paragraph as necessary for each project.

1.01 CONSTRUCTION SEQUENCE

A. Perform the Work as required to complete the entire Project within the Contract Times and in the sequence stipulated below:

Sequence No.	Description	Predecessor Condition

B. Complete Work within the specified Milestones for these items:

Description	Milestone Date

C. Consider the sequences, duration limitations, and governing factors outlined in this Section to prepare the schedule for the Work.

D. Perform the Work not specifically described in this Section as required to complete the entire Project within the Contract Times.

1.02 CRITICAL OPERATIONS

A. The Owner has identified critical operations that must not be out of service longer than the designated maximum out of service time and/or must be performed only during the designated times. These have been identified in the table below:

Critical Operation	Max. Time Out of Operation	Hours Operation Can Be Shut Down	Liquidated Damages ($/hour)

B. Submit a written Plan of Action per Section 01 31 13 "Project Coordination" for approval for critical operations.

C. Work affecting critical operations is to be performed on a 24-hour a day basis until Owner's normal operations have been restored.

D. Provide additional manpower and equipment as required to complete the Work affecting critical operations within the allotted time.

E. Liquidated damages will be assessed if Work on critical operations is not completed within the time indicated.

Note to Specifier: In the subparagraphs below include a description of the critical nature of operations (e.g., operation of existing distribution system, pipeline, plant, etc.).

1. These items are critical to the **[specify/describe critical nature of operations]**.
2. Loss of **[specify/describe critical nature of operations]** can subject the Owner to loss of revenue, additional operations cost, and fines from regulatory agencies.
3. Liquidated damages have been established for each critical operation.

Note to Specifier: The list of critical operations in the paragraph below should be coordinated with the critical operations included in the table above.

F. Designated Critical Operations are described in more detail as follows:

1. **[Critical Operation 1 Title]** – **[Provide detailed description of Critical Operation 1]**.
2. **[Critical Operation 2 Title]** – **[Provide detailed description of Critical Operation 2]**.
3. **[Critical Operation 3 Title]** – **[Provide detailed description of Critical Operation 3]**.

Note to Specifier: Revise the "Owner Assistance" Article as necessary for each project. Describe those actions to be provided by the Owner and those Owner operations that are to be conducted by the Contractor.

1.03 OWNER ASSISTANCE

A. The Owner will assist the Contractor in **[specify actions to be provided by the Owner]**. The Contractor will be responsible for **[specify operations that are to be conducted by the Contractor]**.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

01 35 10 ENVIRONMENTAL SAFETY AND WORKER PROTECTION

1.00 GENERAL

1.01 SECTION INCLUDES

A. Environmental Safety and Worker Protection including monitoring emissions and exposure to workers and providing an appropriate response. The role of the Certified Industrial Hygienist (CIH) is also defined.

1.02 MEASUREMENT AND PAYMENT

A. No separate measurement and payment for work performed under this Section. The Contractor shall include the cost for this work in the contract bid price for work of which this is a component part.

1.03 REFERENCES

The following is a list of applicable requirements to this project. It is not intended to be a complete listing of all laws and regulations to which the Contractor must comply.

A. Code of Federal Regulations

1. 29 CFR 1910, "Occupational Safety and Health Standards".

    a. 29 CFR 1910.146 "Permit-required confined spaces".

2. 29 CFR 1926, "Safety and Health Regulations for Construction" (Construction Industry Standards).

    a. 29 CFR 1926.33 "Access to Employee Exposure and Medical Records".

    b. 29 CFR 1926.51, "Sanitation Standard".

    c. 29 CFR 1926.59, "Hazard Communication".

    d. 29 CFR 1926.62, "Lead".

    e. 29 CFR 1926.103 "Respiratory Protection".

3. 40 CFR 50, "National Primary and Secondary Ambient Air Quality Standards"

    a. 40 CFR 50 Appendix B, "Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere (High Volume Method)".

    b. 40 CFR 50 Appendix G, "Reference Method for the Determination of Lead in Suspended Particulate Matter Collected from Ambient Air".

4. 40 CFR 58, "Ambient Air Quality Surveillance".

5. 40 CFR 60 Appendix A, "Visual Determination of Fugitive Emissions from Material Sources and Smoke Emissions from Fires".

6. 40 CFR 117, "Determination of Reportable Quantities for Hazardous Substances".

7. 40 CFR 122, "Administered Permit Program: The National Pollutant Discharge Elimination System".

B. National Institute for Occupational Health and Safety NIOSH Method 7082, "Lead" (or equivalent).

C. American Society for Testing and Materials

1. ASTM D3335, "Test Method for Low Concentrations for Lead, Cadmium, and Cobalt in Paint by Atomic Absorption Spectroscopy."

D. EPA (Environmental Protection Agency) Publications

1. SW-846, "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods".

2. EPA Method 3050, "Acid Digestion of Sediments, Sludges, and Soils".

E. SSPC Guide 6, "Guide for Containing Debris Generated During Paint Removal Operations".

F. SSPC Guide 7, "Guide for the Disposal of Lead Contaminated Surface Preparation Debris".

G. SSPC Publication 91-18, "Industrial Lead Paint Removal Handbook".

H. Texas Commission on Environmental Quality

1. Texas Administrative Code (TAC) 30, Chapter 101, "General Rules".

2. Texas Administrative Code (TAC) 30, Chapter 111, "Control of Air Pollution from Visible Emissions and Particulate Matter".

3. Texas Administrative Code (TAC) 30, Chapter 290, "Water Hygiene".

4. Texas Administrative Code (TAC) 30, Chapter 307, "Surface Water Quality Standards".

5. Texas Administrative Code (TAC) 30, Chapter 309, "Effluent Limitations".

6. Texas Administrative Code (TAC) 30, Chapter 335, "Industrial Solid Waste and Municipal Hazardous Waste".

1.04 SUBMITTALS

A. Submittals shall conform to requirements of Section 01 33 00 – Submittal Procedures.

B. Submittals shall conform to appropriate codes for regulatory requirements.

1.05 DEFINITION

A. Acceptance Criteria: Minimum standards for the content of programs, plans, procedures, and designs required by this specification for the performance of this project. Acceptance criteria will be the basis for judging the responsiveness of Contractors' programs and will also be used as a basis for suspending work, if necessary.

B. Action Level: Employee exposure, without regard to the use of respirators, to an airborne concentration of lead of 30 micrograms per cubic meter of air (µg/m3) calculated as an eight hour time-weighted average (TWA).

C. CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act; commonly called Superfund. Federal laws addressing the clean up of hazardous waste sites. Amended in 1986 by Superfund Amendments and Re- Authorization Act (SARA). EPA implementing regulations are contained in 40 CFR 300-373.

D. Competent Person: One who is capable of identifying existing and predictable lead hazards in the surroundings or working conditions and who has authorization to take prompt corrective measures to eliminate them.

E. Containment System: An enclosure built around lead paint removal areas designed to contain lead paint debris and prevent emissions to the environment.

F. Dust Collection: Mechanical ventilation system designed specifically for the containment, capture, and removal of airborne particulate from the containment. Dust collection systems shall include ductwork, plenums and/or hoppers, and dust collector(s) for the removal of leaded paint dust from the air stream prior to discharging to the atmosphere.

G. Emission: A release of material to the air, water, or ground.

H. Entry/Exit Airlock: An isolated enclosure located at the entrance of the containment in which the workers remove contaminated dust and debris from their work clothes.

I. EPA: The US. Environmental Protection Agency. Regulations are contained in Title 40 of the Code of Federal Regulations (40 CFR).

J. Hazardous Waste (lead paint debris): Waste that is classified as hazardous due to its concentrations of regulated hazardous substances. Paint debris is classified as hazardous waste if, after testing by the Toxicity Characteristic Leaching Procedure (TCLP), the leachate contains any of the 8 metals or other substances in concentrations at or above limits established in 40 CFR 261.

K. HEPA: A high efficiency particulate filter (HEPA) that is 99.97% efficient against particles of 0.3 microns in size or larger.

L. Lead Containing Dust and Debris: Dust and debris generated during the project which contains lead in

any amount, including but not limited to pulverized paint, spent abrasive, filters (wet and dry), and containment materials upon which lead is still present.

M. NIOSH: National Institute of Occupational Safety and Health.

N. OSHA: Occupational Safety and Health Administration. Standards are contained in Title 29 of the Code of Federal Regulations, Parts 1910 and 1926 (29 CFR 1910 and 29 CFR 1926).

O. Owner: The West Harris County Regional Water Authority

P. PEL: Permissible Exposure Limit. An employee exposure, without regard to the use of respirators, to an airborne concentration of lead of 50 µg/m3 over an 8 hour TWA.

Q. POTW: Publicly Owned Treatment Works

R. RCRA: Resource Conservation and Recovery Act. Federal law pertaining to hazardous waste management. EPA implementing regulations are contained in 40 CFR 240-280.

S. Regulated Area: Area established by the Contractor to demarcate the zone(s) beyond which airborne concentrations of lead do not exceed the Action Level.

T. SSPC: Society for Protective Coatings. An independent, non-profit organization of engineers, technical specialists, and Contractors whose goal is research and development of new coatings and methods for removal, application, and disposal of existing coatings on industrial structures.

U. Tarpaulins: Flexible fabric, vinyl, plastic or canvas cover sheets, impenetrable to dust, wind, and water, used to enclose the cable and/or scaffold support system comprising the containment enclosure.

V. TCLP: Toxicity Characteristic Leaching Procedure. Laboratory tests conducted on wastes that determine the amount of hazardous materials that leach out into a test solution. The test is intended to simulate the properties of water as it leaches through a solid waste landfill. TCLP testing is defined in 40 CFR 261, Appendix II.

W. TSP: Total Suspended Particulate

2.00 PRODUCTS

2.01 MATERIAL AND EQUIPMENT

A. The Contractor is to supply materials and equipment to insure the safety and protection of workers and the environment in accordance with these specifications.

3.00 EXECUTION

3.01 ENVIRONMENTAL PROTECTION AND MONITORING

A. Protection of Ambient Air: Visible emissions are to be controlled to meet, as a minimum, TAC 30

Chapter 111," Control of Air Pollution from Visible Emissions and Particulate Matter" requirements and SSPC-Guide 6I (CON), Level 1 Emissions. Air monitoring and analysis may be performed by the Authority during abrasive blast cleaning operations. Such monitoring will be in accordance with 40 CFR 50, Appendix B, "Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere" and/or 40 CFR 50, Appendix G, "Reference Method for the Determination of Lead in Suspended Particulate Matter Collected from Ambient Air". The limits for downwind pollutant concentrations allowed during blasting operations are as follows:

1. PM-10: 450 micrograms/cubic meter/ 8 hr.. (40 CFR 50.6)

2. Lead (Pb): 13.5 micrograms/cubic meter/8 hr.. (40 CFR 50.12)

Visible emissions and/or monitored emissions for PM-10 and TSP lead in excess of the above levels shall be cause for shut down of the project until corrections to control/ containment system or paint removal/ surface preparation operations are made to comply with these requirements.

B. Protection of Surface and Storm Water: The Contractor shall take all necessary precautions to ensure lead contaminants do not enter surface waters or storm water drainage systems.

1. The Contractor shall protect the area around ditches and drainage inlets. Daily verification of proper protection to minimize the potential contaminants reaching the drainage system shall be performed.

2. The Contractor shall collect all potentially contaminated process waters for testing and, as appropriate, treatment. Process water from pressure washing, wet abrasive blast cleaning or hygiene facilities shall not be discharged to drainage systems or surface waters.

3. The Contractor may remove lead or other heavy metals from such waters through filtration, ion exchange or other approved means. Following treatment, water samples must be tested prior to disposal. Discharge to sanitary sewer lines requires authorization, in writing, from a POTW.

C. Protection of Soil and Grounds: The Contractor shall protect the soil around the structure to ensure that the soil does not become contaminated. Where lead is present in the coatings to be removed, as indicated in Section 02136 "Waste Material Handling and Disposal", the Contractor shall provide for the sampling and analysis of soil samples for total lead content.

1. Sampling and analysis shall be performed prior to commencement of paint removal operations to establish a background "base level". Soil samples shall be taken 3 feet from the base of the tank(s), at a distance of 6-10 feet beyond the proposed containment structure and at the property line.

2. Samples from each area shall be taken in a minimum of four directions, at circular increments of 90^0, one of which shall include the direction of prevailing wind. Samples shall also be obtained, at the direction of the Design Professional of Record or Engineer, at the closest points of public access (i.e. housing, park, school).

3. The soil sampling procedure shall be as outlined in SSPC Guide 6 Section

4. 5.5.5. Each sampling point shall be sufficiently identified on a site map to allow return to the exact location upon project completion.

5. Each sample shall be split in two portions, one for immediate analysis and the other sealed, preserved and furnished to the Engineer. The samples shall be analyzed in accordance with EPA Method 3050, "Acid Digestion of Sediments, Sludges and Soils", and shall be performed by a qualified laboratory approved by the Engineer.

6. Samples shall be obtained at the completion of work (post-construction samples) from all locations from which pre-construction samples were obtained. Samples shall be collected, handled and tested in the same manner as described above.

7. Upon completion of the work, soils found to be contaminated with lead in greater quantity than found in the background "base level", established at the start of the work, shall be removed by the Contractor to the depth necessary to achieve a lead content equivalent to, or below, the pre- construction back ground levels. Disposal shall be in accordance with applicable regulations.

8. The Contractor shall replace in-kind (i.e., topsoil, structural fill, etc.) with an equivalent amount of non-contaminated soil, compact in place and grade to pre-existing conditions. The Contractor shall also replace in-kind any surface improvements, such as grass, shrubs, etc. that were damaged or destroyed by the work. The soil removal, replacement and related work is to be performed by the Contractor at no additional cost to the Owner.

3.02 WORKER PROTECTION

A. The Contractor shall develop a written Compliance Program to establish and implement practices and procedures for assuring that no employee is exposed to lead at concentrations greater than 50 micrograms per cubic meter of air ($\mu g/m^3$), the OSHA permissible exposure limit (PEL). This program is in addition to other OSHA hazard communication and safety and health requirements of the project, and shall be revised and updated at least every six months.

1. The program shall establish methods for complying with this specification and the OSHA Construction Industry Lead Standard, 29 CFR 1926.62(e)(2)(ii). The Federal regulation is referred to as the "Lead Standard" for the purpose of this specification.

2. The program shall apply to all Contractor employees associated with lead on the project, and to subcontractors working under the direct control of the Contractor who are associated with lead on the project.

3. The program shall assign the specific responsibility for implementation and enforcement of the program to the Contractors' company management. The Contractor's Competent Person(s) shall be identified, by name, and qualifications submitted. The Competent Person shall be on-site

during any operations which involve the removal, handling or disturbing of lead containing materials.

4. The program shall contain a description of each activity in which lead is emitted (e.g. equipment used, material involved, controls in place, crew size, employee job responsibilities, operating procedures and maintenance practices).

5. The program shall contain a report of the technology considered in meeting the PEL and air monitoring data which documents the source of lead emissions.

6. The program shall contain a work practice program which includes items required in the lead standard such as protective clothing and equipment, housekeeping, and hygiene facilities and practices.

B. Exposure Monitoring: The Contractor shall be responsible for conducting and reporting worker exposure assessments in accordance with 29 CFR 1926.62.

1. Representative personal air samples shall be collected at the beginning of the lead removal work to determine employee lead exposures. Tasks involving potential lead exposure include, but are not limited to, paint removal operations, clean-up, and debris handling operations. Full shift (at least 7 hours) air samples shall be collected for each job classification in the exposure area. The range of exposures for lead removal and cleanup activities shall be determined.

2. During the initial monitoring, workers performing the following activities (or equivalent) shall be protected to the anticipated exposure levels which are dictated by the lead standard:

   a. 500 $\mu g/m^3$: Manual demolition of structures containing lead- containing coatings or paint (e.g., dry wall), manual scraping, manual sanding, heat gun applications, power tool cleaning with dust collection systems, and spray painting with lead paint.

   b. 2,500 $\mu g/m^3$: Using lead-containing mortar, lead burning, or conducting the following activities where lead-containing coatings or paint are present: rivet busting, power tool cleaning without dust collection systems, clean-up activities where dry expendable abrasives are used, and the movement and removal of abrasive blasting enclosures.

   c. More than 2,500 $\mu g/m^3$: Activities involving lead containing coatings or paint on structures disturbed by abrasive blasting, welding, cutting, and torch burning.

3. Protection requires compliance with the necessary respiratory protection, personal protective clothing and equipment, change areas and washing facilities, blood lead and zinc protoporphyrin monitoring, and employee training. The protection measures shall be modified, as necessary, after the exposure results are received.

4. Where initial monitoring indicates that lead exposures are below the Action Level, and where work

activities and conditions remain the same as at the time of initial sampling, additional monitoring need not be repeated for that work activity.

5. Where the initial monitoring of a given work activity indicates that lead exposures are at or above the Action Level, additional exposure monitoring shall be conducted monthly. The monthly monitoring is more frequent than frequencies established in the lead standard which are at least every 6 months if above the Action Level, but below the PEL, or every 3 months if above the PEL.

6. All air samples shall be collected and analyzed according to NIOSH Method 7082, or equivalent. All samples shall be analyzed by laboratories accredited by the American Industrial Hygiene Association for metals analysis.

7. All exposed employees shall be notified in writing of the monitoring results within five (5) days after receiving the results.

8. The Action Level for airborne lead exposure is 30 $\mu g/m^3$, as an 8-hour time weighted average (TWA) concentration, without regard to the use of respirators. Whenever workers' airborne lead exposures exceed the Action Level, the Contractor shall implement the following:

    a. Periodic Exposure Monitoring

    b. Employee Information and Training

    c. Employee Medical Surveillance and Medical Removal Protection

    d. Housekeeping

    e. Record keeping

    f. Signs and Regulated Areas

9. The Permissible Exposure Limit (PEL) for airborne lead exposure is 50 $\mu g/m^3$, as an 8-hour TWA concentration. When the work area contains airborne lead levels above the PEL the Contractor shall implement the following in addition to those items listed in 3.2.B.8 of this section:

    a. Compliance Program

    b. Respiratory Protection

    c. Protective Clothing and Equipment

    d. Hygiene Facilities and Practices

C. Respiratory Protection: After feasible engineering controls and work practices have been implemented, respiratory protection shall be used to maintain employees' lead exposures below the

PEL.

1. Respirators shall be worn by all employees, other Contractors, representatives, or observers who enter regulated areas.

2. The Contractor shall develop a written Respiratory Protection Program in compliance with 29 CFR 1910.134, paragraphs (b), (d), (e), and (f), and the lead standard. The program shall address the selection, use, maintenance, and inspection of respirators, and qualifications for respirator users.

D. Protective Clothing and Equipment: The Contractor shall provide protective clothing and equipment and ensure they are worn by all employees whose lead exposures exceed the PEL, or who enter regulated areas.

1. Protective clothing shall include washable and/or disposable full body coveralls, gloves, foot coverings, and hoods. Other protective equipment shall include face shields, hard hats, eye protection, and hearing protection as appropriate.

2. Disposable protective clothing shall be used for no more than one work day. Such clothing may have to be disposed of as hazardous waste.

3. Reusable protective equipment shall be cleaned or replaced weekly if exposure levels are less than 200 $\mu g/m^3$, or daily if the exposure levels are greater than or equal to 200 $\mu g/m^3$.

4. Clothing shall not be removed or "cleaned" by any means which could reintroduce the lead dust into the ambient air. This includes brushing, shaking, and blowing. Vacuums equipped with HEPA filters shall be used for this purpose.

5. Reusable coveralls shall be collected at the end of each work day in closed containers. The containers shall be labeled in accordance with the requirements of 29 CFR 1926.62(g)(2)(vii). Contaminated clothing shall be cleaned in accordance with all applicable Federal, State, or local regulations pertaining to lead-contaminated laundry and water discharge. Laundries shall be informed that the clothing contains lead. If the clothing is washed on site, the discharge water shall be filtered, containerized, and arrangements made with the local POTW or other approved means of proper disposal.

6. Protective clothing and equipment shall be removed in the contaminated section of the change area and shall not be worn into any clean areas.

7. The Contractor shall provide the necessary clothing and equipment for use by the Owner and its designated representatives.

E. Housekeeping: Accumulations of lead-containing dust and debris generated by work activities shall be removed and cleaned daily.

1. All persons doing the cleanup shall be trained in performing lead activities, respirator qualified, and

participate in the medical surveillance program. Respirators and protective clothing shall be worn by all persons doing the cleanup.

2. Compressed air may be used for housekeeping if used within containment and in conjunction with a ventilation system designed to capture the dust. Otherwise, HEPA-filtered vacuum cleaners shall be employed.

3. All lead-containing dust and debris shall be collected in sealed containers. The waste shall be tested to determine whether it will be disposed of as hazardous waste.

F. Personal Hygiene Facilities and Practices

1. Clean change areas shall be provided when employees' lead exposures exceed the PEL. The change areas shall be equipped with storage facilities for street clothing and a separate area for the removal and storage of lead-contaminated clothing and equipment. They shall be designed and used so that contamination of street clothing does not occur. Employees shall not leave the project site wearing any clothing worn while performing lead activities. Airborne lead exposures in the change area shall be maintained below the Action Level.

2. Shower facilities shall be provided whenever employees' lead exposures exceed the PEL. Shower facilities shall comply with OSHA Sanitation Standard, 29 CFR 1929.51. All employees whose lead exposures exceed the PEL shall shower at the end of each work shift or before leaving the project area. The shower facilities shall be made available for use by the Owner and its representatives, such as inspectors or observers.

3. Arrangements shall be made with the local POTW for the proper disposal of the shower and wash water after filtration (e.g., through a three stage 100, 50, and 5 micron filtering system), ion exchange, or other approved treatment technology.

4. Clean lunch areas shall be provided for all employees whose lead exposures exceed the PEL. Employees shall remove or clean (by vacuuming) their protective clothing and wash their hands and face before entering the lunch area. Lead exposures in the lunch area shall be maintained as free as practicable from lead contamination.

5. An adequate number of clean lavatory and hand washing facilities shall be provided. These shall comply with the OSHA Sanitation Standard, 29 CFR 1929.51.

6. Eating, drinking, smoking, chewing of food or tobacco products, or the application of cosmetics shall not be permitted in any areas where the lead exposures exceed the PEL. Thorough washing of hands and face is required prior to undertaking any of these activities.

G. Medical Surveillance and Medical Removal Protection

1. All employees who are exposed to lead above the Action Level in a single day during this project shall be provided with initial and periodic medical examinations and blood lead tests as required

by the lead standard. A final blood lead test shall be provided for each worker upon completion of the project, or at any time a worker's employment at the project ceases.

2. When blood lead levels over 50 µg/dl are encountered, the Contractor shall provide for the temporary removal of employees from lead exposure above the Action Level. The required medical surveillance and periodic blood lead tests shall be provided in strict accordance with the lead standard throughout the removal.

3. Employees who will be required to wear a respirator or who request one shall be provided with a respirator and the necessary medical examinations to determine their ability to wear a respirator.

4. All examinations shall be provided by the Contractor and shall be performed by or under the direct supervision of a licensedphysician.

H. Employee Information and Training

1. The Contractor shall provide lead training for all employees who are exposed to lead above the Action Level for this project.

2. The content of lead training shall include, as a minimum, those items listed in the lead standard.

3. Training shall also include hazard communication in accordance with 29 CFR 1926.59.

4. The Contractor shall notify other employers at the project site of the nature of the lead exposure work, the need to remain out of exposure areas, the warning sign and labeling system in effect, and the potential need for them to take measures to protect their employees.

I. Signs and Regulated Areas

1. The Contractor shall establish a regulated area surrounding activities where lead exposures exceed the Action Level. This includes locations where lead-containing debris is handled or transferred to storage containers.

2. The regulated area shall be demarcated by ropes, tape, walls, or containment's with caution signs posted at all accessible sides. Signs shall contain the legend:

   WARNING LEAD WORK AREA

   POISON

   NO SMOKING OR EATING

3. The Contractor shall control access of persons into regulated areas. Access shall be limited to individuals with proper training and personal protective equipment, and medical surveillance testing.

4. All persons entering regulated areas shall wear protective clothing and respirators.

5. Eating, drinking, smoking, and chewing of food or tobacco products shall be prohibited in regulated areas and in any area where lead exposures exceed the Action Level.

J. Record keeping: All records relating to training, medical examinations, blood lead monitoring, and exposure monitoring shall be maintained by the Contractor as required by the lead standard. All records shall be available for review by the Owner or its representative upon request.

3.03 CERTIFIED INDUSTRIAL HYGIENIST (CIH)

A. The Contractor shall provide for the services of a Certified Industrial Hygienist (CIH) who must be certified by the American Board of Industrial Hygiene in comprehensive practice.

B. Duties of the CIH shall be as follows:

1. Conduct and/or verify training for contractor employees in accordance with 29 CFR 1926.62 (l).

2. Review and approve Contractor's Written Compliance Plan for conformance to 29 CFR 1926.62(e)(2)(ii) and this Specification.

3. Monitor and evaluate work weekly to assure conformance with the approved plan and that hazardous exposure is adequately controlled in accordance with worker safety and health requirements of these specifications

4. Provide monthly reports of work compliance with control requirements in regards to working in a lead environment.

C. Activities of the CIH shall include:

1. Meet with Authority to discuss details of Contractor's Written Compliance Plan for lead paint removal.

2. Ensure worker and area air monitoring, testing and reporting are conducted by or under the direction of the CIH.

3. Furnish a detailed worker and area air monitoring schedule coordinated with Contractor's proposed production schedule.

4. Directing, monitoring and inspecting lead paint removal work to ensure that the requirements of the Contract have been satisfied during the entire lead paint removal operation.

5. Report results of air monitoring samples to the Engineer, signed by the CIH within 48 hours after the air samples are taken.

6. The CIH shall review sampling data, collected on a day when lead paint removal operations occur, to determine if conditions require any change in work methods. Removal work

shall not continue until approval is given by the CIH.

7. The CIH shall verify in writing and submit monitoring data to verify that:

   a. Air borne lead levels at and beyond the lead control (regulated) area were and remained less than 30 mg/m^3 of air

   b. Contractor conformance to 29 CFR 1926.62 and Item 3.2, above

   c. There were no visible accumulations of lead contaminated paint, dust or debris on the work site. Adjacent areas that may have become contaminated were properly cleaned and inspected.

   d. The CIH shall verify that the work area and contractor's equipment have been adequately cleaned of lead contamination prior to demobilization from the work site.

3.04 DEMOBILIZATION

The Contractor shall not remove the lead control area, boundaries, warning signs, etc. prior to proper removal of all hazardous wastes, debris and materials from the site and the Authority's receipt and acceptance of the CIH's verification.

END OF SECTION

GUIDELINES FOR USING SPECIFICATION SECTION 01 40 00 "QUALITY MANAGEMENT"

Purpose and Intended Use

This Section provides the overall framework for quality management for the Project, and delineates the responsibilities of the Contractor and Owner's Project Team (OPT) for managing quality for the Project.

Other Documents

Provisions regarding tests and inspections are included in the General Conditions for the following:

1. Freese and Nichols 2018 General Conditions — Section 00 72 00 "General Conditions (FNI 2018)", Article 14.
2. EJCDC 2018 General Conditions — Section 00 72 00 "General Conditions (EJCDC 2018)", Article 14.
3. AIA 2017 General Conditions — A201-2017 Standard General Condition for DBB.

Specific testing requirements related to specific Work or products are included in technical Specifications for that Work, or may be in a testing specification for that Division.

Notes to Specifier

Notes to Specifier are provided to assist in the preparation of project specific documents. Notes to Specifier provide specific information for editing the document. When alternate paragraphs for different situation are presented, explanations on how to select the most appropriate alternate will be provided, with direction to delete paragraphs not used. These notes are intended for use by the Specifier in the preparation of the document and are not intended to be included in the completed document. They should be retained in the document until quality control reviews have been completed and then be deleted before documents are published for distribution in final form.

Editing This Document

It is intended that this document be edited for each project. Guidelines for editing include:

1. Type in required information as indicated by brackets (**[]** or **{ }**). Bracketed text may provide instructions for what is to be inserted in place of the brackets. Delete brackets and change formatting to match existing text after project specific text has been added, e.g. change "**[Project Name]**" to "Peach Street Renovation" (without brackets or bold, or quotation marks).
2. Fill in blanks, if any. It will be more common for information to be inserted by Specifier to be indicated by a prompt in brackets, as described in Paragraph 1 above, rather than by an underline-style blank.
3. Most Notes to Specifier are presented before the text to which they apply; some Notes to Specifier are interspersed in the text, usually within brackets. Delete all "Notes to Specifier" after reviewing each note and taking appropriate action. Delete all associated numbering and brackets while using the Track Changes function in Word. Track Changes versions of the document are to be used for review purposes. Accept All Changes and Stop Tracking can be used after the review is complete and documents are ready to publish.

Guidelines for Use

General

In general terms, the Contractor is responsible for the quality of its Work in all regards, whether testing is performed or not. By signing the Contract, the Contractor is committed to building the Project to meet the quality standards established in the Contract Documents. Quality Management applies to everything associated with delivering a quality Project, not just testing and inspection. Testing and inspection do play a central role in quality management and are the key focus of this document.

Testing and inspection can be divided into two primary functions:

1. In process testing and inspection to determine that the Contractor's efforts will produce acceptable Work; and
2. Acceptance testing to determine that the finished Work complies with the quality requirements established in the Contract Documents.

Testing performed during construction as described in Paragraph 1 above is quality control since it is testing the Work during production to see that the specified result is achieved. This testing is part of the Contractor's means and methods and, unless specified to the contrary, should be left to the Contractor to perform and include in the Contract Price offered. To help avoid confusion, this is referred to as production testing.

Tests and inspections of the Work as defined in Paragraph 2 above are performed to demonstrate that the Contractor is producing Work that meets the requirement of the Contract Documents before the Owner pays the Contractor for this Work. This is a prudent practice for the Owner for several reasons. This effort is typically considered to be quality assurance since the purpose for this effort is to determine that the Contractor's quality control efforts have been effective in producing acceptable Work. To avoid confusion, testing to determine if the Work is acceptable is referred to as verification testing.

It is easy to see that in construction, production testing and verification testing may be the same test. A test by the Contractor used as a quality control measure to indicate that their production process has been successful in producing an acceptable result can also be used by the OPT to verify that the Work complies with the Contract Documents and is acceptable. This duplicity creates a conundrum when determining whether the Contractor or OPT should be responsible for arranging for and paying for testing and inspections.

Responsibility for Testing

In theory the Contractor should be responsible for all testing up to and including a passing test as part of its means and methods before notifying the Owner it is time to perform a similar test for acceptance of the Work. This quality control effort is, after all, part of the Contractor's means and methods for delivering a quality project. There are several practical reasons why this theory does not work.

Having the Owner perform duplicate testing for acceptance increases the cost of testing with no tangible benefit. It should be recognized that the Owner ultimately pays for testing, either directly, through the Construction Manager, or through the Contractor, regardless of which entity is given the responsibility. Assigning the responsibility for hiring and paying a Construction Materials Inspection and Testing (CMIT) Laboratory to the Contractor means that the CMIT provider now works directly for the Contractor, and will be paid by the Contractor. This cost, with markup for managing the effort, is included in the Contract Price.

Requiring the Contractor to provide verification testing for its Work creates an inherent conflict of interest which should be avoided. A failed test may mean the Contractor will not be paid for Work it has completed and Work may have to be removed and replaced at the Contractor's expense. CMIT providers typically do not like providing acceptance testing for an Owner while subcontracted to the Contractor since this creates a similar conflict of interest where they, as professional engineers, may be forced to choose between a responsibility to their Contractor employer and serving the public interest. Texas and other states have passed laws that require that the Owner pay for acceptance testing for this very reason.

However, Laws and Regulations are not always well written and are subject to interpretation. Laws and Regulations often do not account for the duplicitous nature of testing, or recognize that some testing, by its very nature is best performed by the Contractor. Pressure testing for pipe, is an example of testing best performed by the Contractor, and witnessed by the OPT, since the Contractor has the tools, equipment and resources to do so.

Unless provisions to the contrary are written into the Contract Documents, the OPT has little or no control over the testing to be performed when assigned to the Contractor since this becomes part of the Contractor's means and methods. That said, even if the OPT places the responsibility for testing on the Contractor, the testing required should be clearly identified in the Contract Documents and be included in a testing plan for use during construction to aid in determining that these requirements are met. It is not advisable to simply say the Contractor is responsible for all testing, and trust that all testing requirements will be met.

For these reasons, practical implementation of testing requires that testing responsibilities be shared to minimize cost while providing the assurance to the OPT that Work is acceptable, and payment should be made to the Contractor. Best practice dictates that the Owners should pay for verification testing.

Based on the above discussion, testing responsibilities in the Specification follow these guidelines:

1. Contractor is responsible for all testing associated with locating a source of material and demonstrating in a Shop Drawing that it meets the requirements of the Contract Documents. Contractor is to include all cost for this in the offered Contract Price. A Contractor can expend a great amount of time and money trying to locate an acceptable source of material at the lowest cost. This is typically done after the Contract Price is set and Owner can spend a large portion of its testing budget with no tangible benefit since the cost for materials is already set in the Contract Price.
2. Contractor is responsible for all testing associated with controlling the quality of their efforts to produce acceptable end results. Contractor can rely on verification testing performed for the OPT when Contractor's production testing efforts would duplicate those planned by the OPT. Contractor is to include all in process testing they deem necessary to supplement testing by the OPT in the offered Contract Price. The OPT must make the Contractor aware of the testing they will provide as part of the procurement documents for the Contractor to determine the cost they should include in the Contract Price. Contract provisions should allow the Contractor to ask for additional compensation if the OPT does not provide the testing proposed in the Owner's Quality Management Plan and Contractor can demonstrate these tests were performed as part of their production testing efforts.
3. Testing, such as pipe pressure testing, should be observed by the OPT to determine that tests are performed properly and to verify the results of that test indicate the Work is acceptable when the Contractor performs testing. This includes performance testing by equipment suppliers.

4. OPT should provide all verification testing that is not performed directly by the Contractor or its Subcontractor and Suppliers other than testing agencies and CMIT providers.

Although these guidelines are best practice, and avoid creating a conflict of interest, Owners may choose to have CMIT services provided through the construction contract. This is typically done because the Owner wants to avoid managing another contract, or needs to have the entire construction budget in a single contract. If the Owner's motivation is to avoid having another contract to administer, materials testing can be subcontracted through the Construction Manager or Design Professional when providing Construction Phase Services. This has the advantage of avoiding the conflict of interest posed when the Contractor oversees testing for their own Work and allowing the Owner to negotiate the markup allowed for these professional services. Typically, the Construction Manager or Design Professional manages the efforts of CMIT firms as part of their scope of services anyway, so this is a logical extension of those services.

If the Contractor is to provide CMIT services through its contract, it should provide a Contractor's Quality Control Plan, so it can be determined that all of the required CMIT services are to be provided.

Owner's Quality Management Program

An Owner's Quality Management Program (OQMP) should be prepared for each project listing the testing required by the Contract Documents. This OQMP serves several functions:

1. It provides the information required by the Contractor to estimate the cost for its Quality Control Plan without duplicating the Owner's efforts;
2. Provides scope of services for Owner's procurement of CMIT services;
3. Allows the Construction Manager or Design Professional to determine the scope of services for CMIT services when contracted through the Construction Manager, and to provide its own scope of services related to Quality Management Services.

Without this plan, all entities will be at a disadvantage in determining the cost for CMIT services.

01 40 00 QUALITY MANAGEMENT

Note to Specifier: Verify all references to: (1) paragraphs within this Section; (2) other Sections of the Specifications; and (3) any other applicable standards or sources of information.

PART 1 - GENERAL

1.01 OVERVIEW

A. Quality management refers to the overall process of delivering a completed Project to the Owner that complies with the requirements of the Contract Documents. Quality management applies to documentation, products, services and the Work.

B. The Contractor is responsible for the quality of documentation, products, services and the Work provided.

1. Contractor is to integrate quality control procedures into the execution of the Work that are adequate to produce a Project that meets the requirements of the Contract Documents while minimizing loss of time and increased cost. Contractor is solely responsible for time and cost impacts of correcting Defective Work.

2. Contractor is to provide all testing and inspection required to control the quality of the Work in progress to determine that completed Work will comply with the requirements of the Contract Documents.

3. Contractor is to provide verification or acceptance testing as required by the Contract Documents to demonstrate that the completed Work complies with the requirements of the Contract Documents, except for those test that the OPT has determined are to be conducted independent of the Contractor and identified as OPT testing in the Owner's Quality Management Plan.

1.02 STANDARDS

A. Provide testing laboratories that comply with the American Council of Independent Laboratories (ACIL) "Recommended Requirements for Independent Laboratory Qualifications."

B. Perform testing per recognized test procedures as listed in the various Sections of the Specifications, standards of the State Department of Transportation, ASTM International (American Society for Testing and Materials), or other testing associations. Perform tests in accordance with published procedures for testing issued by these organizations.

1.03 DOCUMENTATION

A. Provide documentation which includes:

1. Contractor's Quality Management Plan that establishes the methods of ensuring compliance with the Contract Documents. Submit this plan as Product Data per Section 01 31 13 "Project Coordination."

2. A statement of qualifications for any proposed testing laboratory that includes a list of the engineers and technical staff that will provide testing services on the Project, descriptions of the qualifications of these individuals, list of tests that can be

performed, equipment used with date of last certification, and a list of recent projects for which testing has been performed with references for those projects.

3. Certified Test Reports for products to be incorporated into the Project. Provide reports to indicate that the proposed products comply with the Contract Documents or indicate that the proposed products do not comply with the Contract Documents and why those products do not comply. Submit Certified Test Reports as part of a Shop Drawing submitted per Section 01 33 02 "Shop Drawings."

4. Certified Test Reports for inspections and testing required in this Section and in other Sections of the Specifications. Provide reports to indicate that the Work complies with the Contract Documents or indicate that the Work does not comply with the Contract Documents and why the Work does not comply. Submit these test reports on forms provided by the Construction Manager per Section 01 33 00 "Document Management."

Note to Specifier: When resident representation will be provided by a Construction Manager, Defective Work will be logged and tracked by the Construction Manager, use Subparagraph 5. If resident representation is not provided, Contractor will need to self-report on Defective Work and successful correction of the defect. Use Subparagraph 6 if resident representation is not provided. Delete the subparagraph not used.

5. Certified Test Reports of Defective Work and Certified Test Reports documenting that successful corrective action has produced Work that complies with the Contract Documents. Construction Manager will maintain a Defective Work register. Progress on correction of Defective Work will be discussed at progress meetings as described in Paragraph **[1.05.E]**. The final Defective Work register will be incorporated into closeout documentation required per Section 01 70 00 "Execution and Closeout Requirements" as a record that all Defective Work has been corrected.

6. Certified Test Reports of Defective Work and Certified Test Reports documenting that successful corrective action has produced Work that complies with the Contract Documents. Maintain a register listing Defective Work and record when corrective action has produced Work that complies with the Contract Documents. Present this Defective Work register as part of the Quality Report at progress meetings as described in Paragraph **[1.05.E]**. Incorporate this register in the closeout documentation per Section 01 70 00 "Execution and Closeout Requirements" to demonstrate that all Defective Work has been corrected.

1.04 OWNER'S QUALITY MANAGEMENT ACTIVITIES

A. OPT may perform its own verification testing independent of the Contractor. Owner's Quality Management Plan describes the OPT's anticipated verification testing program for this Project. The preliminary testing plan **[is provided as Appendix {X} to the Contract Documents] [is shown in Paragraph {3.05}]**. This plan outlines the anticipated testing in general terms and may not reflect the actual testing performed by the OPT. Actual testing will depend on the Contractor's means, methods, and procedures of construction which will not be known until the Contractor submits the Contractor's Quality Control Plan (CQCP) to the OPT. There is no guarantee that all testing in the preliminary OQMP included in the Bidding/Proposal Documents will be performed by the OPT. Contractor will arrange and

pay for all production control testing deemed necessary by the Contractor to produce quality results.

B. Quality management activities of the OPT are for verifying the results of the Contractor's Work complies with the requirements of the Contract Documents. Performance or non-performance of verification activities by the OPT:

1. Does not relieve the Contractor of its responsibility to provide Work and furnish products that comply with the requirements of the Contract Documents;

2. Does not relieve the Contractor of its responsibility to provide adequate quality control measures to produce quality documents, products, services or Work;

3. Does not relieve the Contractor of its responsibility for damage to or loss of Work or products before OPT's acceptance; and

4. Does not affect the continuing rights of the Owner after OPT's acceptance of the completed Work.

C. The Work is subject to OPT's observations or testing at any time. Products which have been tested or inspected and accepted by the OPT at a supply source or staging area may be inspected or tested again by the OPT before, during, or after incorporation into the Work and rejected if products do not comply with the Contract Documents. Verification testing performed by the OPT will be paid for by the Owner, except for testing related to Defective Work as discussed in Paragraph **[3.03]**.

1.05 CONTRACTOR'S RESPONSIBILITIES

A. Review the OQMP and provide a Contractor's Quality Control Plan (CQCP) outlining testing to be provided by the Contractor per Paragraph **[1.07]**.

B. Implement the CQCP to provide Work that complies with the requirements of the Contract Documents.

1. Provide quality documents meeting the requirements of the Contract Documents.

2. Provide services meeting the requirements of the Contract Documents.

3. Provide the services of a Construction Materials Inspection and Testing (CMIT) provider meeting the requirements of this Section to provide testing required by the Contract Documents to demonstrate that products proposed for the Project in Shop Drawings and Product Data fully comply with the Contract Documents.

4. Inspect and test products to be incorporated into the Project to identify defects before installing them. Do not install Defective products. Conspicuously mark Defective products and remove from the Site. If products are installed before the defect is recognized, remove the Defective products, mark them as Defective and remove them from the Site when the defect is recognized.

5. Integrate production quality control measures into construction activities to produce Work meeting the requirements of the Contract Documents. Inspect self-performed Work and the Work of Subcontractors and Suppliers to identify defects. Correct or replace Defective Work.

6. Provide facilities, equipment, and Samples required for inspections and tests.

a. Give the Construction Manager adequate notice before proceeding with Work that would interfere with inspections or testing.

b. Notify the Construction Manager and CMIT provider prior to the time that testing is required, providing adequate lead time to allow arrangements for inspections or testing to be performed.

c. Do not proceed with Work that would impact the ability to correct defects, or with Work that would require that it be removed to correct defects, until testing is complete, and test results indicate that the corrected Work is acceptable.

d. Provide safe access for all CMIT activities, including those to be conducted as part of the Owner's Quality Management Program.

e. Cooperate fully with the performance of sampling, inspection, and testing. Provide personnel to assist with sampling or to assist in making inspections and field tests.

f. Provide Samples and products in adequate quantities for testing at the Site or at the production source of the product for testing.

g. Provide facilities required to store and cure test Samples.

h. Provide calibrated scales and measuring devices for OPT's use in performing inspections and testing.

i. Provide adequate lighting to allow OPT observations.

j. Make Contract Documents available to testing agencies when requested.

C. Perform tests as indicated in Contract Documents. All verification testing is to be observed by the Construction Manager or its designated representative.

D. Submit test reports to the Construction Manager.

E. Provide an update on quality control activities performed the previous month and planned for the coming month at monthly progress meetings required by Section 01 31 13 "Project Coordination."

F. Determine testing or inspections required to implement the CQCP. Include costs for additional testing and inspections required to meet Contractor's quality control obligations in the Contract Price.

1.06 CONTRACTOR'S QUALITY CONTROL MANAGER

A. Provide a Quality Control Manager for the Project. The Quality Control Manager must have authority to reject Defective Work, redirect the efforts of the Contractor, Subcontractor and Suppliers to correct Defective Work and implement steps to prevent future Defective Work.

Note to Specifier: For small projects it is acceptable for the Contractor's resident superintendent to serve as Quality Control Manager. As projects become larger and more complex, this role should be filled by someone other than the superintendent, such as the Contractor's on-site project engineer, if there is concern that the resident superintendent can fill this role while performing other obligations. If a project engineer is to fulfil this role, this person must have time available to direct project quality and take appropriate action as a priority to any other assigned duties. For larger and more complex

projects, it may be prudent to require that an individual other than the project superintendent, but with equal authority, serve full-time as Contractor's Quality Control Manager. Cost of a full-time Quality Control Manager can significantly increase project costs and this option should be selected only when justified by the size and complexity of the Project. Select Paragraph B, C or D as appropriate and delete the paragraphs not used. Coordinate this decision with the requirements in the Division 00 "Qualifications Statement" Section.

B. The resident superintendent or an approved assistant can serve as Quality Control Manager, provided other duties will allow adequate time to serve in this capacity.

C. An individual other than the resident superintendent must serve as Quality Control Manager. The person named as Quality Control Manager, while working under the supervision of the Contractor's superintendent, must have time to direct project quality control efforts and take appropriate action as required. Quality control duties must take priority over any other assigned duties.

D. An individual other than the resident superintendent is to serve as Quality Control Manager. This individual is to have authority equal to that of the resident superintended and serve fulltime as Contractor's Quality Control Manager. The Quality Control Manager is to have the authority to stop work that will not produce Work that complies with the Contract Documents, authorize Defective Work to be removed and corrected independent of the actions or direction of the resident superintendent.

1.07 CONTRACTOR'S QUALITY CONTROL PLAN

A. Provide a CQCP that describes testing and inspections for Work performed at the Site and at remote locations. Include Work by Subcontractors and Suppliers. The CQCP is to include:

1. A description of the quality control organization, including an organization chart showing lines of authority to control the quality of Work;

2. Documentation describing name, qualifications (in resume format), duties, responsibilities, and level of authority of the Quality Control Manager.;

3. The name, qualifications (in resume format), duties, responsibilities, and authorities of other persons assigned a quality control function;

4. Procedures for scheduling, reviewing, certifying, and managing documentation including documentation provided by Subcontractors and Suppliers;

5. Control, verification, and acceptance testing procedures for each specific test. Include:

   a. Name of tests to be performed,

   b. Specification paragraph requiring test,

   c. Parameters of Work to be tested,

   d. Test frequency,

   e. Persons responsible for each test, and

   f. Applicable industry testing standards and laboratory facilities to be used for the test;

6. Incorporate the testing specified in the OQMP into the CQCP, specifically identifying the tests or inspections that will be provided by the OQMP;

7. Procedures for tracking and documenting quality management efforts per Paragraph **[1.03]**.

8. Reporting procedures which incorporate the use of forms provided by the Construction Manager.

9. The name of the proposed testing laboratories along with documentation of qualifications per Paragraph **[1.03]**.

B. Use the Contractor's Quality Control Plan Checklist provided by the Construction Manager to review the CQCP before submitting and include a copy of the completed checklist with the CQCP. Do not begin Work until the CQCP is accepted. Submit an interim plan covering only the portion of Work to be performed if the Contractor plans to begin Work prior to submitting the complete CQCP for the Project. Do not begin Work on other parts of the Project until the complete CQCP is accepted.

C. Meet with the OPT 7 days after CQCP is submitted and before start of construction to discuss the CQCP.

D. Notify the Construction Manager of any changes to the CQCP or quality control personnel.

1.08 CONTRACTOR'S USE OF OWNER'S TEST REPORTS

A. Contractor will receive copies of all test reports documenting Owner's verification tests. Contractor is entitled to rely on the accuracy of these tests results and use these as part of its quality control efforts.

B. Contractor may submit a Change Proposal if the Owner's testing program deviates significantly from the OQMP. Contractor must demonstrate that actual testing and inspection costs were incurred implementing the CQCP as a result of OPT's decision to not provide testing described in the OQMP.

1.09 LIMITATION OF AUTHORITY OF THE TESTING LABORATORY

A. The testing laboratory representatives are limited to providing testing services and interpreting the results of the test performed.

B. The testing laboratory is not authorized to:

1. Alter the requirements of the Contract Documents;

2. Accept or reject any portion of the Work;

3. Perform any of the duties of the Contractor; or

4. Direct or stop the Work.

1.10 TEST REPORTS

A. Certified Test Reports are to be prepared for all tests.

1. Tests performed by testing laboratories may be submitted on their standard test report forms if acceptable to the OPT using the process directed by the Construction Manager. These reports must include the following:

a. Name of the Owner, Project title and number, and name of the Contractor;

b. Name, address, and telephone number of the laboratory;

c. Name and signature of the laboratory personnel performing the test;

d. Description of the product being sampled or tested;

e. Date and time of sampling, inspection, and testing;

f. Date the report was issued;

g. Description of the test performed;

h. Weather conditions and temperature at time of test or sampling;

i. Location at the Site or structure where the test was taken;

j. Standard or test procedure used in making the test;

k. A description of the results of the test;

l. Statement of compliance or non-compliance with the Contract Documents; and

m. Interpretations of test results, if appropriate.

2. Submit reports on tests performed by Contractor, Subcontractors, or Suppliers on the as directed by the Construction Manager.

3. OPT will prepare test reports on tests performed by the OPT.

B. Submit test reports as directed by the Construction Manager within 24 hours of completing the test. Flag tests reports with results that do not comply with Contract Documents for immediate attention. Notify the Construction Manager using acceptable means other than the test report, immediately of any test that fails to comply with the Contract Documents.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Handle and protect test specimens of products and construction materials at the Site in accordance with recognized test procedures. Provide facilities for storing, curing, and processing test specimens as required by test standards to maintain the integrity of Samples. Transport test specimens in a manner to prevent damage to specimens while in transit.

PART 2 - PRODUCTS

2.01 TESTING APPARATUS

A. Furnish testing apparatus and related accessories necessary to perform the tests.

2.02 SAMPLE PRODUCTS

A. Provide Samples of products in adequate quantity for testing.

PART 3 - EXECUTION

3.01 IMPLEMENTING CONTRACTOR'S QUALITY CONTROL PLAN

A. Perform quality control observations and testing as required in each Section of the Specifications and where indicated on the Drawings.

B. Include the following phases for each definable work task. A definable work task is one which is separate and distinct from other tasks, has separate control requirements, may be provided by different trades or disciplines, or may be work by the same trade in a different environment.

1. Planning Phase: Perform the following before beginning each definable work task:

a. Review the Contract Documents.

b. Review documents the Contractor will submit and determine that they are complete in accordance with the Contract Documents.

c. Check to ensure that all materials and/or equipment have been tested, submitted, and approved.

d. Examine the work area to ensure that all required preliminary Work has been completed and complies with the Contract Documents.

e. Examine required materials, equipment, and sample Work to ensure that they are on hand, conform to Contract Documents, Shop Drawings and Product Data, and are properly stored.

f. Review requirements for quality control inspection and testing.

g. Discuss procedures for controlling quality of the Work. Document construction tolerances and workmanship standards for the work task.

h. Check that the portion of the plan for the Work to be performed incorporates document review comments.

i. Discuss results of planning phase with the Construction Manager. Conduct a meeting attended by the Construction Manager, Quality Control Manager, superintendent, other quality control personnel as applicable, and the foreman responsible for the work task. Instruct applicable workers as to the acceptable level of workmanship required to meet the requirements of the Contract Documents. Document the results of the planning phase actions by separate meeting minutes prepared by the Quality Control Manager and attached to the quality control report.

j. Do not move to the next phase unless results of investigations required for the planning phase indicate that requirements have been met.

2. Work Phase: Complete this phase after the planning phase:

a. Notify the Construction Manager at least 1 week in advance of beginning the Work and discuss the review of the planning phase effort to indicate that requirements have been met.

b. Check the Work to ensure that it is in full compliance with the Contract Documents.

c. Verify adequacy of controls to ensure full compliance with Contract Documents. Verify required control inspection and testing is performed.

d. Verify that established levels of workmanship meet acceptable workmanship standards. Compare with required Sample panels as appropriate.

e. Repeat the work phase for each new crew to work on-site, or any time acceptable specified quality standards are not being met.

3. Follow-Up Phase: Perform daily checks to ensure control activities, including control testing, are providing continued compliance with contract requirements:

a. Make checks daily and record observations in the quality control documentation.

b. Conduct follow-up checks and correct all defects prior to the start of additional work tasks that may be affected by the Defective Work. Do not build upon nor conceal Defective Work.

c. Conduct a review of the Work at least 1 month prior to the expiration of the correction period prescribed in the General Conditions with the OPT. Correct defects as noted during the review.

C. Conduct additional planning and work phases if:

1. The quality of on-going Work is unacceptable;

2. Changes are made in applicable quality control staff, on-site production supervision, or crews;

3. Work on a task is resumed after a substantial period of inactivity; or

4. Other quality problems develop.

3.02 DEFECTIVE WORK

A. Immediately correct any Defective Work or notify the Construction Manager why the Work is not to be corrected immediately and when corrective action will be completed.

B. Work performed that is connected or adjacent to Defective Work or Work that would have to be removed to correct Defective Work is also considered to be Defective. Contractor is responsible for all costs associated with replacing any acceptable Work that must be removed, or might be damaged by corrective actions.

C. Document Defective Work, corrective actions taken to correct defects and that corrected Work complies with the Contract Documents.

D. Implement countermeasures to prevent future Defective Work.

E. No payment will be made for Defective Work. Remove Work from the Application for Payment if Work paid for on a previous Application for Payment is found to be Defective.

F. Owner will withhold payment for Defective Work or Work that has not been tested or inspected in accordance with the CQCP, OQCP, or the Contract Documents.

3.03 VERIFICATION TESTING FOR CORRECTED DEFECTS

A. Provide verification testing on corrected Work when corrective action is complete to demonstrate that the corrected Work complies with the Contract Documents. Conduct the same tests or inspections used to determine that the original Work was Defective. Different tests or methods may be used if approved by the OPT. Document that Defective Work has been corrected with the Construction Manager.

B. Pay for verification testing until Work meets quality requirement set forth in the Contract Documents. OPT may perform verification testing as part of its Quality Management Program and impose a Set-off to recover the cost for this testing.

3.04 OWNER'S PRELIMINARY QUALITY CONTROL PLAN

Note to Specifier: The "Owner's Quality Management Activities" Article provides two options for presenting the Owner's Preliminary Quality Control Plan. For larger more complex projects, testing could require more detail and justify the use of a separate document included in the Contract Documents as an Appendix. For other projects, the following table may provide the level of detail needed. The table includes typical information regarding testing from technical specification. This table should be coordinated with the testing requirements in the technical specifications and altered for each project.

Spec. Section	Test / Frequency	OPT or Contractor
03 30 00	Compressive strength. One set of three cylinders for each concrete placement with one additional set of cylinders for each 50 yards in a single placement.	OPT
	Pressure and leakage test (entire pipeline)	Contractor
	Internal deflection testing of pipelines	Contractor
	Protective coatings testing	OPT
	Factory witness testing	OPT

END OF SECTION

01 40 01 IBC SPECIAL INSPECTIONS

Notes to Specifier:

1. **If FNI has been hired to perform special inspections or as the project resident representative, then this Section will need to be reviewed in its entirety.**
2. **Verify all references to: (1) paragraphs within this Section; (2) other Sections of the Specifications; and (3) any other applicable standards or sources of information.**

PART 1 - GENERAL

1.01 OVERVIEW

A. The purpose of this Section is to provide the Owner and the Contractor with an understanding of what constitutes special inspections as defined by the International Building Code (IBC), Chapter 17, "Special Inspections and Tests," and the Contractor's requirements per IBC and role in enabling the Owner to perform the inspections, and provide the Owner with a Statement of Special Inspection specific to this Project's Special Inspection requirements.

B. IBC Special Inspections are not a substitute for other testing required elsewhere in the Contract Documents.

C. IBC Special Inspections may not be performed by the Contractor, unless the Contractor and Owner are the same entity.

1.02 CONTRACTOR RESPONSIBILITIES

A. Enable the OPT to conduct the required IBC Special Inspections as outlined below in "Special Inspection Activities by the Owner."

1. Set up pre-construction meeting and coordinate with OPT, prior to beginning construction, regarding the specific inspection needs and requirements that will be performed as part of these Special Inspections.

2. Provide complete access to the Site and make Contract Documents available at the Site.

a. Provide and pay for all means necessary to enable inspection access at each location requiring inspection. This includes ladders, scaffolding, trench boxes/shielding, fall protection, adequate lighting, adequate ventilation, and designated area(s) for storing inspector equipment and test Samples. All required access must be in accordance with OSHA.

b. Protect Special Inspection test specimens of products and construction materials at the Site in accordance with recognized test procedures.

c. Provide sample materials needed to perform tests.

3. Notify the Construction Manager a minimum of 2 working days in advance of when construction activities requiring testing will be performed or when construction activities will limit and/or prevent inspector(s) from observing construction Work already performed.

a. Provide adequate notice before proceeding with Work that would interfere with sampling, testing, or other required verification.

b. Notify the Construction Manager prior to the time that sampling or testing is required. Lead time is to be adequate to allow arrangements to be made for testing.

c. Do not proceed with any Work until tests indicate that the Work is acceptable.

d. Notify the Construction Manager when schedules change as soon as a delay is expected.

4. Provide adequate quantities of representative product to be tested to the laboratory at the designated location.

B. Submit the following documentation as Product Data in accordance with Section 01 31 13 "Project Coordination":

1. A schedule that establishes the approximate major and/or critical inspection Milestones. Provide a revised schedule for alterations to the schedule.

2. Contractor's test and inspection log described in Paragraph **[3.01]** at Substantial Completion.

Note to Specifier: <u>Provide information required in the paragraph below in the Statement of Special Inspection when required by IBC for high wind and/or seismic areas. Refer to 1704.3.2 and 1704.3.3. Delete paragraph below if not applicable.</u>

3. If the "Special Inspections for Wind Resistance" table and/or the "Special Inspections for Seismic Resistance" table is included in the Structural Statement of Special Inspections (Attachment A), then each Contractor responsible for the construction of the components listed must submit the documentation required by IBC Section 1704.4, "Contractor Responsibility."

C. Special Inspection activities are for the purpose of monitoring the results of the Contractor's Work to see that it is in compliance with the requirements of the Contract Documents.

D. Special Inspection testing requirements mentioned in this Section do not release the Contractor from providing Contractor required testing specified elsewhere in the Contract Documents.

1. Provide all testing documentation required by the Contract Documents.

2. Pay for testing performed to verify Work performed to cure Defective Work complies with the Contract Documents.

E. Special Inspection activities or non-performance of Special Inspection activities do not:

1. Relieve the Contractor of its responsibility to perform Work and furnish materials and products and constructed Work conforming to the requirements of the Contract Documents.

2. Relieve the Contractor of its responsibility for providing adequate quality control measures.

3. Relieve the Contractor of its responsibility for damage to or loss of the material, product, or Work before Owner's acceptance.

4. Constitute or imply Owner's acceptance.

5. Affect the continuing rights of the Owner after Owner's acceptance of the completed Work.

F. All materials and products are subject to Owner's verification testing. Material or products which have been tested or observed by Owner at a supply source or staging area may be re-observed or re-tested by Owner at any time and rejected if they do not comply with the Contract Documents.

1.03 SPECIAL INSPECTION ACTIVITIES BY THE OWNER

A. OPT will provide registered design professionals for special inspection to meet the requirements of **[2012] [2015] [2018]** IBC Chapter 17, Structural Tests and Special Inspections, adopted by the **[specify authority (city, county, state)]**. The registered design professional in responsible charge (RDPIRC) will coordinate and provide IBC special inspections during construction on the types of work listed below. Additionally, the OPT will employee one or more approved agencies to perform inspections and tests during construction on the types of work listed in the Statement of Special Inspection.

B. The OPT will perform the following:

1. Permit: As required by the Building Official for permit issuance, submit the Statement of Special Inspection shown in Attachment A.

2. Preconstruction: Submit names and qualifications of each individual inspector scheduled to perform these inspections to the Building Official prior to the start of construction. Minimum requirements for inspectors must be as indicated in the Statement of Special Inspection.

3. Inspections: The RDPIRC will forward a copy of all inspection and test reports to the Building Official. Discrepancies must be brought to the immediate attention of the Contractor and Construction Manager.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 TEST AND INSPECTION REGISTER

A. Contractor Test and Inspection Register: Include the following:

1. Date Owner was notified of impending construction Work that requires testing and/or that would interfere with subsequent inspections.

2. Name of person notified and the means of notification.

3. Date construction Work in question was completed.

4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain an up-to-date copy of the Contractor Test and Inspection Register at the Site and with Record Documents. Post changes and revisions as they occur. Provide access to the Contractor Test and Inspection Register for RDPIRC, OPT, and AHJ reference during normal working hours.

3.02 REPAIR AND PROTECTION

A. General:

1. On completion of inspections and tests, repair damaged construction and restore substrates and finishes.

2. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration in adjoining areas with durable seams that are invisible as possible.

B. Protect construction exposed by or for special inspection activities.

END OF SECTION

ATTACHMENT A

STRUCTURAL STATEMENT OF SPECIAL INSPECTIONS

This Statement of Special Inspections has been prepared in accordance with International Building Code **[2012] [2015] [2018]** Chapter 17 by the Structural Engineer of Record for the following Project:

Project Name: _____

Location: _____

Owner: _____

Structural Engineer of Record: _____

Design Professional in Responsible Charge: _____

Special Inspector for _____ : _____

Special Inspector for _____ : _____

Special Inspector for _____ : _____

Abbreviations

Inspectors

Note to Specifier: Review inspector qualifications and designations below for project and project site specific requirements. Adjust as required.

AWS-CWI: An American Welding Society/American Institute of Steel Construction certified welding inspector.
AWS/AISC-SSI: An American Welding Society certified structural steel inspector.
ACI: An American Concrete Institute certified technician, certified in the applicable construction type.
EIT: An Engineer-In-Training, a graduate engineer who has passed the Fundamentals of Engineering exam, and is under the direct supervision of a PE.
NICET: A National Institute for Certification in Engineering Technologies certified technician, certified in the applicable construction type.
PE: A licensed professional engineer and/or a structural engineer (SE) competent in the area of construction being inspected.

Specifications

ACI 318: American Concrete Institute Building Code Requirements for Structural Concrete.
AISC 360: American Institute of Steel Construction, Specification for Structural Steel Buildings.
ASTM: ASTM International (American Society for Testing and Materials).
AWS: American Welding Society
RCSC: RCSC Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts.

Common Words

C: Continuous observation of specified construction activity.
P: Periodic observation of specified construction activity.
CFSF: Cold formed steel framing.
CD: Contract Documents and/or Shop Drawings (if item is performance specified).

Note to Specifier: Requirements are based on IBC 2015. Review sections and coordinate with IBC 2018 as applicable.

Special Inspector Qualifications

Special Inspectors minimum qualifications are listed below for each area of competency.

Applicable IBC Section	Minimum Inspector Qualifications	Remarks
1704.2.5 & 1705.10 Fabricated Items	N/A	Inspection of a fabrication facility is not required if the fabricator is exempt per IBC. Exemption typically requires a manufacturer be certified by an independent organization (e.g. AISC, IAS, SJI, or NPCA).
1705.2 Steel Construction	AWS-CWI AWS/AISC-SSI, PE, or EIT	All welds must be inspected by an AWS-CWI.
1705.3 Concrete Construction	ACI or NICET, PE, or EIT AWS-CWI	All welds must be inspected by an AWS-CWI.
1705.3 Post-Installed Concrete Anchors	**PE**	**Professional engineer performing inspection must have knowledge of post-installed anchor installation requirements and experience in the design and specifying post-installed anchors.**
1705.4 Masonry Construction	ACI or NICET, PE, or EIT AWS-CWI	All welds must be inspected by an AWS-CWI.
1705.5 Wood Construction	Inspector, PE, or EIT	Inspector must have a minimum of 5 years of related experience.
1705.6 Soils	ACI, NICET, PE, or EIT	
1705.7 Driven Deep Foundations	NICET, PE, or EIT	
1705.8 Cast-in-Place Deep Foundations	NICET, PE, or EIT	
1705.9 Helical Pile Foundations	NICET, PE, or EIT	
1705.11 Wind Resistance	PE and AWS-CWI	All welds must be inspected by an AWS-CWI.
1705.12 Seismic Resistance	PE and AWS-CWI	All welds must be inspected by an AWS-CWI.
1705.13 Seismic Resistance Testing	TBD	TBD

Steel Construction

Note to Specifier: Review IBC requirements where CFSF is provided or welded deck or CFSF is used. Adjust table as required.

The inspection requirements for this type of construction include structural steel and metal deck **[cold formed steel framing]**.

Verification and Inspection	Frequency		Remarks
	C	P	
Material Verification of Cold-Formed Steel Deck	-	X	Identification markings to conform to ASTM standards specified in approved construction documents.
	-	X	Review manufacturer's certified test reports.
Steel Deck Installation	-	X	Verify fastener size, type, and spacing is in conformance with CD.
	-	X	Verify standard and special details have been accurately constructed in accordance with CD.
Inspection Tasks Prior to Welding	-	-	Refer to AISC 360, Table N5.4-1 QA requirements.
Inspection Tasks During Welding	-	-	Refer to AISC 360, Table N5.4-2 QA requirements.
Inspection Tasks After Welding	-	-	Refer to AISC 360, Table N5.4-3 QA requirements.
Inspection Tasks Prior to Bolting	-	-	Refer to AISC 360, N5.6 and Table N5.6-1 QA requirements.
Inspection Tasks During Bolting	-	-	Refer to AISC 360, N5.6 and Table N5.6-2QA requirements.
Inspection Tasks After Bolting	-	-	Refer to AISC 360, N5.6 and Table N5.6-3 QA requirements.
Steel Embedded in Concrete	X	-	Prior to placement of concrete verify anchor rods and other embedments supporting structural steel. As a minimum, the diameter, grade, type and length of anchor rod or embedded item, and the extent/depth of embedment into concrete.
Connections and Framing Details	-	X	Verify compliance with CD: including braces and stiffening members, member locations, and application of joint details and applicable notes at each connection.
Cold-Formed Steel Trusses	-	X	Where a cold-formed steel truss clear span is 60 ft. or greater, verify temporary installation bracing and permanent bracing for both the truss and truss members is in accordance with approved Shop Drawings.
Open-Web Steel Joists and Joist Girders	-	X	Check end connections and bridge is in accordance with approved Shop Drawings and CD.
Fabrication	**-**	**X**	**If fabricator is audited by an independent agency for each of the items above, then no manufacturer plant verification is required. If fabricator is not exempt, then review fabrication operations and quality control procedures per IBC and AISC, and for each product in accordance with the inspection items noted above.**

Concrete Construction

Note to Specifier: Certain exceptions in IBC may allow this Section to be eliminated. Refer to IBC for exceptions. Additionally, for prestressed and post-tensioned concrete, check IBC for additional requirements.

The inspection requirements for this type of construction include **[cast-in-place concrete] [and precast concrete]**.

Verification and Inspection	Frequency		Remarks
	C	P	
Formwork	-	X	Verify formwork for shape, location and dimensions of the concrete member being formed are in conformance with CD.
Reinforcing Steel Material and Type	-	X	Verify size of bars and/or stressing strands, ASTM standard, and grade are in conformance with CD.
Reinforcing Steel Position	-	X	Verify quantity and spacing of bars and/or stressing strands, concrete clear cover on all sides. Verify lap splice type, location, and size. Verify no welding of reinforcing except where specifically noted.
Welding of Reinforcing Steel	X	-	Verify material being welded is ASTM A706 and per CD. Verify personnel, equipment, materials, and welds per AWS D1.4. Provide 100% visual inspection of all welds.
Cast-In-Place Anchors	-	X	Verify size, type, position, and embedment prior to concrete placement. Verify position after concrete placement.
Cast-In-Place Anchors	X	-	Verify placement and consolidation of concrete around anchors.
Mix Design	-	X	Verify batch plant tickets' mix number matches approved mix design for each mix design and application.
Fresh Concrete Samples	X	-	At the same time fresh concrete is sampled to fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete. Sample per ASTM C31, C143, C231 (or C173), C1064. Refer to Section 03 33 00 "Cast-In-Place Concrete"
Placement Technique	X	-	At the time of concrete or shotcrete placement, verify that proper application techniques are being implemented per the CD and ACI 301.
Curing Technique	-	X	Verify that approved means of curing and extreme weather protection are implemented in accordance with the CD.
Prestressed Concrete	X	-	Verify in-situ concrete strength prior to stressing. Refer to CD requirements. Verify application of prestressing forces. Observe grouting of bonded tendons.
Shore Removal	-	X	Verify in-situ concrete strength prior to stressing. Refer to CD requirements.

Verification and Inspection	Frequency		Remarks
	C	P	
Fabrication of Precast Members	-	X	If fabricator is audited by an independent agency for each of the items above, then no manufacturer plant verification is required for precast members. If fabricator is not exempt, then review fabrication operations and quality control procedures, and for each product in accordance with the inspection items noted above.
Erection of Precast Members	-	X	Verify conformance with the CD including welded connections, grouting, and bolting. Where welded connections are specified, verify personnel, equipment, materials, and welds per AWS D1.1. Provide 100% visual inspection of all welds.

Post-Installed Concrete Anchors

Note to Specifier: Provide additional requirements if proof loading is required. Typically, proof loading is not required for standard installations – installations that are in conformance with manufacturer's specified limitations. Adjust Frequency to 'C' for upwardly inclined, sustained tension adhesive anchors.

The inspection requirements for this type of construction include adhesive and expansion type anchors installed in hardened concrete and masonry construction.

For each construction personnel, anchor type, diameter, and embedment the inspection of initial anchors placed must be continuous based on the requirements below. With the exception of anchors that are upwardly inclined, continuously load in tension, after initial anchor placement inspections have been performed, then inspector may perform quality assurance on a periodic basis.

Any change in personnel or anchor type must require an initial continuous inspection as indicated here.

Verification and Inspection	Frequency		Remarks
	C	P	
Inspection Tasks Prior to Anchor Hole Drilling	-	X	Verify all personnel are qualified to install anchors. Installation of adhesive anchors horizontally or upwardly inclined must be performed by personnel certified by an acceptable program.
	-	X	Verify Contractor has manufacturer's printed installation instructions (MPII) on-site and available for reference by construction personnel.
	-	X	If manufacturer does not have a representative on-site, then special inspector must review MPII with Contractor personnel prior to beginning construction.
	-	X	Verify edge distance limitations indicated in CD's and existing reinforcing locations compared to proposed anchor hole locations.
	-	X	Verify drill bit diameter matches MPII for anchor diameter indicated in CD's. Special inspector does not need to be present during actual drilling of holes.

Verification and Inspection	Frequency		Remarks
	C	P	
Inspection Tasks After Drilling Prior to Anchor Placement	-	X	Verify every hole diameter is in accordance with MPII and verify embedment is in accordance with CD's and hole depth is in accordance with MPII (hole depth may need to exceed embedment depth, refer to MPII).
	-	X	Verify cleaning operations are in accordance with CD's and MPII.
	-	X	Verify anchor type, material, diameter, and length.
	-	X	Where adhesive anchors are specified: verify adhesive type is per CD's, adhesive expiration date, and adhesive dispensing equipment is per MPII.
	-	X	Verify that for horizontal and upwardly inclined adhesive anchors have all MPII required installation items (e.g. piston-plug)
Inspection Tasks During Anchor Placement	-	X	Verify that all anchors are installed in accordance with MPII.

Masonry Construction – Level B Quality Assurance

Note to Specifier: This is for Risk Categories I, II, and III. Note: that this assumes all mortar and grout mixes are pre-packaged dry mixes, only water is added on-site. Note: that this assumes grout and mortar by proportions and unit strength method for determining f'm, which requires testing of CMU blocks per ASTM C140 – this should be indicated in specification. For Risk Category IV, refer to additional requirements in IBC. Additionally, if prestressed reinforcing is used, then review ACI 530 requirements.

The inspection requirements for this type of construction include load bearing and reinforced concrete masonry construction.

Verification and Inspection	Frequency		Remarks
	C	P	
Grout and Mortar Mixes	-	X	Verify grout and mortar mixes on-site match the CD and approved submittals.
CMU Units	-	X	Verify CMU units on-site match the CD and approved submittals.
Mortar Joints	-	X	Verify application of mortar at head and bed joints, joint dimensions, and tooled joint surface are as specified in the CD.
Reinforcement	-	X	Verify the correct use of rebar positioners and the position of reinforcing bars matches what is specified in the CD. Verify the correct ASTM, grade, and spacing are being used.
Welding of Reinforcement	X	-	Verify ASTM A706 reinforcing bars are being used and welding is in accordance with AWS D1.4. Provide 100% visual inspection of all welds.
Joint Reinforcement	-	X	Verify joint reinforcement is of the type and size specified and is installed in accordance with the CD.

Verification and Inspection	Frequency		Remarks
	C	P	
Member Sizes	-	X	Verify size and location of structural elements per ACI 530.1 Article 3.3F and CD.
Anchors	-	X	Verify anchor size, grade, type, location, and spacing. Verify grouted cells are provided where required for cast-in-place and post-installed anchors.
Reinforcement Lap Splices	-	X	Verify lap lengths being used. If laps are welded, then provide continuous observation, and verify personnel, equipment, materials, and welds per AWS D1.4. Provide 100% visual inspection of all welds.
Prior to Grouting	-	X	Verify grout space is clean, protrusions of mortar into cell cavity are less than 1/2 in., minimum grout space dimensions are provided, and reinforcing and connectors are correctly located as specified in CD.
Grouting	X	-	Verify compliance with code and construction documents.
Grout Slump	-	X	Verify correct slump per ASTM C143 for each lift, but not less than one test per 2 cu. yd. and grout is consolidated per ACI 530.1 article 3.5E.
Cold Weather	-	X	Verify protection of masonry during cold weather in accordance with the CD.

Wood

Note to Specifier: Complete this Section as required.

Verification and Inspection	Frequency		Remarks
	C	P	
High-Load Diaphragms	-	X	Verify the following are in accordance with CD: wood structural panel sheathing for grade and thickness; supporting framing member sizes and location; fastener type and spacing.
Metal-Plate-Connected Wood Trusses	-	X	Where truss span is 60 ft. or greater, verify temporary and permanent bracing, as required by approved Shop Drawings, have been installed.
Connections and Framing Details	-	X	Verify compliance with CD: including braces, shear walls, member locations and sizes, and application of joint details and applicable notes at each connection.

Soils

The inspection requirements for this type of construction include structural fill and compacted fill, and **[shallow footings] [, isolated footings] [, strip footings] [, and slabs-on-grade]**.

Verification and Inspection	Frequency		Remarks
	C	P	
Subgrade for Shallow Footings	-	X	Verify that materials below shallow foundations are adequate to achieve the design bearing capacity, excavations are extended to the proper depth, and have reached the proper material.
Backfill Materials	-	X	Perform classification and testing of compacted fill materials. Test per ASTM D422, D1140, and D698 as required to verify fill materials are in accordance with the CD.
Subgrade Preparation	-	X	Verify the use of proper subgrade preparation per the CD, including but not limited to proof rolling and scarifying.
Compaction	X	-	Verify proper fill materials, densities, and lift thicknesses during placement and compaction of fill is in accordance with the CD. Test density of each lift per ASTM D698.

Driven Deep Foundation Elements

The inspection requirements for this type of construction include driven sheet piles and precast concrete piles.

Verification and Inspection	Frequency		Remarks
	C	P	
Member	X	-	Verify element materials, sizes and lengths comply with the CD requirements.
Testing	X	-	Determine capacities of test elements and conduct additional testing as required by CD's
Driving	X	-	Observe driving operations and maintain complete and accurate records for each element driven.
Accuracy	X	-	Verify placement locations and plumbness, confirm type and size of hammer, record number of blows per foot of penetration for each foot driven, determine required penetrations to achieve design capacity, record tip elevations and document any damage to foundation elements.
Re-tapping	X	-	Observe re-tapping operations and maintain complete and accurate records for each element re-tapped.
Concrete	-	-	Verify all concrete elements are in accordance with the Concrete Construction table above.
Steel	-	-	Verify all steel elements are in accordance with the Steel Construction Table above.

Cast-in-Place Deep Foundation Elements

The inspection requirements for this type of construction include drilled shafts.

Verification and Inspection	Frequency		Remarks
	C	P	
Drilling	X	-	Observe drilling operations and maintain complete and accurate records for each element. Including ground surface elevation at time of drilling, depth of each strata penetrated, final depth, description of bearing strata and depth of bearing strata penetration below casings if applicable.
Accuracy	X	-	Verify placement locations and plumbness, confirm element diameter(s), and lengths are per the CD.
Concrete	X	-	Verify all concrete elements in accordance with the Concrete Construction table above.

Special Inspections for Wind Resistance

Designated System Component		

Special Inspections for Seismic Resistance

Designated System Component		

END OF ATTACHMENT A

01 41 00 TPDES REQUIREMENTS

1.00 GENERAL

1.01 SECTION INCLUDES

A. Documentation to be prepared and signed by Contractor/Operator before conducting construction operations, in accordance with the Texas Pollutant Discharge Elimination System (TPDES) Construction General Permit Number TXR 150000 issued February 15, 2008 (the Construction General Permit).

B. Implementation, maintenance inspection, and termination of storm water pollution prevention control measures including, but not limited to, erosion and sediment controls, storm water management plans, waste collection and disposal, off-site vehicle tracking, and other appropriate practices shown on the Drawings or specified elsewhere in the Contract.

C. Review of the Storm Water Pollution Prevention Plan (SWP3) implementation in a meeting with Engineer prior to start of construction.

1.02 DEFINITIONS

A. Commencement of Construction Activities: The exposure of soil resulting from activities such as clearing, grading, and excavation activities, as well as other construction related activities (e.g., stock piling of fill material, demolition).

B. Large Construction Activity Project that:

1. disturbs five acres or more, or

2. disturbs less than five acres but is part of a larger common plan of development that will disturb five acres or more of land.

C. Small Construction Activity Project that:

1. disturbs one or more acres but less than five acres, or

2. disturbs less than one acre but is part of a larger common plan of development that will ultimately disturb one or more acres but less than five acres.

D. TPDES Operator:

1. Operator - The person or persons associated with a large or small construction activity that is either a primary or secondary as defined below:

2. Primary Operator – the person or persons associated with a large or small construction activity that meets either of the following two criteria:

a. the persons have operational control over construction plans and specifications, including the ability to make modifications to those plans and specifications; or

b. the person or persons have day-to-day operational control of those activities at a construction site that are necessary to ensure compliance with a storm water pollution prevention plan (SWP3) for the site or other permit conditions (e.g., they are authorized to direct workers at a site to carry out activities required by the SWP3 or comply with other permit conditions).

3. Secondary Operator – The person whose operational control is limited to the employment of other operators or to the ability to approve or disapprove changes to plans and specifications. A secondary operator is also defined as a primary operator if there are no other operators at the construction site.

2.00 PRODUCTS - NOT USED

3.00 EXECUTION

3.01 SITE SPECIFIC STORM WATER POLLUTION PREVENTION PLAN (SWP3)

A. Prepare a SWP3 following Part III of the Construction General Permit and the Storm Water Management Handbook for Construction Activities issued by Harris County. If conflicts exist between the Construction General Permit and the handbook, the more stringent requirements will apply.

B. Update or revise the SWP3 as needed during the construction following Part III, Section E of the Construction General Permit.

C. Submit the SWP3 and any updates or revisions to Engineer for review and address comments prior to commencing, or continuing, construction activities.

3.02 NOTICE OF INTENT FOR LARGE CONSTRUCION ACTIVITY

A. Fill out, sign, and date TCEQ Form 20022 (03/05/2008) Notice of Intent (NOI) for Storm Water Discharges Associated with Construction Activity under the TPDES Construction General Permit (TXR 150000), ATTACHMENT 1 of this Section 01410.

B. Transmit the signed Contractor's copy of TCEQ Form 20022 (03/05/2008), along with a $325.00 check, made out to Texas Commission on Environmental Quality, and the completed Payment Submittal Form to Engineer.

C. Engineer will complete a separate TCEQ Form 20022 (03/05/2008) for Authority's Notice of Intent, and will submit both Notices, along with checks for application fees, to the TCEQ.

D. Submission of the Notice of Intent form by both the Authority and Contractor to TCEQ if mailing is required a minimum of seven days before Commencement of Construction Activities.

3.03 CONSTRUCTION SITE NOTICE FOR SMALL CONSTRUCTION ACTIVITY

A. Fill out, sign, and date the Construction Site Notice, Attachment 2 to TPDES General Permit TXR 150000, "Construction Site Notice", ATTACHMENT 2 of this Section 01410.

B. Transmit the signed Construction Site Notice to Engineer at least seven days prior to Commencement of Construction Activity.

3.04 CERTIFICATION REQUIREMENTS

A. Fill out TPDES Operator's Information form, ATTACHMENT 3 of this Section 01410, including Contractor's name, address, and telephone number, and the names of persons or firms responsible for maintenance and inspection of erosion and sediment control measures. Use multiple copies as required to document full information.

B. Contractor and Subcontractors shall sign and date the Contractor's / Subcontractor's Certification for TPDES Permitting, ATTACHMENT 4 of this Section 01 41 00. Include this certification with other Project certification forms.

C. Submit properly completed certification forms to Engineer for review before beginning construction operations.

D. Conduct inspections in accordance with TCEQ requirements. Ensure persons or firms responsible for maintenance and inspection of erosion and sediment control measures read, fill out, sign, and date the Erosion Control Contractor's Certification for Inspection and Maintenance. Use the Authority Storm Water Pollution Prevention Plan, Construction Site Inspection Report, ATTACHMENT 5 of this Section 01 41 00 to record maintenance inspections and repairs.

3.05 RETENTION OF RECORDS

A. Keep a copy of this document and the SWP3 in a readily accessible location at the construction site from Commencement of Construction Activity until submission of the Notice of Termination (NOT) for Storm Water Discharges Associated with Construction Activity under TPDES Construction General Permit (TXR 150000). Contractors with day-to-day operational control over SWP3 implementation shall have a copy of the SWP3 available at a central location, on-site, for the use of all operators and those identified as having responsibilities under the SWP3. Upon submission of the NOT, submit all required forms and a copy of the SWP3 with all revisions to Engineer.

3.06 REQUIRED NOTICES

A. Post the following notices from effective date of the SWP3 until date of final site stabilization as defined in the Construction General Permit:

1. Post the TPDES permit number for Large Construction Activity, with a signed TCEQ Construction Site Notice for large or Small Construction Activity. Signed copies of the Authority's and Contractor's NOI must also be posted.

2. Post notices near the main entrance of the construction site in a prominent place where it is safely and readily available for viewing by General Public, Local, State, and Federal Authorities. Post name and telephone number of Contractor's local contact person, brief project description and location of the SWP3.

    a. If posting near a main entrance is not feasible due to safety concerns, coordinate posting of notice with Engineer to conform to requirements of the Construction General Permit.

    b. If Project is a linear construction project (e.g.: road, utilities, etc.), post notice in a publicly accessible location near active construction. Move notice as necessary.

3. Post a notice to equipment and vehicles operators, instructing them to stop, check, and clean tires of debris and mud before driving onto traffic lanes. Post at each stabilized construction access area.

4. Post a notice of waste disposal procedures in a readily visible location on site.

3.07 ON-SITE WASTE MATERIAL STORAGE

A. On-site waste material storage shall be self-contained and shall satisfy appropriate local, state, and federal rules and regulations.

B. Prepare list of waste material to be stored on-site. Update list as necessary to include up-to-date information. Keep a copy of updated list with the SWP3.

C. Prepare description of controls to reduce pollutants generated from on-site storage. Include storage practices necessary to minimize exposure of materials to storm water, and spill prevention and response measures consistent with best management practices. Keep a copy of the description with the SWP3.

3.08 NOTICE OF TERMINATION

A. Submit a NOT, ATTACHMENT 6 of this Section 01 41 00, to Engineer within 30 days after:

1. Final stabilization has been achieved on all portions of the site that are the responsibility of the Contractor; or

2. Another operator has assumed control over all areas of the site that have not been stabilized; and

3. All silt fences and other temporary erosion controls have either been removed, scheduled to be removed as defined in the SWP3, or transferred to a new operator if the new operator has sought permit coverage.

B. Engineer will complete Authority's NOT and submit Contractor and Authority's notices to the TCEQ and MS4 entities.

END OF SECTION

ATTACHMENT 1

Notice of Intent (NOI) for Storm Water Discharges Associated with Construction Activity under the TPDES Construction General Permit (TXR150000)

For help completing this application, read the TXR150000 NOI Instructions (TCEQ-20022-Instructions).

TCEQ Office Use Only
TPDES Permit Number: TXR15|__|__|__|__|__| - NO
GIN Number: |__|__|__|__|__|__|__|__|

A. Construction Site Operator ☐ New ☐ No Change Customer Reference Number: CN_____
Name: _____
Mailing Address: _____ City: _____ State: ____ Zip Code: _____
Country Mailing Information (*if outside USA*) Territory: _____ Country Code: _____ Postal Code: _____
Phone Number: _____ Extension: _____ Fax Number: _____
E-mail Address: _____
Type of Operator: ☐ Individual ☐ Sole Proprietorship - D.B.A. ☐ Partnership ☐ Corporation ☐ Federal Government
☐ State Government ☐ County Government ☐ City Government ☐ Other: _____
Independent Operator? ☐ Yes ☐ No Number of Employees: ☐ 0-20 ☐ 21-100 ☐ 101-250 ☐ 251-500 ☐ 501 or higher
Federal Tax ID: _____ State Franchise Tax ID Number: _____ DUNS Number: _____

B. Billing Address
Name: _____
Mailing Address: _____ City: _____ State: ____ Zip Code: _____
Country Mailing Information (*if outside USA*) Territory: _____ Country Code: _____ Postal Code: _____

C. Project / Site Information ☐ New ☐ No Change Regulated Entity Reference Number: RN_____
Name: _____
Mailing Address: _____ City: _____ State: ____ Zip Code: _____
Physical Address: _____ City: _____ County: _____ Zip Code: _____
Location Access Description: _____
Latitude: ___ ° ___ ' ___ " N Longitude: ___ ° ___ ' ___ " W Degrees (°), Minutes ('), and Seconds (")
Latitude: _____ Longitude: - _____ Decimal Form
Standard Industrial Classification (SIC) code: _____ Also, describe the construction activity at this site *(do not repeat the SIC code)*:
_____
Has a storm water pollution prevention plan been prepared as specified in the general permit (TXR150000)? ☐ Yes ☐ No
Estimated area of land disturbed (to the nearest acre): _____ Is the project / site located on Indian Country Lands? ☐ Yes ☐ No
Does this project / site discharge storm water into a municipal separate storm sewer system (MS4)? ☐ Yes ☐ No
If yes, provide the name of the MS4 operator: _____
Provide the name or segment number of the water body that receives storm water from this project / site: _____

D. Contact - If the TCEQ needs additional information regarding this application, who should be contacted?
Name: _____ Title: _____
Phone Number: _____ Extension: _____ Fax Number: _____
E-mail Address: _____

E. Payment Information - Check / Money Order Number: _____ Name on Check / Money Order: _____

F. Certification
I certify under penalty of law that this document was prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Construction Site Operator:
Prefix: _____ First: _____ Middle: _____
Last: _____ Suffix: _____ Title: _____
Signature: _____ Date: _____

If you have questions on how to fill out this form or about the storm water program, please contact us at (512) 239-4671.
Individuals are entitled to request and review their personal information that the agency gathers on its forms. They may also have any errors in their information corrected. To review such information, contact us at (512) 239-3282.

The completed NOI must be mailed to the following address. Use the attached document to submit the $100 application fee. Please note that the NOI and application fee are submitted separately to different addresses.

Texas Commission on Environmental Quality
Storm Water & General Permits Team; MC - 228
P.O. Box 13087
Austin, Texas 78711-3087

TCEQ-20022 (05/03) **Page 1 of 2**

ATTACHMENT 1

Texas Commission on Environmental Quality
Payment Submittal Form

The storm water application fee shall be sent under separate cover to the Texas Commission on Environmental Quality.

This form must be used to submit your Storm Water Application Fee. Please complete the following information, staple your check in the space provided at the bottom of this document, and mail it to:

BY REGULAR U.S. MAIL

Texas Commission on Environmental Quality
Financial Administration Division
Cashier's Office, MC-214
P.O. Box 13088
Austin, TX 78711-3088

BY OVERNIGHT/EXPRESS MAIL

Texas Commission on Environmental Quality
Financial Administration Division
Cashier's Office, MC-214
12100 Park 35 Circle
Austin, TX 78753

Fee Code: GPA

Storm Water General Permit: TXR150000

Check / Money Order No: _____ Amount of Check/Money Order: _____

Date of Check or Money Order: _____

Name on Check or Money Order: _____

Facility / Site Name: _____

Facility / Site Physical Address: _____

City: _____ Zip Code: _____

Staple Check In This Space

TCEQ-20022 (05/03)

ATTACHMENT 1

Completing the Notice of Intent for Storm Water Discharges Associated with Construction Activity under the TPDES Construction General Permit (TXR150000)

A. Construction Site Operator Information

Check boxes and Customer Reference Number
These boxes designate the operator's status as a TCEQ "customer"—in other words, an individual or business that is involved in an activity that we regulate. We assign each customer a number that begins with "CN," followed by nine digits. ***This is not a permit number, registration number, or license number.*** In the remainder of this section, we will use "this customer" to mean the operator for Part A of the form.

- If this customer has not been assigned a Customer Reference Number or if this number is unknown, check "New" and leave the space for the Customer Reference Number blank.
- If this customer has already been assigned this number, enter the operator's Customer Reference Number and:
  - Check "No Change" if all the remaining customer information is the same as previously reported. However, you must still complete most blanks in this form for this notice of intent to be valid.
  - If this customer's information has changed since the last time it was reported to the TCEQ, check neither box and complete the remainder of this notice of intent.
- ***Do not enter a permit number, registration number, or license number in place of the Customer Reference Number.***

Name
Enter the legal name of this customer as authorized to do business in Texas. Include any abbreviations (LLC, Inc., etc.).

Mailing Address
Enter a central and general mailing address for this customer to receive mail from the TCEQ. For example, if this customer is a large company, this address might be the corporate or regional headquarters. On the other hand, for a smaller business, this address could be the same as the site address.

If this is a street address, please follow US Postal Service standards. In brief, these standards require this information in this order:

- the "house" number—for example, the 1401 in 1401 Main St
- if there is a direction before the street name, the one- or two-letter abbreviation of that direction (N, S, E, W, NE, SE, SW, or NW)
- the street name (if a numbered street, do not spell out the number—for example, 6th St, not Sixth St)
- an appropriate abbreviation of the type of street—for example, St, Ave, Blvd, Fwy, Exwy, Hwy, Cr, Ct, Ln
- if there is a direction after the street name, the one- or two-letter abbreviation of that direction (N, S, E, W, NE, SE, SW, or NW)
- if there is a room number, suite number, or company mail code

City, State, *and* ZIP Code
Enter the name of the city, the two-letter USPS abbreviation for the state (for example, TX), and the ZIP Code. (Enter the full ZIP+4 if you know it.)

Country Mailing Information
If this address is ***outside*** the United States, enter the territory name, country code, and any non-ZIP mailing codes or other non–U.S. Postal Service features here. If this address is ***inside*** the United States, leave these spaces blank.

Phone Number *and* Extension
This number should correspond to this customer's mailing address given earlier. Enter the area code and phone number here. Leave "Extension" blank if this customer's phone system lacks this feature.

Fax Number
This number should correspond to this customer's mailing address given earlier. Enter the area code and fax number here.

E-mail Address
As with the mailing address, this should be a general address that is appropriate for e-mail to this customer's central or regional headquarters, if applicable.

If "No Change" was checked for this customer, you may skip the rest of the fields in this part of the form and continue to the next part of the NOI.

Type of Operator
Check ***only one*** box.

Check ...	*if this customer ...*
Individual	is a person and has not established a business to do whatever causes them to be regulated by us.
Sole Proprietorship—D.B.A.	is a business that is owned by only one person and has not been incorporated. This business may: • be under the person's name • have its own name ("doing business as," or d.b.a.) • have any number of employees
Partnership	is a business that is established as a partnership as defined by the Texas Secretary of State's Office.
Corporation	meets all of these conditions: • is a legally incorporated entity under the laws of any state or country • is recognized as a corporation by the Texas Secretary of State • has proper operating authority to operate in Texas
Federal, state, county, or city government (as appropriate)	is either an agency of one of these levels of government or the governmental body itself (If a utility district, water district, tribal government, college district, council of governments, or river authority, check "Other" and write in the specific type of government.)
Other	fits none of the above descriptions. Enter a short description of the type of customer in the blank provided.

Independent Operator?
Check "No" if this customer is a subsidiary or part of a larger company. Otherwise, check "Yes."

Number of Employees
Check one box to show the number of employees for this customer's entire company, at all locations. ***This is not necessarily the number of employees at the site named in this NOI.***

Federal Tax ID
All businesses, except for some small sole proprietors, should have a federal taxpayer identification number (TIN). Enter this number here. Use no prefixes, dashes, or hyphens. Individuals and sole proprietors do not need to provide a federal tax ID.

State Franchise Tax ID
Corporations and limited liability companies that operate in Texas are issued a franchise tax identification number. If this customer is a corporation or limited liability company, enter this number here.

DUNS Number
Most businesses have a DUNS (Data Universal Numbering System) number issued by Dun and Bradstreet Corp. If this customer has one, enter it here.

B. Billing Address

We will mail the annual fee invoice for this site to the address entered in this section.

Name
Enter the legal name of the person or business to which we should mail this site's fee invoice each year.

Mailing Address
Enter the specific mailing address to which we should mail this site's fee invoice each year. If this is a street address, please follow the US Postal Service standards as described under "A. Construction Site Operator Information" on page 1 of these instructions.

City, State, *and* ZIP Code
Enter the name of the city, the two-letter USPS abbreviation for the state (for example, TX), and the ZIP Code. (Enter the full ZIP+4 if you know it.)

Country Mailing Information
If this address is ***outside*** the United States, enter the territory name, country code, and any non-ZIP mailing codes or other non–U.S. Postal

ATTACHMENT 1

Service features here. If this address is ***inside*** the United States, leave these spaces blank.

C. Project / Site Information

Check boxes *and* Regulated Entity Reference Number
These boxes designate this site's status as a TCEQ "regulated entity"—in other words, a location where an activity that we regulate occurs. We assign each regulated entity a number that begins with "RN," followed by nine digits. ***This is not a permit number, registration number, or license number.***

- If this site has not been assigned a Regulated Entity Reference Number or if this number is unknown, check "New" and leave the space for the Regulated Entity Reference Number blank.
- If this site has already been assigned this number, enter the Regulated Entity Reference Number and:
  - Check "No Change" if all the remaining information is the same as previously reported. However, even if there has been no change, you must complete this section at least through "E-mail Address" for this NOI to be valid.
  - If this site's information has changed since the last time it was reported to the TCEQ, check neither box and complete the remainder of this notice of intent.
- ***Do not enter a permit number, registration number, or license number in place of the Regulated Entity Reference Number.***

Name
Enter the name by which you want this site to be known to the TCEQ.

Mailing Address
Enter the specific mailing address for this site. If this is a street address, please follow the US Postal Service standards as described under "A. Construction Site Operator Information" on page 1 of these instructions. If the project / site's mailing address is the same as what is provided in Section A, you may enter "Same as Section A".

City, State, *and* ZIP Code
Enter the name of the city, the two-letter USPS abbreviation for the state (for example, TX), and the ZIP Code. (Enter the full ZIP+4 if you know it.)

Physical Address
Enter the physical address of the site itself. TCEQ staff should be able to use this address to find the site. Please follow the US Postal Service standards as described under "A. Construction Site Operator Information" on page 1 of these instructions. If the project / site does not have a physical address, enter "No Address".

City, County, *and* ZIP Code
Enter the name of the city, the county, and the ZIP Code. (Enter the full ZIP+4 if you know it.) This information must be provided even if you have entered "No Address" in the previous field.

Location Access Description
Enter a physical description of the location of the site based on highway intersections and/or permanent landmarks.

Latitude *and* Longitude
Enter the latitude and longitude of the site in ***either*** degrees, minutes, and seconds ***or*** decimal form.

For help obtaining the latitude and longitude, go to:
http://www.tnrcc.state.tx.us/gis/drgview.html

Standard Industrial Classification (SIC) Code and Activity Description

Provide the SIC code that best describes the construction activity being conducted at the site.

For help with SIC codes, go to:
http://www.osha.gov/oshstats/sicser.html

In addition to the SIC code, you must also provide a description of the construction activity being conducted at the site. This may include such descriptions as: "Apartment Building Construction" or "Shopping Center Construction."

Storm Water Pollution Prevention Plan
This plan identifies the areas and activities that could produce contaminated runoff at your site and then tells how you will ensure that this contamination is mitigated. For example, in describing your mitigation measures, your site's plan might identify the devices that collect and filter storm water, tell how those devices are to be maintained, and tell how frequently that maintenance is to be carried out. ***You must develop this plan before you complete this NOI.*** This plan must be available for a TCEQ investigator to review on request. Specific requirements for the development of the plan can be found in the *Texas Pollutant Discharge Elimination System Construction General Permit (TXR150000)*.

Estimated Area of Land Disturbed
Provide the approximate number of acres that the construction site will disturb. It is appropriate to enter a value less than 5, only if the project is part of a larger common plan that disturbs five or more acres. If the acreage is less than 1, enter 1. "Disturb" means any clearing, grading, excavating, or other similar activities.

Is the site located on Indian Country Lands?
Check "Yes" only if the site is on a reservation or other areas designated by the federal government as Indian Country Lands. If not, check "No."

Destination of Storm Water Discharge
The storm water from your site eventually reaches a receiving water body such as a local stream or lake, possibly via a drainage ditch. The discharge may initially be into a municipal separate storm sewer system (MS4). Check the appropriate boxes for whether storm water is discharged into an MS4. If you checked "Yes" to "An MS4?", then enter the name of the entity that operates the storm sewer—often a city, town, or utility district, but possibly another form of government.

You must also provide the name of the water body that receives the discharge from the construction site (a local stream or lake). Storm water may be discharged directly to a receiving stream or via a storm sewer system. If known, please include the segment number if the discharge is to a classified water body.

For a map that includes segment numbers, go to:
http://www.tnrcc.state.tx.us/water/quality/data/index.html

D. Contact
Give all the relevant information for the person whom TCEQ can contact if there are questions about any of the information on this form—perhaps the same person who completed the form.

E. Payment Information
Provide the number and account holder name from the check or money order used to pay the $100 application fee.

F. Certification
The operator must sign and date this statement to validate this NOI. Be sure to enter the full legal name of the person signing the form and the relevant title—for example, "Operator," "Vice-President," or "Partner." Use the "Prefix" blank for such titles as Dr., Mr., or Ms., as desired. Use the "Suffix" blank for such designations as Ph.D., Jr., Sr., III, or J.D., if applicable.

For a corporation, the application shall be signed by a responsible corporate officer. A responsible corporate officer means a president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation; or the manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25 million (in second-quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures. Corporate procedures governing authority to sign permit applications may provide for assignment or delegation to applicable corporate positions rather than to specific individuals.

For a partnership or sole proprietorship, the application shall be signed by a general partner or the proprietor, respectively.

For a municipality, state, federal, or other public agency, the application shall be signed by either a principal executive officer or a ranking elected official. For purposes of this application, a principal executive officer of a federal agency includes the chief executive officer of the agency, or a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g. regional administrator of the United States Environmental Protection Agency).

Questions?
If you have questions about any of the information on this form, contact our Storm Water Program at 512/239-4671 or look for "Storm Water" on our Web site:
www.tceq.state.tx.us

ATTACHMENT 2

CONSTRUCTION SITE NOTICE

FOR THE
Texas Commission on Environmental Quality (TCEQ)
Storm Water Program

TPDES GENERAL PERMIT TXR150000

The following information is posted in compliance with **Part II.D.2.** of the TCEQ General Permit Number TXR150000 for discharges of storm water runoff from construction sites. Additional information regarding the TCEQ storm water permit program may be found on the internet at:
www.tnrcc.state.tx.us/permitting/waterperm/wwperm/tpdestorm

Contact Name and Phone Number:	
Project Description: (Physical address or description of the site's location, estimated start date and projected end date, or date that disturbed soils will be stabilized)	
Location of Storm Water Pollution Prevention Plan :	

For Construction Sites Authorized Under Part II.D.2. (Obtaining Authorization to Discharge) the following certification must be completed:

I _____ (Typed or Printed Name Person Completing This Certification) certify under penalty of law that I have read and understand the eligibility requirements for claiming an authorization under Part II.D.2. of TPDES General Permit TXR150000 and agree to comply with the terms of this permit. A storm water pollution prevention plan has been developed and implemented according to permit requirements. A copy of this signed notice is supplied to the operator of the MS4 if discharges enter an MS4 system. I am aware there are significant penalties for providing false information or for conducting unauthorized discharges, including the possibility of fine and imprisonment for knowing violations.

_____ _____
Signature and Title Date

ATTACHMENT 3

TPDES OPERATOR'S INFORMATION

Owner'sNameandAddress: West Harris County Regional Water Authority

Mr. _____

(Authority Official)

_____

(Department)

Contractors' Names and Addresses:

GeneralContractor:

_____

_____

_____

_____

Telephone: _____

Site Superintendent:

_____

_____

_____

Telephone:

Erosion Control and _____

Maintenance Inspection: _____

_____

_____

Telephone: _____

Subcontractors' Names and Addresses:

_____ _____

_____ _____

_____ _____

Phone:_____ Phone: _____

Note: Insert name, address, and telephone number of person orfirms

ATTACHMENT 4

CONTRACTOR'S / SUBCONTRACTOR'S

CERTIFICATION FOR TPDES PERMITTING

I certify under penalty of law that I understand the terms and conditions of TPDES General Permit No. TXR150000 and the Storm Water Pollution Prevention Plan for the construction site identified as part of this certification.

Signature: _____
Name: (printed or typed) _____
Title: _____
Company: _____
Address: _____
Date: _____

Signature: _____
Name: (printed or typed) _____
Title: _____
Company: _____
Address: _____
Date: _____

Signature: _____
Name: (printed or typed) _____
Title: _____
Company: _____
Address: _____
Date: _____

ATTACHMENT 5

EPA NPDES Construction Inspection Form

The following inspection is being performed in compliance with Part IV.D.4. of the NPDES Region 6 Storm Water Construction General Permit [63 Fed. Reg. 36502] and being retained in accordance with Part V of the Permit. Qualified personnel (provided by the permittee or cooperatively by multiple permittees) shall inspect disturbed areas of the construction site that have not been finally stabilized, areas used for storage of materials that are exposed to precipitation, placement and effectiveness of structural control measures, and locations where vehicles enter or exit the site. Inspections shall be performed at least once every 14 days and within 24 hours of the end of a storm event of 0.5 inches or greater. Where sites have been temporarily stabilized, runoff is unlikely due to winter conditions, or during seasonal arid periods in arid areas (0-10 inches of rainfall annually) and semi-arid areas (10-20 inches annually) such inspections shall be conducted at least once every month. This form is primarily intended for use with construction projects in Texas and New Mexico. Permittees on Indian Country lands in Oklahoma, Louisiana and Arkansas and some oil and gas facilities in Oklahoma may use this form if they are eligible for this permit. Other facilities need to check with their NPDES authority before using this form.

If you do not know your NPDES Permit Number, contact the NOI Processing Center at (301)495-4145. This form was prepared as an example and it is not a required form for use with the permit. Alternative forms may be used if they contain all of the required information as set forth in the permit. This form and additional information regarding the NPDES Region 6 storm water program may be found on the Internet at http://www.epa.gov/region6/sw/. Any person with a complaint about the operation of this facility in regards to this permit should contact EPA Region 6 at (214)665-7112.

Permit Number(s) covered by this inspection (e.g. owners, developers, general contractor, builders)		
Signature and Certification in accordance with Part VI.G of the permit:	I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. Signature_____Date_____	
Date of Inspection		
Inspector Name		
Is there a copy of the permit language with the SWPPP?	❒ YES	❒ NO
Is the inspector qualified and are the qualifications documented in the SWPPP?	❒ YES	❒ NO
Is an NPDES storm water construction sign posted at the entrance for all permittees?	❒ YES	❒ NO

You may want to use EPA Region 6 construction checklist to assure components of the SWPPP are complete. This form, the construction sign, and the checklist are available on the Region 6 NPDES Storm Water Forms and Documents web page which may be found on the internet at http://www.epa.gov/earth1r6/6en/w/formsw.htm In addition to the checklist, you should provide a narrative (see next page) on the existing Best Management Practices and Structural Controls found during each inspection. Any problems identified in an inspection should be corrected within 7 days. The inspection should cover all components of the SWPPP and all potential pollutants. While eroded soil is the primary pollutant of concern, do not forget to inspect for other pollutant sources such as fuel tanks, paints, solvents, stabilization materials, concrete hardner, batch plants, and construction debris. The inspector will need to update the SWPPP to reflect findings of the inspection. The site map should be updated after an inspection to show controls that have been added or removed, to ensure the site map is kept current in accordance with Part IV.C. of the permit.

Revision 4, March 1, 2000

ATTACHMENT 5

Narrative Findings of the inspection:

Observations should include any findings of Best Management Practices or controls that are not in accordance with the SWPPP. If a control is not in place or failed, observe the reason why. A control removed temporarily for work is not necessarily a violation if properly recorded in the SWPPP. If it has been removed, record why it was removed and, if applicable, when it will be reinstalled. If the control has failed, observe the conditions so a conclusion may be made as to wether the control failed for improper maintenance or improper design. The qualified inspector will know when a failed control is inadequate and should be replaced by an improved control mechanism. Qualified inspectors are to have authority to make changes to the SWPPP to assure compliance. Controls that have not been installed should be given a reason why they are not installed and/or a scheduled date for installation if they are designed for a later phase of construction. After the inspection, the SWPPP and its site map should be updated to reflect current conditions of controls and Best Management Practices at the time of the inspection. This includes removing uninstalled controls from the site map or otherwise denoting on the site map if they are no longer installed if the controls have been removed because they are no longer necessary (e.g. stabilization has been achieved in that area).

Revision 4, March 1, 2000

ATTACHMENT 6

Notice of Termination (NOT) for Storm Water Discharges Associated with Construction Activity under the TPDES Construction General Permit (TXR150000)

TCEQ Office Use Only
TPDES Permit Number: TXR15|__|__|__|__|__| - NO
GIN Number: __|__ __|__ __|__|__|

For help completing this application, read the TXR150000 NOI Instructions (TCEQ-20023-Instructions).

A. TPDES Permit Number: TXR15_____

B. Construction Site Operator Customer Reference Number: CN _____
Name: _____
Mailing Address: _____
City: _____ State: -- _____ Zip Code: _____
Country Mailing Information (*if outside USA*) Territory: _____ Country Code: _____ Postal Code: _____
Phone Number: _____ Extension: _____ Fax Number: _____
E-mail Address: _____

C. Project / Site Information Regulated Entity Reference Number: RN _____
Name: _____
Physical Address: _____
Location Access Description: _____
City: _____ County: -- _____ Zip Code: _____

D. Contact - If the TCEQ needs additional information regarding this termination, who should be contacted?
Name: _____ Title: _____
Phone Number: _____ Extension: _____ Fax Number: _____
E-mail Address: _____

E. Certification

I certify under penalty of law that authorization under the TPDES Construction General Permit (TXR150000) is no longer necessary based on the provisions of the general permit. I understand that by submitting this Notice of Termination, I am no longer authorized to discharge storm water associated with construction activity under the general permit TXR150000, and that discharging pollutants in storm water associated with construction activity to waters of the U.S. is unlawful under the Clean Water Act where the discharge is not authorized by a TPDES permit. I also understand that the submittal of this Notice of Termination does not release an operator from liability for any violations of this permit or the Clean Water Act.

Construction Site Operator Representative:

Prefix: _____ First: _____ Middle: _____
Last: _____ Suffix: _____
Title: _____

Signature: _____ Date: _____

If you have questions on how to fill out this form or about the storm water program, please contact us at (512) 239-4671. Individuals are entitled to request and review their personal information that the agency gathers on its forms. They may also have any errors in their information corrected. To review such information, contact us at (512) 239-3282.

The completed NOT must be mailed to the following address:

Texas Commission on Environmental Quality
Storm Water & General Permits Team; MC - 228
P.O. Box 13087
Austin, Texas 78711-3087

TCEQ - 20023 (02/03) **Page 1 of 1**

ATTACHMENT 6

Completing the Notice of Termination for Storm Water Discharges Associated with Construction Activity under the TPDES Construction General Permit (TXR150000)

Who May File a Notice of Termination (NOT) Form
Permittees disturbing 5 acres or more (or part of a larger common plan of development or sale disturbing 5 acres or more) who are presently covered under the Texas Pollutant Discharge Elimination System (TPDES) Construction General Permit must submit a Notice of Termination (NOT) when final stabilization has been achieved on all portions of the site that is the responsibility of the permittee; or another permitted operator has assumed control over all areas of the site that have not been finally stabilized and all silt fences and other temporary erosion controls have either been removed, scheduled for removal as defined in the SWP3, or transferred to a new operator if the new operator has sought permit coverage. Erosion controls that are designed to remain in place for an indefinite period, such as mulches and fiber mats, are not required to be removed or scheduled for removal.

Final Stabilization occurs when either of the following conditions are met:

(a) All soil disturbing activities at the site have been completed and a uniform (e.g, evenly distributed, without large bare areas) perennial vegetative cover with a density of 70% of the native background vegetative cover for the area has been established on all unpaved areas and areas not covered by permanent structures, or equivalent permanent stabilization measures (such as the use of riprap, gabions, or goetextiles) have been employed.

(b) For individual lots in a residential construction site by either:

(1) the homebuilder completing final stabilization as specified in condition (a) above; or

(2) the homebuilder establishing temporary stabilization for an individual lot prior to the time of transfer of the ownership of the home to the buyer and after informing the homeowner of the need for, and benefits of, final stabilization.

(c) For construction activities on land used for agricultural purposes (e.g. pipelines across crop or range land), final stabilization may be accomplished by returning the disturbed land to its preconstruction agricultural use. Areas disturbed that were not previously used for agricultural activities, such as buffer strips immediately adjacent to a surface water and areas which are not being returned to their preconstruction agricultural use must meet the final stabilization conditions of condition (a) above.

A. TPDES Permit Number
Provide the TPDES permit number assigned to the operator of the construction site.

B. Construction Site Operator Information
Customer Reference Number
This number designates the operator's status as a TCEQ "customer"—in other words, an individual or business that is involved in an activity that we regulate. We assign each customer a number that begins with "CN," followed by nine digits. ***This is not a permit number, registration number, or license number.*** In the remainder of this section, we will use "this customer" to mean the operator for Part B of the form.

- If this customer has not been assigned a Customer Reference Number, leave the space for the Customer Reference Number blank.
- If this customer has already been assigned this number, enter the operator's Customer Reference Number.
- ***Do not enter a permit number, registration number, or license number in place of the Customer Reference Number.***

Name
Enter the legal name of this customer as authorized to do business in Texas. Include any abbreviations (LLC, Inc., etc.).

Mailing Address
Enter a central and general mailing address for this customer to receive mail from the TCEQ. For example, if this customer is a large company, this address might be the corporate or regional headquarters. On the other hand, for a smaller business, this address could be the same as the site address.

If this is a street address, please follow US Postal Service standards. In brief, these standards require this information in this order:

- the "house" number—for example, the 1401 in 1401 Main St
- if there is a direction before the street name, the one- or two-letter abbreviation of that direction (N, S, E, W, NE, SE, SW, or NW)
- the street name (if a numbered street, do not spell out the number—for example, 6th St, not Sixth St)
- an appropriate abbreviation of the type of street—for example, St, Ave, Blvd, Fwy, Exwy, Hwy, Cr, Ct, Ln
- if there is a direction after the street name, the one- or two-letter abbreviation of that direction (N, S, E, W, NE, SE, SW, or NW)
- if there is a room number, suite number, or company mail code

City, State, *and* ZIP Code
Enter the name of the city, the two-letter USPS abbreviation for the state (for example, TX), and the ZIP Code. (Enter the full ZIP+4 if you know it.)

ATTACHMENT 6

Country Mailing Information
If this address is ***outside*** the United States, enter the territory name, country code, and any non-ZIP mailing codes or other non–U.S. Postal Service features here. If this address is ***inside*** the United States, leave these spaces blank.

Phone Number *and* Extension
This number should correspond to this customer's mailing address given earlier. Enter the area code and phone number here. Leave "Extension" blank if this customer's phone system lacks this feature.

Fax Number
This number should correspond to this customer's mailing address given earlier. Enter the area code and fax number here.

E-mail Address
As with the mailing address, this should be a general address that is appropriate for e-mail to this customer's central or regional headquarters, if applicable.

C. Project / Site Information

Regulated Entity Reference Number
This number designates this site's status as a TCEQ "regulated entity"—in other words, a location where an activity that we regulate occurs. We assign each regulated entity a number that begins with "RN," followed by nine digits. ***This is not a permit number, registration number, or license number.***

- If this site has not been assigned a Regulated Entity Reference Number, leave the space for the Regulated Entity Reference Number blank.
- If this site has already been assigned this number, enter the Regulated Entity Reference Number.
- ***Do not enter a permit number, registration number, or license number in place of the Regulated Entity Reference Number.***

Name
Enter the name by which you want this site to be known to the TCEQ.

Physical Address
Enter the physical address of the site itself. TCEQ staff should be able to use this address to find the site.

Location Description
Enter a physical description of the location of the site based on highway intersections and/or permanent landmarks.

City, County, *and* ZIP Code
Enter the name of the city, the county, and the ZIP Code. (Enter the full ZIP+4 if you know it.)

D. Contact

Give all the relevant information for the person whom TCEQ can contact if there are questions about any of the information on this form—perhaps the same person who completed the form.

E. Certification

The operator must sign and date this statement to validate this NOI. Be sure to enter the full legal name of the person signing the form and the relevant title—for example, "Operator," "Operator's attorney," or "Senior Site Manager." Use the "Prefix" blank for such titles as Dr., Mr., or Ms., as desired. Use the "Suffix" blank for such designations as Ph.D., Jr., Sr., III, or J.D., if applicable.

For a corporation, the application shall be signed by a responsible corporate officer. A responsible corporate officer means a president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation; or the manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25 million (in second-quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures. Corporate procedures governing authority to sign permit applications may provide for assignment or delegation to applicable corporate positions rather than to specific individuals.

For a partnership or sole proprietorship, the application shall be signed by a general partner or the proprietor, respectively.

For a municipality, state, federal, or other public agency, the application shall be signed by either a principal executive officer or a ranking elected official. For purposes of this application, a principal executive officer of a federal agency includes the chief executive officer of the agency, or a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g. regional administrator of the United States Environmental Protection Agency).

Questions?

If you have questions about any of the information on this form, contact our Storm Water Program at 512/239-4671 or look for "Storm Water" on our Web site:

www.tceq.state.tx.us

01 42 20 REFERENCE STANDARDS

1.00 GENERAL

1.01 SECTION INCLUDES

A. Section includes general quality assurance as related to Reference Standards and a list of references.

1.02 QUALITY ASSURANCE

A. For Products or workmanship specified by association, trade, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of issue current on the date as stated in the General Conditions.

C. Request clarification from Engineer before proceeding should specified reference standards conflict with Contract documents.

1.03 SCHEDULE OF REFERENCES

AASHTO	American Association of State Highway and Transportation Officials 444 North Capitol Street, N.W, Suite 249 Washington, DC 20001
ACI	American Concrete Institute 38800 Country Club Drive Farmington Hills, MI 48331-3439
AGC	Associated General Contractors of America 2300 Wilson Blvd, Suite 300 Arlington, VA 22201
AI	Asphalt Institute 2696 Research Park Drive Lexington, KY 40511-8480
AITC	American Institute of Timber Construction 7012 S. Revere Parkway, Suite 140 Centennial, CO 80112

AISC	American Institute of Steel Construction 130 East Randolph Street, Suite 2000 Chicago, Illinois 60601
AISI	American Iron and Steel Institute 25 Massachusetts Ave NW, Suite 800 Washington, DC 20001
ASME	American Society of Mechanical Engineers Two Park Avenue New York, NY 10016-5990
ANSI	American National Standards Institute 1899 L Street, NW, 11th Floor Washington, D.C. 20036
APA	American Plywood Association 7011 S. 19th Street Tacoma, WA 98466-5333
API	American Petroleum Institute 1220 L Street, NW Washington, DC 20005-4070
AREMA	American Railway Engineering and Maintenance of Way Association 4501 Forbes Blvd, Suite 130 Lanham, Maryland 20706
ASTM	American Society for Testing and Materials 100 Barr Harbor Drive, PO Box C700 West Conshohocken, PA 19428-2959
AWPA	American Wood Preservers' Association (or American Wood Protection Association) 100 Chase Park S, Suite 116 Birmingham, AL 35244-1851
AWS	American Welding Society 8669 NW 36 Street, #130 Miami, FL 33166-6672

AWWA	American Water Works Association 6666 West Quincy Avenue Denver, CO 80235
COH	City of Houston 900 Bagby Street Houston, TX 77002
CLFMI	Chain Link Fence Manufacturers Institute 10015 Old Columbia Rd, Suite B215 Columbia, MD 21046
CRSI	Concrete Reinforcing Steel Institute 933 North Plum Grove Road Schaumburg, IL 60173-4758
EJMA	Expansion Joint Manufacturers Association 25 North Broadway Tarrytown, NY 10591
FS	Federal Standardization Documents General Services Administration Specifications Unit (WFSIS) 7th and D Streets, S.W. Washington, DC 20406
ICEA	Insulated Cable Engineer Association P.O. Box 493 Miamitown, OH 45041-9998
IEEE	Institute of Electrical and Electronics Engineers 2001 L St NW Washington, District of Columbia 20036
ISA	International Society of Arboriculture P.O. Box 3129 Champaign, IL 61826-3129
MIL	Military Specifications General Services Administration Specifications Unit (WFSIS)

	7th and D Streets, S.W. Washington, DC 20406
NACE	National Association of Corrosion Engineers 15835 Park 10 Place Houston, TX 77084
NEMA	National Electrical Manufacturers' Association 1300 North 17th Street, Suite 1847 Rosslyn, VA 22209
NFPA	National Fire Protection Association 1 Batterymarch Park Quincy, MA 02169
OSHA	Occupational Safety and Health Administration U.S. Department of Labor 200 Constitution Avenue, NW Room Number N3626, Washington, D.C. 20210
PCA	Portland Cement Association 5420 Old Orchard Road Skokie, IL 60077-1083
PCI	Prestressed Concrete Institute 200 West Adams, Suite 2100 Chicago, IL 60606
SDI	Steel Deck Institute P.O. Box 25 Fox River Grove, IL 60021
SSPC	Society for Protective Coatings (Steel Structures Painting Council) 800 Trumbull Drive Pittsburgh, PA 15205
TAC	Texas Administrative Code Texas Water Resources Conservation Commission 1019 Brazos, Room 245

	Austin, Texas 78701
TxDOT	Texas Department of Transportation 125 East 11th Street Austin, TX 78701-2483
UL	Underwriters' Laboratories, Inc. 333 Pfingsten Road Northbrook, IL 60062
UNI BELL	UNI BELL Pipe Association (PVC Pipe Association) 2711 Lyndon B Johnson Fwy #1000 Dallas, TX 75234

2.00 PRODUCTS NOT USED

3.00 EXECUTION - NOT USED

END OF SECTION

01 45 20 RESIDENT PROJECT REPRESENTATION

1.00 GENERAL

1.01 SECTION INCLUDES

A. Engineer shall furnish a Resident Project Representative (RPR), assistants and other field staff to inspect Contractor's performance of work.

B. Through more extensive on-site inspections of work in progress and field checks of materials and equipment by RPR and assistants, DPOR shall endeavor to provide further protection for Owner against defects and deficiencies in work; but furnishing of such services will not make DPOR responsible for or give DPOR control over construction means, methods, techniques, sequences or procedures or for safety precautions or programs, or responsibility for Contractor's failure to perform work in accordance with contract documents.

C. RPR is Engineer's representative at site. RPR will act as directed by and under supervision of DPOR, and will confer with Engineer regarding RPR's actions.

1.02 DUTIES AND RESPONSIBILITIES OF RPR

A. Schedules: Review progress schedule, schedule of shop drawing submittals and schedule of values prepared by Contractor and consult with DPOR concerning acceptability.

B. Conferences and Meetings: Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences and other project-related meetings, and prepare and circulate copies of minutes thereof.

C. Liaison:

1. Serve as DPOR's liaison with Contractor, working principally through Contractor's superintendent and assist in understanding intent of contract documents; and assist DPOR in serving as Owner's liaison with Contractor when Contractor's operations affect Owner's on-site operations.

2. Assist in obtaining from Owner additional details or information, when required for proper execution of work.

D. Shop Drawings and Samples:

1. Record date of receipt of shop drawings and samples.

2. Receive samples which are furnished at site by Contractor, and notify DPOR of availability of samples for examination.

3. Advise DPOR and Contractor of commencement of any work requiring a shop drawing or sample when submittal has not been approved by DPOR.

E. Review of Work, Rejection of Defective Work, Inspection and Tests:

1. RPR will conduct on-site observations of work in progress to assist DPOR in determining when work is in general proceeding in accordance with contract documents.

2. RPR will report to DPOR whenever RPR believes that any work is unsatisfactory, faulty, damaged, defective or does not conform to contract documents. RPR will advise DPOR of work that RPR believes should be corrected, rejected, uncovered for observation, or requires special testing, inspection or approval.

3. RPR will verify that tests, equipment and system startups and operating and maintenance training are conducted in presence of appropriate personnel, and that Contractor maintains adequate records. Observe, record and report to DPOR appropriate details relative to test procedures and startups.

4. RPR will accompany visiting inspectors representing public or other agencies having jurisdiction over project, record results of these inspections and report to DPOR.

F. Interpretation of Contract Documents: RPR will report to DPOR when clarifications and interpretations of contract documents are needed and transmit to Contractor clarifications and interpretations as issued by DPOR.

G. Modifications: RPR will consider and evaluate Contractor's suggestions for modifications in drawings or specifications and report with recommendations to DPOR. RPR will transmit to Contractor decisions issued by DPOR.

H. Records:

1. RPR will maintain at job site orderly files for correspondence, reports of job conferences, shop drawings and samples, reproductions of original contract documents including all work directive changes, addenda, change orders, field orders, additional drawings issued subsequent to execution of contract, DPOR's clarifications and interpretations of contract documents, progress reports, and other project related documents.

2. RPR will keep a daily log, record Contractor hours on job site, amount of work completed, weather conditions, data relative to questions of work directive changes, change orders or changed conditions, list of job site visitors, daily activities, decisions, observations in general, and specific observations in more detail as in case of observing test procedures; and send copies to DPOR.

3. RPR will record names, addresses and telephone numbers of all contractors, subcontractors and major suppliers of materials and equipment.

I. Reports:

1. RPR will furnish DPOR periodic reports as required of progress of work and of Contractor's compliance with progress schedule, schedule of shop drawing and sample submittals.

2. RPR will consult with DPOR in advance of scheduled major tests, inspections or start of important phases of work.

3. RPR will draft proposed change orders and work directive changes, obtaining backup material from Contractor and recommend to DPOR change orders, work directive changes and field orders.

4. RPR will report immediately to DPOR and Owner upon occurrence of any accident.

J. Payment Requests: RPR will review applications for payment with Contractor for compliance with established procedure for their submission and forward with recommendations to DPOR, noting particularly the relationship of payment requested to schedule of values, work completed and materials and equipment delivered at site but not incorporated in work.

K. Certificates, Maintenance and Operation Manuals: During course of work, verify that certificates, maintenance and operation manuals and other data required to be assembled and furnished by Contractor are applicable to items actually installed and in accordance with contract documents, and have this material delivered to DPOR for review and forwarding to Owner prior to final payment for work.

L. Completion:

1. Before DPOR issues a Certificate of Substantial Completion, RPR will submit to Contractor a list of observed items requiring completion or correction.

2. RPR will conduct final inspection in company of DPOR, Owner and Contractor and prepare a final list of items to be completed or corrected.

3. RPR will observe that all items on final list have been completed or corrected and make recommendations to DPOR concerning acceptance.

1.03 LIMITATIONS OF AUTHORITY

A. Resident Project Representative:

1. Shall not authorize any deviation from contract documents or substitution of materials or equipment, unless authorized by DPOR.

2. Shall not exceed limitations of DPOR's authority as set forth in contract documents.

3. Shall not undertake any of responsibilities of Contractor, subcontractors or Contractor's superintendent.

4. Shall not advise on, issue directions relative to or assume control over any aspect of means, methods, techniques, sequences or procedures of construction unless such advice or directions are specifically required by contract documents.

5. Shall not advise on, issue directions regarding or assume control over safety precautions and programs in connection with work.

6. Shall not accept shop drawing or sample submittals from anyone other than Contractor.

7. Shall not authorize Owner to occupy project in whole or in part.

8. Shall participate in specialized field or laboratory tests or inspections conducted by others as specifically authorized by DPOR.

1.04 DEFINITIONS

A. Working Day: Resident Project Representative assistants and other field staff to assist DPOR are not required to work on Sundays or legal holidays. When Contractor is permitted to work on Sunday or legal holiday, prior arrangements shall be made for RPR not later than 2:00 p.m. on fourth working day prior to Sunday or legal holiday.

B. Uninspected Work: Any work performed on Sunday or legal holiday without benefit of RPR may require removal and replacement if so directed by the Inspector (an RPR). Removal and replacement shall be completed at no additional cost.

1.05 NOTICE OF NONCONFORMANCE

A. If, during the course of this project, Contractor does not comply with Contract Documents, the following procedure may be initiated by Engineer.

1. Notify Contractor in writing of areas of nonconformance. Immediate compliance will be required unless otherwise approved by Engineer.

2. Failure to come into compliance, will result in removal of Resident Project Representative (RPR) from site. NO PAYMENT WILL BE MADE FOR WORK PERFORMED WITHOUT RESIDENT PROJECT REPRESENTATIVE ON SITE AND NO SCHEDULE OR COST CHANGES WILL BE GRANTED.

3. Engineer will direct RPR to return to site when compliance with Contract Documents is attained and written assurances provided from principal of firm that actions which lead to nonconforming work will not occur again.

2.00 PRODUCTS - NOT USED

3.00 EXECUTION - NOT USED

END OF SECTION

01 50 20 MOBILIZATION

1.00 GENERAL

1.01 SECTION INCLUDES

A. Mobilization of construction equipment and facilities onto the site.

1.02 MEASUREMENT AND PAYMENT

A. Unit Price Contracts. If Contract is Unit Price Contract, measurement for mobilization is on a lump sum basis.

B. Stipulated Price (Lump Sum) Contract. If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

C. Mobilization payments will be included in monthly payment estimates upon written application by Contractor subject to the following provisions:

1. Authorization for payment of 50 percent of that portion of Contract Price designated for mobilization will be made upon receipt and approval by Engineer of the following items, as applicable:

a. Schedule of Values (Section 01 29 20).

b. Pre-Construction site assessment, Construction Photographs or Videos (Section 01 32 10), as required.

c. Construction Schedule and Billing Forecast (Section 01 32 50 as applicable).

d. Submittal Schedule (Section 01 33 00).

e. Site specific Storm Water Pollution Prevention Plan (SWPPP) and Notice of Intent (NOI) along with storm water application fee (Section 01 41 00), if required.

f. Contractor's Quality Control Plan (Section 01 40 00), if required.

g. Establishment of a Field Office for Engineer meeting requirements of Section 01 52 00 - Temporary Field Office.

h. Traffic Control Plan (Section 01 55 50), if required.

i. Plan for Control of Ground and Surface Water (Section 01 57 80), if required.

j. Project Signs Submittal.

k. Trench Safety Program (Section 31 23 33.14), if required.

l. Dewatering plan, when required.

2. Authorization for payment of the balance of that portion of Contract Price designated for mobilization will be made upon completion of the Work amounting to five percent of Original Contract Price. The amount of Contract Price designated for mobilization may not be applied in computing whether or not five percent of the Original Contract Price has been obtained.

3. Mobilization payments will be subject to retainage amounts stipulated in Document 00700 – General Conditions.

D. De-Mobilization/Re-Mobilization for project delaying items are included in the bid items for each of the Levels identified in this Section. Authorization for payment of 50 percent of that portion will be made after completely demobilizing from the site including, but not limited to securing the site, temporary restoration, and removal of construction equipment, personnel and construction materials. Authorization for payment of the remaining cost will be made after all construction equipment and materials are transported back to the construction site. Payment for the above will only be granted once and must be approved by Engineer.

1.03 DE-MOBILIZATION AND RE-MOBILIZATION:

A. De-Mobilization/Re-Mobilization to be used at the direction of the Engineer. Contractor shall discontinue Work and return at a later date to complete the Work. Contract Time will be suspended during the demobilized period, or additional time may be added to the Contract for the demobilized period, including time to temporarily restore the site, remove equipment, and to re-mobilize. Some Unit Price Items, identified in Document 00410, may have to be repeated (e.g. Groundwater Control). These repeated work items shall be paid under their respective Unit Price Items the appropriate number of times the Work is performed. Contractor shall notify the Engineer which items are anticipated to be repeated upon notice of de-mobilization and work conscientiously to minimize the repeated work.

Payment also includes the effort to Re-mobilize, as directed by Engineer, following the demobilized period of time. All equipment and materials, including traffic control, should be returned to the site and temporary restoration measures shall be removed.

2.00 PRODUCTS - NOT USED

3.00 EXECUTION - NOT USED

END OF SECTION

01 50 40 TEMPORARY FACILITIES AND CONTROLS

1.00 GENERAL

1.01 SECTION INCLUDES

A. Temporary facilities and necessary controls for the Project, including utilities, telephone, sanitary facilities, storage sheds and building, safety requirements, first aid equipment, fire protection, security measures, protection of the Work and property, access roads and parking, environmental controls, pest and rodent control and disposal of trash, debris and excavated material.

B. Facilities and controls specified in this section are considered minimum for the Project. Provide additional facilities and controls for proper execution of the Work and to meet Contractor's responsibilities for protection of persons and property.

1.02 MEASUREMENT AND PAYMENT

A. UNIT PRICES

1. No separate payment will be made for any temporary facilities and controls required under this section. Include cost of such work in contract price listed for mobilization.

1.03 CONTRACTOR'S RESPONSIBILITY

A. Comply with applicable requirements specified in other sections of Specifications.

1. Maintain and operate temporary facilities and systems to assure continuous service.

2. Modify and extend systems as the Work progress requires.

3. Completely remove temporary materials and equipment when no longer required.

4. Restore existing facilities used for temporary services to specified or original condition.

2.00 PRODUCTS - NOT USED

3.00 EXECUTION

3.01 TEMPORARY UTILITIES

A. Obtaining Temporary Service:

1. Make arrangements with utility service companies for temporary services.

2. Abide by rules and regulations of the utility service companies or authorities having jurisdiction.

3. Be responsible for utility service costs until Date of Substantial Completion. Included are fuel, power, light, heat, and other utility services necessary for execution, completion, testing, and initial operation of work.

B. Water:

1. Provide water required for and in connection with work to be performed and for specified tests of piping, equipment, devices, or for other use as required for proper completion of the Work.

2. Provide and maintain an adequate supply of potable water for domestic consumption by Contractor personnel, Engineer and representatives of the Authority.

C. Electricity and lighting:

1. Provide electric power service required for the Work including required testing, lighting, operation of equipment, and other Contractor use.

2. Electric power service includes temporary power or generators required to maintain plant operations during scheduled shutdowns.

3. Minimum lighting level shall be 10 foot-candles for open areas; 20-foot-candles for stairs and shops. Provide a minimum of one 300-watt lamp for each 200 square feet of work area.

D. Temporary Heat and Ventilation:

1. Provide temporary heat necessary for protection or completion of the Work.

2. Provide temporary heat and ventilation to assure safe working conditions; maintain enclosed areas at a minimum of 50 degrees F.

E. Telephone:

1. Provide emergency telephone service at Project site for use by Contractor personnel and others performing work or furnishing services at the site.

2. Provide Houston-Metro lines, allowing unlimited calls, without charge in Greater Houston Metropolitan area with "call waiting" and "call forwarding" options. Provide one telephone answering machine with beeperless remote message retrieval capability.

F. Sanitary Facilities:

1. Provide and maintain sanitary facilities for persons on the site; comply with regulations of State and local departments of health.

2. Enforce use of sanitary facilities by construction personnel at site. Enclose sanitary facilities. Pit-type toilets are not permitted. No discharge will be allowed from these facilities. Collect and store sewage and waste so as not to cause nuisance or health problems. Haul sewage and waste off-site and properly dispose in accordance with applicable regulations.

3. Locate toilets near the Work site and secluded from view insofar as possible. Keep toilets clean and supplied throughout the course of the Work.

3.02 STORAGE SHEDS AND BUILDINGS

A. Provide adequately ventilated, watertight storage facilities with floor above ground level for Products susceptible to weather damage.

B. Storage of Products not susceptible to weather damage may be on blocks off the ground.

C. Store Products in a neat and orderly manner. Place Products to permit easy access for identification, inspection and inventory.

D. Fill and grade site for temporary structures to provide drainage away from temporary and existing buildings.

3.03 SAFETY REQUIREMENTS

A. Submit a safety program at the pre-construction meeting and follow the program in accordance with Document 00700 – General Conditions. Include documented response to trench safety requirements of Section 31 23 33.14 - Trench Safety System.

B. Conduct operations in strict accordance with applicable Federal, State and local safety codes and statutes and with good construction practice. Establish and maintain procedures for safety of all work, personnel and equipment involved in the Work.

C. Observe and comply with Texas Occupational Safety Act (Art. 5182a, V.C.S.) and with all safety and health standards promulgated by Secretary of Labor under Section 107 of Contract Work Hours and Standards Act, published in 29 CFR Part 1926 and adopted by Secretary of Labor as occupational safety and health standards under Williams-Steiger Occupational Safety and Health Act of 1970, and to other legislation enacted for safety and health of Contractor employees. Safety and health standards apply to Subcontractors and Suppliers as well as to the Contractor.

D. Observance of and compliance with safety regulations is Contractor’s responsibility without reliance or superintendence of or direction by Engineer. Immediately advise Engineer of investigation or inspection by Federal Safety and Health inspectors of Contractor’s or Subcontractor's work or place of work on site under the Contract, and after investigation or

inspection, advise Engineer of results. Submit one copy of accident reports to Engineer within 10 days of occurrence.

E. Protect areas occupied by workmen using the best available devices for detection of lethal and combustible gases. Test devices frequently to assure functional capability. Constantly observe infiltration of liquids into the Work area for visual or odor evidence of contamination, and immediately take appropriate steps to seal off entry of contaminated liquids to the Work area.

F. Implement safety measures, including but not limited to safety personnel, first-aid equipment, ventilating equipment and other safety equipment specified or detailed on Drawings.

G. Maintain required coordination with Authority, Police, and Fire Departments during entire period covered by the Contract.

H. Include Project safety analysis in safety plan. Itemize major tasks and potential safety hazards. Plan to eliminate hazards or protect workers and public from each hazard.

3.04 FIRST AID EQUIPMENT

A. Provide a first aid kit throughout the construction period. List telephone numbers for physicians, hospitals, and ambulance services in each first aid kit.

B. Have at least one person thoroughly trained in first aid and CPR procedures present on the site when work is in progress. Contractor to conform to protocols and requirements for training and protection against “blood borne pathogens”.

3.05 FIRE PROTECTION

A. Conform to specified fire protection and prevention requirements established by Federal, State, or local governmental agencies and as provided in Safety Program.

3.06 SECURITY MEASURES

A. Protect the Work, materials, equipment, and property from loss, theft, damage, or vandalism. Protect Authority property used in performance of the Contract.

B. If existing fencing or barriers are breached or removed for purposes of construction, provide and maintain temporary security fencing equal to existing.

3.07 PROTECTION OF UTILITIES AND PIPELINES

A. Prevent damage to existing public utilities during construction. Approximate locations of known utilities are shown on Drawings, but all lines may not be shown. Excavate with caution and repair lines damaged by construction operations.

B. Use the Utility Coordinating Committee One Call System, telephone number, (713) 223-4567, which must be called 48 hours in advance. The toll-free telephone number is 1-800-669-8344, Texas One Call System.

C. Before excavating, locate underground utilities by appropriate means including the use of metal detection equipment, and probes, or by excavation or surveys. Repair damage caused by investigative work and by failure to locate or to preserve underground utilities.

D. Give utility owners a minimum five-day notice before commencing excavation to allow time to locate utilities and make adjustments or relocations when they conflict with the Work. Include cost for temporary relocation of water, wastewater, and storm drainage lines, necessary to accommodate construction, in unit prices for utility construction unless otherwise noted. Bypassing of sanitary waste to storm drainage facilities is not allowed.

E. Prior to excavation near pipelines, request a representative of the pipeline company to meet with Contractor and Engineer at the site to discuss procedures to be used. Request pipeline company's representative to locate the pipelines in at least three locations: at each side and at centerline of proposed excavation of proposed utility. Also request representative and Engineer to be present to observe Contractor operations when excavation is conducted within 15 feet of pipeline.

F. Utility service lines are not shown on the construction document drawings. Contractor should anticipate that such service lines exit and should exercise extreme caution during construction. The utility service lines should be repaired and restored immediately as per the specification, if damaged due to any construction activities. No separate payment will be made for this repair and restoration work. Include payment in unit price for work in appropriate sections.

G. Prior to abandonment of utility, make appropriate arrangements with Authority and owner of utility to terminate service, remove meters, transformers, and poles as may be required by site conditions.

3.08 PROTECTION OF THE WORK AND PROPERTY

A. Preventive Actions

1. Take necessary precautions and actions to prevent damage, injury, or loss to the Work or public and private property, including:

a. Storage of apparatus, supplies, and Products in an orderly, safe manner to limit interference with progress of the Work or work of other contractors, utility service companies, or the Authority's operations.

b. Suitable storage for Products subject to damage by exposure to weather, theft, breakage, etc.

c. Limitation of loading pressures imposed upon portions of the Work.

d. Frequent cleanup of refuse, scrap materials, and debris from construction operations, necessary to maintain the site in a safe and orderly condition.

e. Provision of barricades and guard rails to protect pedestrian and traffic around openings, scaffolding, temporary stairs and ramps, excavations, elevated walkways, and other hazardous areas.

2. Protect public and private property adjacent to the site. Obtain written consent before entering or occupying privately-owned land except on easements provided for construction. Restore property damaged by construction operations to condition equal to or better than that existing before the damage.

B. Barricades and Warning Systems

1. Where work is performed on or adjacent to roadways, rights-of-ways, or public land, provide barricades, fences, lights, warning signs, danger signals, and other precautionary measures necessary for protection of persons or property and for protection of the Work.

a. Erect sufficient barricades to keep vehicles and pedestrians from entering the Work. Paint barricades to be visible at night.

1). From sunset to sunrise, provide at least one light at each barricade.

b. Maintain barricades, signs, lights, and provide watchmen until Engineer approves removal. Whenever work creates encroachment onto public roadways, station flagmen to manage traffic flow in accordance with approved traffic control plan.

c. Conform to requirements of section 01 55 50 – Traffic Control and regulation.

C. Protection of Existing Structures

1. Underground Facilities

a. Known Underground Facilities are shown on the Drawings but all Facilities may not be shown. Explore sufficiently ahead of trenching and excavation work to locate Underground Facilities in order to prevent damage to them and to prevent interruption of utility services. Restore damage to Underground Facilities to original condition at no additional cost to the Authority.

b. If necessary to avoid unanticipated Underground Facilities, Engineer may make changes in location of the Work.

c. If permanent relocation of an Underground Facility is required and not provided for in the Contract documents, DPOR will direct Contractor in writing to perform the Work under Modification provisions in Document 00700 - General Conditions.

2. Surface Structures include buildings, tanks, walls, bridges, roads, dams, channels, open drainage, piping, poles, wires, posts, signs, markers, curbs, walks, guard cables, fencing, and other facilities that are visible above the ground level.

3. Protection of Underground Facilities and Surface Structures:

a. Support in place and protect Underground Facilities and

1). Surface Structures located within or adjacent to the limits of the Work from damage. Install supports as required by the owner of the structure. Satisfy Engineer that the owner of the facility or structure has approved methods and procedures before installing structure supports.

b. Avoid moving or changing public utility or private corporation property without prior written consent of a responsible official of the facility or structure. Allow representatives of utilities to enter the construction site for maintenance and repair purposes or to make necessary changes.

c. Notify utility and pipeline owners and operators of the nature of construction operations and dates when operations will be performed. When construction operations are required in immediate vicinity of existing structures, pipelines, or utilities, give a minimum of five working days advance notice. Probe and flag location of Underground Facilities prior to commencement of excavation. Keep flags in place until construction operations uncover the facility.

d. Assume risk for damages and expenses to Underground Facilities and Surface Structures within or adjacent to the Work.

D. Employ a structural engineer to ensure protection measures are adequate for the safety and integrity of structures and facilities.

E. Protection of Installed Products:

1. Provide protection of Installed Products to prevent damage from subsequent operations. Remove protection facilities when no longer needed, prior to completion of the Work.

2. Control traffic to prevent damage to Products and surfaces.

3. Provide coverings to protect Products from damage. Cover projections, wall corners, jambs, sills, and exposed sides of openings in areas used for traffic and passage of materials in subsequent work.

3.09 ROADS AND PARKING

A. Prevent interference with traffic and operations of the Authority on existing roads.

B. Designate temporary parking areas to accommodate construction and Authority personnel. When site space is not adequate, provide additional off-site parking. Locate as approved by Engineer.

C. Minimize use by construction traffic on existing streets and driveways.

D. Do not allow heavy vehicles or construction equipment in existing parking areas.

3.10 ENVIRONMENTAL CONTROLS

A. Use methods, equipment, and temporary construction necessary for control of environmental conditions at the site and adjacent areas.

B. Comply with statutes, regulations, and ordinances relating to prevention of environmental pollution and preservation of natural resources including National Environmental Policy Act of 1969, PL 91-190, Executive Order 11514.

C. Minimize impact to the surrounding environment. Do not use construction procedures that cause unnecessary excavation and filling of terrain, indiscriminate destruction of vegetation, air or stream pollution, or harassment or destruction of wildlife.

D. Limit disturbed areas to boundaries established by the Contract. Do not pollute on-site streams, sewers, wells, or other water sources.

E. Do not burn rubbish, debris or waste materials.

3.11 POLLUTION CONTROL

A. Provide methods, means, and facilities necessary to prevent contamination of soil, water or the atmosphere by discharge of Pollutants from construction operations.

B. Provide equipment and personnel to perform emergency measures to contain spillage, and to remove contaminated soils or liquids. Excavate and dispose of contaminated earth off-site in accordance with laws and regulations, and replace with suitable compacted fill and topsoil.

C. Provide systems necessary for control of Pollutants.

1. Prevent toxic concentrations of chemicals.

2. Prevent harmful dispersal of Pollutants into the environment.

D. Use equipment that conforms to current Federal, State, and local laws and regulations.

3.12 PEST AND RODENT CONTROL

A. Provide rodent and pest control as necessary to prevent infestation of construction or storage areas.

B. Employ methods and use materials that will not adversely affect conditions at site or on adjoining properties.

3.13 NOISE CONTROL

A. Provide vehicles, equipment, and use construction activities that minimize noise to the greatest degree practicable. Conform to noise levels of Chapter 30 –Noise and Sound Level Regulation, City Code of Ordinances, and latest OSHA standards. Do not permit noise levels to interfere with the Work or create a nuisance to surrounding areas.

B. Conduct construction operations during daylight hours except as approved by Engineer.

C. Select construction equipment that operates with minimum noise and vibration. When directed by Engineer, correct objectionable noise or vibration produced by operation of equipment at no additional cost to the Authority. Sound Power Level (PWL) of equipment shall not exceed 85 dbA (re: 10-12 watts) measured five feet from the equipment, or at a lower level if prescribed by City Ordinances. Equipment noise requirements are contained in equipment specifications.

3.14 DUST CONTROL

A. Use water or other methods approved by Engineer to control amount of dust generated by vehicle and equipment operations.

3.15 WATER RUNOFF AND EROSION CONTROL

A. Comply with requirements of section 01 41 00 – TPDES Requirements.

B. Conduct fill, grading and ditching operations and provide adequate methods necessary to control surface water, runoff, subsurface water, and water from excavations and structures in order to prevent damage to the Work, the site, or adjoining properties.

1. Plan and execute construction and earthwork by methods that control surface drainage from cuts and fills, and from borrow and waste disposal areas.

2. Minimize area of bare soil exposed at one time.

3. Provide temporary control measures, such as berms, dikes, and drains.

4. Provide, operate, and maintain equipment and facilities of adequate size to control surface water.

5. Construct fill and waste areas by selective placement of materials to eliminate erosion of surface silts or clays that may erode.

6. Direct water away from excavations, pits, tunnels, and other construction areas to prevent erosion, sedimentation or damage.

7. Maintain existing drainage patterns adjacent to the site by constructing temporary earth berms, sedimentation basins, retaining areas, and temporary ground cover.

8. Dispose of drainage water in a manner to prevent flooding, erosion, or other damage to the site or adjoining areas, in conformance with environmental requirements.

9. Inspect earthwork periodically to detect any evidence of erosion. Take corrective measures as required to control erosion.

END OF SECTION

01 50 60 DIVERSION PUMPING

1.00 GENERAL

1.01 DEFINITIONS

A. Diversion-pumping: Installation and operation of bulkheads, plugs, hoses, piping, and pumps required to maintain sewer flow and prevent backups and overflows.

1.02 SYSTEM DESCRIPTION

A. Provides continuous sewer service to users of sewer systems while maintenance or construction operations are in progress, by diverting flow around construction locations. Maintain sewer flow to prevent backup or overflow onto streets, yards and unpaved areas or into buildings, adjacent ditches, storm sewers, and waterways. Do not divert sewage outside of sanitary sewer system.

B. When pumps are operating, have an experienced operator on site to monitor operation, adjust pumps, make minor repairs to system, and report problems.

1.03 SUBMITTALS

A. Conform to requirements of Section 01 33 00 - Submittals Procedures.

B. For systems that bypass sanitary sewer line segments of 42-inch diameter or larger, submit a Diversion Pumping Plan prior to installation. Show location, number and size of pumps, number, location, size and type of hoses or rigid piping, and location of downstream discharge; and special features where pipes or hoses cross roadways, temporary trenches, support bridges.

1.04 SCHEDULING

A. When the Authority operates or maintains diversion pumping in construction areas, coordinate construction activities with Engineer.

B. Cease operation of diversion pumping when approved by Engineer.

1.05 MEASUREMENT AND PAYMENT

A. No separate payment will be made for diversion pumping, unless noted on bid form, including bulkheads, plugs, piping, and pumping equipment, required for replacement of existing sanitary sewers.

2.00 PRODUCTS

2.01 MATERIALS

A. Design piping, joints and accessories to withstand at least twice maximum system pressure or 50 psi, whichever is greater.

B. Use self-priming type or submersible electric pumps, with a working pressure gauge on the discharge. Pumps shall meet requirements of City of Houston Noise and Sound Level Regulations.

3.00 EXECUTION

3.01 FIELD QUALITY CONTROL

A. During diversion pumping, do not allow sewage to leak, dump, or spill into or onto areas outside of existing sanitary sewer systems.

B. In the event of an accidental spill or overflow, immediately stop discharge and take action to clean up and disinfect spill. Promptly notify Engineer so required reporting can be made to the Texas Commission on Environmental Quality (TCEQ) and the Environmental Protection Agency (EPA).

3.02 CLEANING

A. When diversion-pumping operations are complete, drain sewage within piping into sanitary sewers prior to disassembly.

END OF SECTION

01 52 00 TEMPORARY FIELD OFFICE

1.00 GENERAL

1.01 SECTION INCLUDES

A. Temporary field office building and associated parking area.

1.02 FACILITY DESCRIPTION

A. Temporary field office to be utilized by authorized representatives of the Authority to coordinate and monitor daily construction activities performed by Contractor.

B. Field office shall be a non-smoking facility.

2.00 PRODUCTS

2.01 FIELD OFFICE

A. General:

1. Locate office in vicinity of the Work at a location approved by Engineer or where indicated on Drawings.

2. Furnish, Install and maintain field office for exclusive use of authorized representatives of the Authority. Provide sufficient room for Project meetings and RPR's office. Provide 2 trailers with minimum area of 360 square feet per trailer.

3. Provide office within 10 days of Date of Commencement of the Work.

4. Construct six all-weather, hard surfaced parking spaces for exclusive use of authorized representatives of the Authority. Provide all-weather surfaced walk between parking spaces and field office.

B. Minimum Construction:

1. Structurally sound foundation and superstructure.

2. Weather tight with insulated roof, walls and 7-foot ceiling (minimum).

3. Stairs or walkway with handrail and covered entrance platform (minimum 4 feet by 4 feet) with mud scraper at door.

4. Resilient floor covering.

5. Screened windows with area equal to approximately 10 percent of floor area sufficient for light, view of the site, and ventilation. Provide each window with operable sash and burglar bars.

6. Secure exterior doors with dead-bolt cylinder locks and burglar bars.

C. Minimum Services: (per provided trailer)

1. Exterior entrance light.
2. Interior lighting of 75 foot-candles minimum at desktop height
3. Automatic heating to maintain 65 degrees F in winter.
4. Automatic cooling to maintain 75 degrees F in summer.
5. Electric power service.
6. One telephone service line for voice for exclusive use of authorized representatives of the Authority.
7. Sanitary facilities in field office with one water closet, one lavatory, and one medicine cabinet for exclusive use of authorized representatives of the Authority.
8. Internet access with wireless internet capabilities. Provide service with minimum download speed of 25 megabits per second (Mbps) or greater.

D. Minimum Furnishings: (per provided trailer)

1. One 5-drawer desk
2. Two swivel desk chairs with casters.
3. One plan table.
4. One drawing plan rack.
5. One 4-drawer legal file cabinet complete with fifty legal-size hanging folders and two full-sized carriers.
6. One marker board with cleaner and markers.
7. Two waste baskets.
8. One 30-inch by 36-inch tack board.
9. One all-purpose fire extinguisher.
10. Six protective helmets (hard hats) with ratchet adjustment for exclusive use of authorized representatives of the Authority.
11. Conference table and chairs to accommodate 10 persons.

12. All in one wireless printer, copier, scanner, including capability to scan 8.5-inch x 14-inch and 11-inch x 17-inch documents.

13. Telephone with speaker-phone/conference call capabilities

14. Refrigerator with minimum capacity of 4 cubic feet.

15. Water dispenser or adequate supply of water bottles for WHCRWA on-site staff.

E. Provide adequate space for one set of Contract documents for ready reference.

3.00 EXECUTION

3.01 MAINTENANCE

A. Maintain all-weather surface driveway and parking areas, buildings, walkways, stairs and required furnishings and equipment for duration of the Contract.

B. Provide janitorial services for duration of the Contract consisting of twice weekly sweeping and mopping floors, trash removal, weekly restroom cleaning, and weekly dusting of furniture and equipment.

C. Provide soap, paper towels, toilet paper, cleansers, printer paper, printer ink, and other necessary consumables.

D. Immediately repair damage, leaks or defective service.

3.02 PROJECT CLOSEOUT

A. Remove temporary field office and signs and restore site as specified in Section 01770 - Closeout Procedures.

END OF SECTION

01 55 40 TRAFFIC CONTROL AND STREET SIGNS

1.00 GENERAL

1.01 SECTION INCLUDES

A. Materials, hardware and installation of Traffic Signs.

1.02 SUBMITTALS

A. Contractor shall submit a list of intended suppliers and products to be used for all signs, posts, and associated hardware. Authority reserves the right to request actual product samples prior to approval.

1.03 MEASUREMENT AND PAYMENT

A. Signs installed or replaced will be measured by each sign. Signs refurbished will be measured by each sign.

B. Payment for installation of traffic signs will be on the basis of each sign installed.

C. The price is full compensation for furnishing and installing new signs and hardware. Cost of associated posts, footings, and miscellaneous mounting hardware will not be paid for directly but is to be included in the unit price bid for installation of each traffic sign.

D. Non-standard signs installed or replaced will be measured by the square foot of the sign face. Non-standard signs shall not be installed without prior approval from the Authority.

2.00 PRODUCTS

2.01 MATERIALS

A. The following ASTM Standards and documents, of the issue in effect on the date of Invitation for Bid, form a part of this specification to the extent herein.

1. ASTM B 209 Specification for Aluminum and Aluminum Alloy Sheet and Plate
2. ASTM D 523 Standard Method for Test for Specular Gloss
3. ASTM D 4956 Standard Specification for Retroreflective Sheeting for Traffic Control
4. ASTM E 284 Standard Definition of Terms Relating to Appearance of Materials
5. ASTM E 308 Computing the Colors of Objects by Using the CIE System
6. ASTM E 810 Standard Test Method for Coefficient of Retroreflection of Retroreflective Sheeting

7. ASTM E 1164 Standard Practice for Obtaining Spectrophotometric Data for Object-Color Evaluation

B. Substrate (Sign Blanks). This shall be aluminum alloy 5052-H38 and otherwise in conformance with ASTM B-209 and have gold chromate finish. The size, shape and thickness of the sign blanks are as indicated on the standard detail sheet in the plans or as specified by the Design Professional of Record.

1. Metal working. The aluminum shall be free of burrs and pits on both sides, including edges and holes, and shall be made ready for applications of the sheeting.

2. Surface Preparation. The aluminum shall be thoroughly cleaned and degreased with solvent and alkaline emulsions cleaner by immersion, spray, or vapor degreasing and dried prior to application of the gold chromate sheeting coat. The aluminum shall be new and corrosion-free with holes drilled or punched, corners rounded to the radii shown in the standard detail sheet, and all edges smoothed prior to application of sheeting. The heavy or medium chromate coating shall conform in color and corrosion resistance to that imparted by the Alodine 1200F treatment.

3. Size. The dimensions of substrate applications for regulatory, warning, and guide signs shall be as specified by the Design Professional of Record and as shown on the plans.

C. Sign Face (Background, Legends, Symbols, and Colors). These shall be in accordance with the Standard Highway Sign Designs (SHSD) for Texas and with the Texas Manual of Uniform Traffic Control Devices (TMUTCD).

1. The sign face, made of electronic film and retro-reflective sheeting shall comply with the appearance, specification, and good workmanship designated by the using agency for sign faces constructed of screen processed retro-reflective sheeting of the same type.

2. All sign blanks shall be covered with appropriate retro-reflective sheeting.

a. All ground mounted stop signs, warning signs, and other regulatory signs, shall use at a minimum High Intensity Prismatic Reflective Sheeting.

b. All overhead signs shall use Diamond Grade Reflective Sheeting.

c. All other signs shall use Super Engineer Grade Sheeting

3. Application Methods. The method of application of sheeting, letters, numbers, and symbols shall be precisely as prescribed in writing by the manufacturer.

a. Legend Spacing and Layout. Spacing and layout for all traffic control signs shall conform to the SHSD.

b. Tolerance for Horizontal Alignment. Letters, numerals, and symbols shall be horizontally aligned to a tolerance of 1/16 inch.

c. Tolerance for Vertical Alignment. Letters, numerals, and symbols shall be vertically aligned to a tolerance of 1/16 on each letter in each line.

D. Sign Posts. Steel post shall conform to the standard specification for hot rolled carbon sheet steel, structural quality, ASTM designation A570, Grade 50. Average minimum yield strength after cold forming is 60,000 psi. The cross section of the post shall be square tube formed steel, carefully rolled to size and shall be welded directly in the corner by high frequency resistance welding or equivalent process and externally scarified to agree with corner radii. Sign posts shall be hot dipped galvanized conforming to ASTM A653, G90.

1. Installation. The square end of the post shall not be modified or pointed.

a. Flange. When sign post installation is required over building basements, bridges and cavities, a galvanized cast iron pipe flange shall be used. The base shall be 8 inches in diameter with six 5/16 inch holes drilled equidistant around the circumference, ⅝ inch from the outer edge. The neck of the flange shall be 3inches in diameter, drilled and threaded to receive a 2 inch diameter galvanized post.

b. Hardware. All ground mounted signs shall be attached to posts using 5/16” nut and bolt assembly, the bolt being 2 ½” in length. Stainless steel banding material, brackets and clips will be used for signs installed on light standards or mast arms.

c. Construction. Anchors shall be anchored in a minimum of one cubic foot of class “C” concrete, 28 inches deep, with a 6 inch long, ⅜ inch diameter pin inserted through the pre-drilled hole 3 inches from the bottom of the pole. Where the pole installation requires surface mounting, an 8 inch flange with a 2 inch threaded collar shall be used. The pole shall be galvanized, two inches in diameter and threaded to fit the flange. Sign placement and orientation shall be as specified in the construction plans.

E. Each finished sign shall have the following sticker affixed to the back in a location where it will be visible when the sign is installed:

1. The sticker shall be Zebra Technologies Z-Ultimate 3000 White or approved equal. Finished product shall be weather and fade resistant for the expected life of the sign.

F. Warranty. The Contractor shall warrant the materials and workmanship of each sign in accordance with the maximum limits of material warranties extended by manufacturers of raw materials, subject to the conditions they specify. The retro-reflective sheeting will be considered unsatisfactory if it has deteriorated due to natural causes to the extent that: (1) the sign is ineffective for its intended purpose when viewed from a moving vehicle under normal day and night driving conditions; or (2) the coefficient of retro-reflection is less than the minimum specified for that sheeting. When sign failure occurs prior to the minimum years indicated and an inspection demonstrates that the failure is caused by materials warranted to contractor to endure at least that long, the sign will be replaced or repaired free of materials charges. When failure occurs and inspection demonstrates that such failure is due to poor workmanship, the sign will be replaced or repaired at Contractor's expense, including shipping charges.

3.00 EXECUTION

3.01 EQUIPMENT

A. The contractor shall provide machinery, tools, and equipment necessary for proper execution of the work.

3.02 CONSTRUCTION

A. Construction shall be high quality with no visible defects in the finished product. Fabrication shall be in accordance with these specifications. Street name signs shall always be supplied and installed at each project intersection whether signs previously existed at the location or not.

B. The removal of existing signs shall be coordinated with the Engineer and arrangements made for a convenient time to deliver Authority signs and poles. All salvaged traffic signs shall be delivered to the Authority. All deliveries require a minimum notice of two (2) working days prior to returning or delivering any sign and/or sign related material.

3.03 RESPONSIBILITIES

A. The contractor is responsible for providing and supplying aluminum traffic signs covered with retro-reflective sheeting, applying standard legends (or special legends if shown in the plans) to the covered sign blanks, galvanized steel sign poles, pole anchors, all hardware for installing the signs and poles, and for installing traffic signs, poles and anchors as shown in the plans or call for in the contract documents, complete and ready for field installations.

END OF SECTION

01 55 50 TRAFFIC CONTROL AND REGULATION

1.00 GENERAL

1.01 SECTION INCLUDES

A. Requirements for signs, signals, control devices, traffic barriers, flares, lights and traffic signals; construction parking control, designated haul routes, and bridging of trenches and excavations.

B. Qualifications and requirements for use of flagmen.

1.02 MEASUREMENT AND PAYMENT

A. Unit Price Contracts.

1. Traffic control and regulation. Payment for traffic control and regulation is on a lump sum basis. Include preparation and submittal of traffic control plan if different than shown on Drawings, and provision of traffic control devices, equipment, and personnel necessary to protect the Work and public. Payment will be based on Contractor's Schedule of Values for traffic control and regulation.

2. Payment for traffic control will be authorized by Engineer in three (3) parts. Partial payment will be made according to following schedule:

a. Payment of 25 percent of traffic control amount will be authorized when permanent control devices and necessary temporary markings, sufficiently deployed along job site as required to maintain progress of work, are installed at job site and approved. This limiting percentage will be prorated based upon extent of Contractor's setup.

b. A payment of 50 percent of traffic control amount will be authorized when pavement replacement commences. This limiting percentage will be prorated based upon linear footage, as measured along centerline axis of water main, of pavement replaced.

c. A payment of 25 percent of traffic control amount will be authorized when permanent pavement markings are restored and all unnecessary permanent and temporary control devices removed. This limiting percentage will be prorated based upon the extent of restoration.

3. Flagmen: Measurement is on a lump sum basis for flagmen as required for the project. The amount invoiced shall be determined based on the schedule of value submitted for flagmen.

4. Refer to Section 01 29 01 - Measurement and Payment for unit price procedures.

B. B. Stipulated Price Contracts. Include payment for work under this section in the total Stipulated Price.

1.03 REFERENCES

A. Texas Manual on Uniform Traffic Control Devices (TMUTCD)

B. Article 4413 (29bb), commonly referred to as Private Investigators and Private Security Agencies Act, and Article 2.12, Texas Code of Criminal Procedure.

C. Code of Ordinances, City of Houston, Texas.

1. Chapter 10 Buildings And Neighborhood Protection, Article X Cleanup After Demolition Or Removal Of Structures

2. Chapter 40 Streets and Sidewalks, Article XVII Pedestrian Way Impairments

1.04 SUBMITTALS

A. Conform to requirements of Section 01 33 00 - Submittal Procedures.

B. Traffic control plan:

1. If using traffic control plan contained in the Contract without modification, submit a letter confirming use of the plan.

2. If using a different traffic control plan, submit the plan for approval. The plan must conform to TMUTCD requirements and be sealed by a Registered Texas Professional Engineer.

C. Submit copies of approved lane closure permits.

D. Submit Schedules of Values for traffic control plan and flagmen within 30 days following Notice to Proceed.

E. Submit records verifying qualifications of Uniformed Peace Officers and Certified Flagmen proposed for use on the Work.

1.05 FLAGMEN

A. Use Uniformed Peace Officers and Certified Flagmen to control movement of vehicular and pedestrian traffic when construction operations encroach on public traffic lanes. Unless otherwise approved by Engineer, use Uniformed Peace Officer for work along major thoroughfares, schools, churches, hospitals and Work at signalized intersections.

B. Uniformed Peace Officer: Individual employed full-time as a peace officer who receives separate compensation as a privately employed flagman.

C. Private employment may be an employee-employer relationship or on an individual basis. Flagman may not be in the employ of another peace officer nor be a reserve peace officer.

1. Uniformed Peace Officers may be:

a. sheriffs and their deputies;

b. constables and deputy constables;

c. marshals or police officers of an incorporated city, town or village; or

d. as otherwise provided by Article 2.12, Code of Criminal Procedure.

2. The Uniformed Peace Officer must be a full-time peace officer, must work a minimum average of 32 paid hours per week, and must be paid a rate not less than the prevailing minimum hourly wage rate set by the federal Wage and Hour Act. The individual must be entitled to vacation, holidays, and insurance and retirement benefits.

D. Certified Flagman: Individual who receives compensation as a flagman and meets the following qualifications:

1. Formally trained and certified in traffic control procedures.

2. Speaks English. Ability to speak Spanish is desirable but not required.

3. Paid for flagman duty at an hourly rate not less than the wage rate set for Rough Carpenter under the Authority's Wage Scale for Engineering Construction.

E. Certified Flagmen must wear a distinctive uniform, bright-colored vest, and be equipped with appropriate flagging and communication devices while at the Work site. They must also have in their possession while on duty, a proof of training identification card issued by the appropriate training institute.

2.00 PRODUCTS

2.01 SIGNS, SIGNALS, AND DEVICES

A. Comply with TMUTCD requirements.

B. Traffic cones and drums, flares and lights: Conform to local jurisdictions' requirements.

2.02 PORTABLE LOW PROFILE CONCRETE BARRIERS

A. The low profile concrete barrier is a patented design. Information concerning this barrier may be obtained from Texas Transportation Institute, Texas A&M University System, College Station, Texas 77843-3135, (409) 845-1712.

3.00 EXECUTION

3.01 PUBLIC ROADS

A. Follow laws and regulations of governing jurisdictions when using public roads. Pay for and obtain permits from jurisdiction before impeding traffic or closing lanes. Coordinate activities with Engineer.

B. Give Engineer one-week notice before implementing approved traffic control phases. Inform local businesses of impending traffic control activities.

C. Notify police department, fire department, METRO, and local schools, churches, and businesses in writing a minimum of five business days prior to beginning work.

D. Maintain 10-foot wide all-weather lanes adjacent to the Work for emergency vehicle use. Keep all-weather lanes free of construction equipment and debris.

E. Do not to obstruct normal flow of traffic from 7:00 a.m. to 9:00 a.m. and 4:00 p.m. to 6:00 p.m. on designated major arterials or as directed by Engineer.

F. Maintain local driveway access to residential and commercial properties adjacent to work areas at all times. Use all-weather materials approved by Engineer to maintain temporary driveway access to commercial and residential driveways.

G. Keep streets entering and leaving job site free of excavated material, debris, and foreign material resulting from construction operations in compliance with applicable ordinances.

H. Remove existing signage and striping that conflict with construction activities or that may cause driver confusion.

I. Provide safe access for pedestrians along major cross streets.

J. Alternate closures of cross streets so that two adjacent cross streets are not closed simultaneously.

K. Do not close more than two consecutive esplanade openings at a time without prior approval from Engineer.

3.02 CONSTRUCTION PARKING CONTROL

A. Control vehicular parking to prevent interference with public traffic and parking, access by emergency vehicles, and the Authority's operations.

B. Monitor parking of construction personnel's vehicles in existing facilities. Maintain vehicular access to and through parking areas.

C. Prevent parking on or adjacent to access roads or in non-designated areas.

3.03 FLARES AND LIGHTS

A. Provide flares and lights during hours of low visibility to delineate traffic lanes and to guide traffic.

3.04 HAUL ROUTES

A. Utilize haul routes designated by authorities or shown on drawings for construction traffic.

B. Confine construction traffic to designated haul routes.

C. Provide traffic control at critical areas of haul routes to regulate traffic and minimize interference with public traffic.

3.05 TRAFFIC SIGNS AND SIGNALS

A. Construct necessary traffic control devices for temporary signals required to complete the Work including loop detectors, traffic signal conduits, traffic signal wiring and crosswalk signals. Notify a minimum of 60 days in advance, the agency concerning control boxes and switchgear. The agency will perform necessary service, programming or adjustments, to signal boxes and switchgear if required during construction.

B. Install and operate traffic control signals to direct and maintain orderly traffic flow in areas under Contractor's control affected by Contractor's operations. Post notices, signs and traffic controls before moving into next phase of traffic control.

C. Relocate traffic signs and signals as the Work progresses to maintain effective traffic control.

D. Unless otherwise approved by Engineer, provide driveway signs with name of business that can be accessed from each crossover. Use two signs for each crossover.

E. Replace existing traffic control devices in Project area.

F. Engineer may direct Contractor to make minor adjustments to traffic control signage to eliminate driver confusion and maintain orderly traffic flow during construction at no additional cost to the Authority.

3.06 BRIDGING TRENCHES AND EXCAVATIONS

A. When necessary, construct bridges over trenches and excavation to permit an unobstructed flow of traffic across construction areas and major drives. Use steel plates of sufficient thickness to support H-20 loading and install to operate with minimum noise.

B. Shore trench or excavation to support bridge and traffic.

C. Secure bridging against displacement with adjustable cleats, angles, bolts or other devices when:

1. bridging is placed over existing bus routes,

2. more than five percent of daily traffic is comprised of commercial or truck traffic,

3. more than two separate plates are used for bridging, and

4. when bridge is to be used for more than five consecutive days.

D. Extend steel plates used for bridging a minimum of 1 foot beyond edges of trench or excavation. Use temporary paving materials such as premix to feather edges of plates to minimize wheel impact on secured bridging.

3.07 REMOVAL

A. Remove equipment and devices when no longer required.

B. Repair damage caused by installation.

C. Remove post settings to a depth of 2 feet.

3.08 TRAFFIC CONTROL, REGULATION AND DIRECTION

A. Use Flagmen to control, regulate and direct an even flow and movement of vehicular and pedestrian traffic, for periods of time as may be required to provide for public safety and convenience, where:

1. multi-lane vehicular traffic must be diverted into single lane vehicular traffic,

2. vehicular traffic must change lanes abruptly,

3. construction equipment must enter or cross vehicular traffic lanes and walks,

4. construction equipment may intermittently encroach on vehicular traffic lanes and unprotected walks and crosswalk,

5. traffic regulation is needed due to rerouting of vehicular traffic around the Work site, and

6. where construction activities might affect public safety and convenience.

B. Use of Flagmen to assist in the regulation of traffic flow and movement does not relieve Contractor of responsibility to take other means necessary to protect the Work and public.

3.09 INSTALLATION STANDARDS

A. Work in other phases shall be permitted, provided 1) phases are not continuous to one work is being done in presently, 2) installation of utility occurs in only one phase. Keep work and operation in second phase to an absolute minimum. Perform work in no more than two phases at a time. Authorization to perform work in second phase shall not relieve any responsibility of completing backfilling and paving operations in accordance with Contract.

B. Place temporary pavement for single lane closures, in accordance with TMUTCD.

C. Reinstall temporary and permanent pavement markings as approved by Engineer. When weather conditions do not allow application according to manufacturer's requirements, alternate markings may be considered. Submit proposed alternate to Engineer for approval prior to installation. No additional payment will be made for use of alternate markings.

3.10 MAINTENANCE OF EQUIPMENT AND MATERIAL

A. Submit name, address and telephone number of individual designated to be responsible for maintenance of traffic handling at construction site to Engineer. Individual must be accessible at all times to immediately correct deficiencies in equipment and materials used to handle traffic including missing, damaged, or obscured signs, drums, barricades, or pavement markings.

B. Inspect signs, barricades, drums, lamps and temporary pavement markings daily to verify that they are visible, in good working order, and conform with traffic handling plans as approved by Engineer. Immediately repair, clean, relocate, realign, or replace equipment or materials that are not in compliance.

C. Keep equipment and materials, signs and pavement markings, clean and free of dust, dirt, grime, oil, mud, or debris.

D. Obtain approval of Engineer to reuse damaged or vandalized signs, drums, and barricades.

END OF SECTION

01 57 00 STORM WATER POLLUTION PREVENTION CONTROL

1.00 GENERAL

1.01 SECTION INCLUDES

A. Implementation of Storm Water Pollution Prevention Plans (SWP3) described in Section 01 41 00 – TPDES Requirement.

B. Installation, maintenance and removal, of storm water pollution prevention structures: diversion dikes, interceptor dikes, diversion swales, interceptor swales, down spout extenders, pipe slope drains, paved flumes and level spreaders.

1. Structures are used during construction and prior to final development of the site.

C. Filter Fabric Barriers:

1. Type 1: Temporary filter fabric barrier for erosion and sediment control in non-channelized flow areas.

2. Type 2: Temporary reinforced filter fabric barrier for erosion and sediment control in channelized flow areas.

D. Hay Bale Fence.

E. Drop Inlet Basket

F. Inlet Sediment Traps

G. Brush Berm

H. Sand Bag Barrier

I. Bagged Gravel Barrier

J. Sediment Basin

K. Inlet Protection Barrier

1.02 MEASUREMENT AND PAYMENT

A. UNIT PRICES

1. Payment for filter fabric barrier is on a linear foot basis measured between limits of beginning and ending of stakes.

2. Payment for reinforced filter fabric barrier is on a linear foot basis measured between limits of beginning and ending of stakes.

3. Payment for drop inlet baskets is on a unit price basis for each drop inlet basket.

4. Payment for storm inlet sediment traps is on a unit price basis for each storm inlet sediment trap.

5. Payment for storm water pollution prevention structures is on a lump sum basis for the project. Earthen structures with outlet and piping include diversion dikes, interceptor dikes, diversion swales, interceptor swales, and excavated earth-outlet sediment trap, embankment earth-outlet sediment trap, down spout extenders, pipe slope drains, paved flumes, stone outlet sediment trap, and level spreaders.

6. Payment for hay bale barrier, if included in Bid Form, is on a linear foot of accepted bale barriers, if not include in cost of storm water pollution prevention structures.

7. Payment for brush berm, if included in Bid Form, is on a linear foot of accepted brush berm, if not include in cost of storm water pollution prevention structures.

8. Payment for sandbag barrier, if included in Bid Form, is on a linear foot basis measured between limits of beginning and ending of sandbags, if not include in cost of storm water pollution prevention structures.

9. Payment for bagged gravel barrier, if included in Bid Form, is on a linear foot basis measured between limits of beginning and ending of bagged gravel barrier, if not include in cost of storm water pollution prevention controls.

10. Payment for inlet protection barriers, if included in Bid Form, is on a linear foot basis measured along outside face of inlet protection barrier, if not include in cost of storm water pollution prevention structures.

11. Refer to Section 01 29 01 - Measurement and Payment for unit price procedures.

B. STIPULATED PRICE (LUMP SUM) CONTRACT.

1. If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated.

1.03 REFERENCE STANDARDS

A. ASTM

1. A 36 – Standard Specification for Carbon Structural Steel.

2. D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600kN-m/m3)).

3. D3786 – Standard Test Method for Hydraulic Bursting Strength for knitted Goods and Nonwoven Fabrics.

4. D 4355 - Standard Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus).

5. D 4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity.

6. D 4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.

7. D 4833 - Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.

8. D 6382 - Standard Practice for Dynamic Mechanical Analysis and Thermogravimetry of Roofing and Waterproofing Membrane Material.

B. Storm Water Management Handbook for Construction Activities prepared by City of Houston, Harris County and Harris County Flood Control District.

1.04 SYSTEM DESCRIPTIONS

A. Filter Fabric Barrier Type 1 and Type 2: Install to allow surface or channel runoff percolation through fabric in sheet-flow manner and to retain and accumulate sediment. Maintain Filter Fabric Barriers to remain in proper position and configuration at all times.

B. Hay Bale Fence: Install to allow surface runoff percolation through hay in sheet-flow manner and to retain and accumulate sediment. Maintain Hay Bale Fence to remain in proper position and configuration at all times.

C. Interceptor Dikes and Swales: Construct to direct surface or channel runoff around the project area or runoff from project area into sediment traps.

D. Drop Inlet Baskets: Install to allow runoff percolation through the basket and to retain and accumulate sediment. Clean accumulation of sediment to prevent clogging and backups.

E. Sediment Traps: Construct to pool surface runoff from construction area to allow sediment to settle onto the bottom of trap.

F. Sand Bags: Used during construction activities in unstabilized minor swales, ditches, or streambeds when the contributing drainage area is no greater than 2 acres. It is also sediment barrier for stage one Inlet.

G. Bagged Gravel Barrier: Used during construction activities in unstabilized minor swales, ditches, or streambeds when the contributing drainage area is no greater than 2 acres. It is also sediment barrier for stage two Inlet.

H. Brush Berm: Constructed along the perimeter of a distribute site within the controlled area.

1.05 SUBMITTALS

A. Conform to requirements of Section 01 33 00 - Submittal Procedures.

B. Submit manufacturer's literature for product specifications and installation instructions.

C. Submit manufacturer’s catalog sheets and other product data on geotextile or filter fabrics, outlet pipe, perforated riser and connectors.

D. Submit proposed methods, equipment, materials, and sequence of operations for storm-water pollution prevention structures.

E. Submit shop drawings for Drop Inlet Baskets.

2.00 PRODUCTS

2.01 CONCRETE

A. Concrete: Class B in accordance with Section 03 30 00 – Concrete or as shown on the Drawings.

2.02 AGREGATE MATERIALS

A. Use poorly graded cobbles with diameter greater than 3 inches and less than 5 inches.

B. Provide gravel lining in accordance with Section 31 05 16 – Aggregates for or as shown on the drawings.

C. Provide clean cobbles and gravel consisting of crushed concrete or stone. Use clean, hard crushed concrete or stone free from adherent coatings, salt, alkali, dirt, clay, loam, shale, soft or flaky materials, or organic matter.

D. Sediment Pump Pit Aggregate: Use nominal 2-inch diameter river gravel.

2.03 PIPE

A. Polyethylene culvert pipe or PVC sewer pipe as shown on the Drawings.

B. Inlet Pipes: Galvanized corrugated steel pipe as shown on the Drawings.

C. Standpipe for Sediment Pump Pits: Galvanized round culvert pipe or round PVC pipe, minimum of 12-inch and a maximum of 24-inch diameter, perforate at 6 to 12 inch centers around circumference.

2.04 GEOTEXTILE FILTER FABRIC

A. Woven or nonwoven geotextile filter fabric made of either polypropylene, polyethylene, ethylene, or polyamide material, in continuous rolls of longest practical length.

B. Grab Strength: 100 psi in any principal direction (ASTM D-4632), Mullen burst strength >200 psi (ASTM D-3786), and equivalent opening size between 50 and 140.

C. Furnish ultraviolet inhibitors and stabilizers for minimum 6 months of expected usable construction life at temperature range of 0 degrees F to 120 degrees F.

D. Mirafi, Inc., Synthetic Industries, or equivalent

2.05 BARRIER

A. Wire Barrier: Woven galvanized steel wire, 14 gauge by 6-inch square mesh spacing, minimum 24 inch roll or sheet width of longest practical length.

B. Barrier Stakes: Nominal 2 by 2 inch moisture-resistant treated wood or steel posts (min. of 1.25 lbs. per linear foot and Brinell Hardness greater than 140) with safety caps on top; length as required for minimum 8 inch bury and full height of filter fabric.

2.06 SANDBAGS

A. Provide woven material made of polypropylene, polyethylene, or polyamide material.

1. Minimum unit weight of four ounces per square yard.

2. Minimum grab strength of 100 lbs in any principal direction (ASTM D4632)

3. Mullen burst strength exceeding 300 lbs (ASTM D4833).

4. Ultraviolet stability exceeding 70 percent. After 500 hours of exposure (ASTM 4355).

5. Size: Length:18 to 24 inches. Width: 12 to 18 inches. Thickness: 6 to 8 inches. Weight: Approximately 40 to 50 pounds not to exceed 75 pounds.

2.07 BAGGED GRAVEL BARRIER

A. Minimum unit weight of four ounces per square yard.

B. Minimum grab strength of 100 lbs in any principal direction (ASTM D4632)

C. Mullen burst strength exceeding 300 lbs (ASTM D4833).

D. Ultraviolet stability exceeding 70 percent. After 500 hours of exposure (ASTM 4355).

E. Size: Length:18 to 24 inches. Width: 12 to 18 inches. Thickness: 6 to 8 inches. Weight: Approximately 40 to 50 pounds not to exceed 75 pounds.

2.08 DROP INLET BASKET

A. Provide steel frame members in accordance with ASTM A36.

B. Construct top frame of basket with two short sides of 2 inch by 2 inch and single long side of 1 inch by 1 inch, 1/8 inch angle iron. Construct basket hangers of 2 inch by 1/4 inch iron bars. Construct bottom frame of 1 inch by 1/4 inch iron bar or 1/4 inch plate with center 3 inches removed. Use minimum 1/4 inch diameter iron rods or equivalent for sides of inlet basket. Weld minimum of 14 rods in place between top frame/basket hanger and bottom frame. Exact dimensions for top frame and insert basket will be determined based on dimensions of type of inlet being protected.

2.09 HAY BALE

A. Hay: Standard-baled agricultural hay bound by wire, nylon, or polypropylene rope. Do not use jute or cotton binding.

B. Hay Bale Stakes (applicable where bales are on soil): No. 3 (3/8 diameter) reinforcing bars, deformed or smooth at Contractor's option, length as required for minimum 18 inch bury and full height bales.

3.00 EXECUTION

3.01 PREPARATION, INSTALLATION AND MAINTEINANCE

A. Provide erosion and sediment control structures at locations shown on the Drawings.

B. Do not clear, grub or rough cut until erosion and sediment control systems are in place unless approved by Engineer to allow installation of erosion and sediment control systems, soil testing and surveying.

C. Maintain existing erosion and sediment control systems located within project site until acceptance of Project or until directed by Engineer to remove and discard existing system.

D. Regularly inspect and repair or replace damaged components of erosion and sediment control structures. Unless otherwise directed, maintain erosion and sediment control structure until project area stabilization is accepted. . Redress and replace granular fill at outlets as needed to replenish depleted granular fill. Remove erosion and sediment control structures promptly when directed by Engineer. Dispose of materials in accordance with Section 01 57 60 - Waste Material Disposal.

E. Remove and dispose sediment deposits at the designated spoil site for the Project. If a project spoil site is not designated on Drawings, dispose of sediment off site at approved location in accordance with Section 01 57 60 - Waste Material Disposal.

F. Unless otherwise shown on the Drawings, compact embankments, excavations, and trenches in accordance with Section 31 23 10 – Structural Excavation and Backfill, 31 23 23.16 – Compacted Earth Fill, and 31 23 33 – Trenching and Backfill.

G. Prohibit equipment and vehicles from maneuvering on areas outside of dedicated right of way and easements for construction. Immediately repair damage caused by construction traffic to erosion and sediment control structures.

3.02 SEDIMENT TRAPS

A. Install sediment traps so that surface runoff shall percolate through system in sheet flow fashion and allow retention and accumulation of sediment.

B. Inspect sediment traps after each rainfall, daily during periods of prolonged rainfall, and at a minimum once each week. Repair or replace damaged sections immediately.

C. Use fill material for embankment in accordance with Section 31 23 33 – Trenching and Backfill.

D. Excavation length and height shall be as specified on Drawings. Use side slopes of 2:1 or flatter.

E. Stone outlet sediment traps:

1. Maintain minimum of 6 inches between top of core material and top of stone outlet, minimum of 4 inches between bottom of core material and existing ground and minimum of 1 foot between top of stone outlet and top of embankment.

2. Embed cobbles minimum of 4 inches into existing ground for stone outlet. Core shall be minimum of 1 foot in height and in width and wrapped in triple layer of geotextile filter fabric.

F. Sediment Basin with Pipe Outlet Construction Methods: Install outlet pipe and riser as shown on the Drawings.

G. Remove sediment deposits when design basin volume is reduced by one- third or sediment level is one foot below principal spillway crest, whichever is less.

3.03 FILTER FABRIC BARRIER CONSTRUCTION METHODS

A. Fence Type 1: Filter Fabric: Barrier

1. Install stakes 3 feet on center maximum and firmly embed minimum 8 inches in soil. If filter fabric is factory preassembled with support netting, then maximum support spacing is 8 feet. Install wood stakes at a slight angle toward the source of anticipated runoff.

2. Trench in the toe of the fence lines so the downward face of the trenches is flat and perpendicular to direction of flow. V-trench configuration as shown on Drawings may also be used.

3. Lay fabric along edges of trenches in longest practical continuous runs to minimize joints. Make joints only at a support post. Splice with minimum 6-inch overlap and seal securely.

4. Staple filter fabric to stakes at maximum 3 inches on center. Extend fabric minimum 18 inches and maximum 36 inches above natural ground.

5. Backfill and compact trench.

B. Barrier Type 2: Reinforced Filter Fabric Barrier

1. Layout barrier same as for Type 1.

2. Install stakes at 6 feet on center maximum and at each joint in wire fence, firmly embedded 1-foot minimum, and inclined it as for Type 1.

3. Tie wire fence to stakes with wire at 6 inches on center maximum. Overlap joints minimum one bay of mesh.

4. Install trench same as for Type 1.

5. Fasten filter fabric wire fence with tie wires at 3 inches on center maximum.

6. Layout fabric same as for Type 1. Fasten to wire fence with wire ties at 3 inches on center maximum and, if applicable, to stakes above top of wire fence it as for Type 1.

7. Backfill and compact trench.

8. Attach filter fabric to wooden fence stakes spaced a maximum of 6 feet apart or steel fence stakes spaced a maximum of 8 feet apart and embedded a minimum of 12 inches. Install stakes at a slight angle toward source of anticipated runoff.

9. Trench in toe of filter fabric barrier with spade or mechanical trencher so that downward face of trench is flat and perpendicular to direction of flow. A V-trench configuration may also be used. Lay filter fabric along edges of trench. Backfill and compact trench upon completion of Construction.

10. Filter fabric fence shall have a minimum height of 18 inches and a maximum height of 36 inches above natural ground.

11. Cut length of fence to minimize use of joints. When joints are necessary, splice fabric together only at support post with minimum 6 inch overlap and seal securely.

12. When used in swales, ditches or diversions, elevation of barrier at top of filter fabric at flow line location in channel shall be lower than bottom elevation of filter fabric at ends of barrier or top of bank, whichever is less, in order to keep storm water discharge in channel from overtopping bank.

C. Triangular Filter Fabric Barrier Construction Methods

1. Attach filter fabric to wire fencing, 18 inches on each side. Provide a fabric cover and skirt with continuous wrapping of fabric. Skirt should form continuous extension of fabric on upstream side of fence.

2. Secure triangular fabric filter barrier in place using one of the following methods:

   a. Toe-in skirt 6 inches with mechanically compacted material;

   b. Weight down skirt with continuous layer of 3-inch to 5-inch graded rock; or

   c. Trench-in entire structure 4 inches.

3. Anchor triangular fabric filter barrier structure and skirt securely in place using 6-inch wire staples on 2-foot centers on both edges and on skirt, or staked using 18-inch by 3/8-inch diameter re-bar with tee ends.

4. Lap fabric filter material by 6 inches to cover segment joints. Fasten joints with galvanized shoat rings.

3.04 DIKE AND SWALE

A. Unless otherwise indicated, maintain minimum dike height of 18 inches, measured from cleared ground at up slope toe to top of dike. Maintain side slopes of 2:1 or flatter.

B. Dike and Swale Stabilization: When shown on the Drawings, place gravel lining 3 inches thick and compacted into the soil or 6 inches thick if truck crossing is expected. Extend gravel lining across bottom and up both sides of swale minimum height of 8 inches vertically, above bottom. Gravel lining on dike side shall extend up the up slope side of dike a minimum height of 8 inches, measured vertically from interface of existing or graded ground and up slope toe of dike, as shown on Drawings.

C. Divert flow from dikes and swales to sediment basins, stabilized outlets, or sediment trapping devices of types and at locations shown on Drawings. Grade dikes and swales as shown on Drawings, or, if not specified, provide positive drainage with maximum grade of 1 percent to outlet or basin.

D. Clear in accordance with Section 31 11 00.20 – Clearing and Grubbing. Compact embankments in accordance with Section 31 23 23.16 – Compacted Earth Fill.

E. Carry out excavation for swale construction so that erosion and water pollution is minimal. Minimum depth shall be 1 foot and bottom width shall be 4 feet, with level swale bottom. Excavation slopes shall be 2:1 or flatter. Clear, grub and strip excavation area of vegetation and root material.

3.05 DOWN SPOUT EXTENDER

A. Down spout extender shall have slope of approximately 1 percent. Use pipe diameter of 4 inches or as shown on the Drawings. Place pipe in accordance with Section 31 23 33 – Trenching and Backfill.

3.06 PIPE SLOPE DRAIN

A. Compact soil around and under drain entrance section to top of embankment in lifts appropriately sized for method of compaction utilized.

B. Inlet pipe shall have slope of 1 percent or greater. Use pipe diameter as shown on the Drawings.

C. Top of embankment over inlet pipe and embankments directing water to pipe shall be at least 1 foot higher at all points than top of inlet pipe.

D. Pipe shall be secured with hold-down grommets spaced 10 feet on centers.

E. Place riprap apron with a depth equal to pipe diameter with 2:1 side slopes.

3.07 PAVED FLUME

A. Compact soil around and under the entrance section to top of the embankment in lifts appropriately sized for method of compaction utilized.

B. Construct subgrade to required elevations. Remove and replace soft sections and unsuitable material. Compact subgrade thoroughly and shape to a smooth, uniform surface.

C. Construct permanent paved flumes in accordance with Drawings.

D. Remove sediment from riprap apron when sediment has accumulated to depth of one foot.

3.08 LEVEL SPREADER

A. Construct level spreader on undisturbed soil and not on fill. Ensure that spreader lip is level for uniform spreading of storm runoff.

B. Maintain at required depth, grade, and cross section as specified on Drawings. Remove sediment deposits as well as projections or other irregularities which will impede normal flow.

3.09 INLET PROTECTION BARRIER

A. Place sandbags for Stage I, Bagged gravel for Stage II and filter fabric barriers at locations shown on the SWP3. Maintain to allow minimal inlet in flow restrictions / blockage during storm event.

3.10 DROP INLET BASKET CONSTRUCTION METHODS

A. Fit inlet insert basket into inlet without gaps around insert at locations shown on the SWP3.

B. Support for inlet insert basket shall consist of fabricated metal as shown on Drawings.

C. Push down and form filter fabric to shape of basket. Use sheet of fabric large enough to be supported by basket frame when holding sediment and extend at least 6 inches past frame. Place inlet grates over basket/frame to serve as fabric anchor.

D. Remove sediment deposit after each storm event and whenever accumulation exceeds 1-inch depth during weekly inspections.

3.11 HAY BALE FENCE CONSTRUCTION METHODS

A. Place bales in row with ends tightly abutting adjacent bales. Place bales with bindings parallel to ground surface.

B. Embed bale in soil a minimum of 4 inches.

C. Securely anchor bales in place with Hay Bale Stakes driven through bales a minimum of 18-inches into ground. Angle first stake in each bale toward previously laid bale to force bales together.

D. Fill gaps between bales with straw to prevent water from channeling between bales. Wedge carefully in order not to separate bales.

E. Replace with new hay bale fence every two months or as required by Engineer.

3.12 BRUSH BERM CONSTRUCTION METHODS

A. Construct brush berm along contour lines by hand placing method. Do not use machine placement of brush berm.

B. Use woody brush and branches having diameter less than 2-inches with 6- inches overlap. Avoid incorporation of annual weeds and soil into brush berm.

C. Use minimum height of 18-inches measured from top of existing ground at upslope toe to top of berm. Top width shall be 24 inches minimum and side slopes shall be 2:1 or flatter.

D. Embed brush berm into soil a minimum of 4-inches and anchor using wire, nylon or polypropylene rope across berm with a minimum tension of 50 pounds. Tie rope securely to 18-inch x 3/8-inch diameter rebar stakes driven into ground on 4-foot centers on both sides of berm.

3.13 STREET AND SIDEWALK CLEANING

A. Keep areas clean of construction debris and mud carried by construction vehicles and equipment. If necessary, install stabilized construction exits at construction, staging, storage, and disposal areas, following Section 01 57 50 - Stabilized Construction Exit.

B. In lieu of or in addition to stabilized construction exits, shovel or sweep pavements as required to keep areas clean. Do not water hose or sweep debris and mud off street into adjacent areas, except, hose sidewalks during off-peak hours, after sweeping.

3.14 WASTE COLLECTION AREAS

A. Prevent water runoff from passing through waste collection areas, and prevent water runoff from waste collection areas migrating outside collection areas.

3.15 EQUIPMENT MAINTENANCE AND REPAIR

A. Confine maintenance and repair of construction machinery and equipment to areas specifically designated for that purpose, so fuels, lubricants, solvents, and other potential pollutants are not washed directly into receiving streams or storm water conveyance systems. Provide these areas with adequate waste disposal receptacles for liquid and solid waste. Clean and inspect maintenance areas daily.

B. Where designated equipment maintenance areas are not feasible, take precautions during each individual repair or maintenance operation to prevent potential pollutants from washing into streams or conveyance systems. Provide temporary waste disposal receptacles.

3.16 VEHICLE/ EQUIPMENT WASHING AREAS

A. Install wash area (stabilized with coarse aggregate) adjacent to stabilized construction access, as required to prevent mud and dirt run-off. Release wash water into drainage swales or inlets protected by erosion and sediment controls. Build wash areas following Section 01 57 50 - Stabilized Construction access. Install gravel or rock base beneath wash areas.

B. Wash vehicles only at designated wash areas. Do not wash vehicles such as concrete delivery trucks or dump trucks and other construction equipment at locations where runoff flows directly into waterways or storm water conveyance systems.

C. Locate wash areas to spread out and evaporate or infiltrate wash water directly into ground, or collect runoff in temporary holding or seepage basins.

3.17 WATER RUNOFF AND EROSION CONTROL

A. Control surface water, runoff, subsurface water, and water from excavations and structures to prevent damage to the Work, the site, or adjoining properties. Follow environment requirements.

B. Control fill, grading and ditching to direct water away from excavations, pits, tunnels, and other construction areas, and to direct drainage to proper runoff courses to prevent erosion, sedimentation or damage.

C. Provide, operate, and maintain equipment and facilities of adequate size to control surface water.

D. Retain existing drainage patterns external to the site by constructing temporary earth berms, sedimentation basins, retaining areas, and temporary ground cover as required to control conditions.

E. Plan and execute construction and earth work to control surface drainage from cuts and fills, and from borrow and waste disposal areas, to prevent erosion and sedimentation.

   1. Hold area of bare soil exposed at one time to a minimum.

   2. Provide temporary controls such as berms, dikes, and drains.

F. Construct fill and waste areas by selective placement to eliminate surface silts or clays which will erode.

G. Inspect earthwork periodically to detect start of erosion. Immediately apply corrective measures as required to control erosion.

H. Dispose of sediments offsite, not in or adjacent to waterways or floodplains, nor allow sediments to flush into streams or drainage ways. Assume responsibility for offsite disposal location.

I. Unless otherwise indicated, compact embankments, excavations, and trenches by mechanically blading, tamping, and rolling soil in maximum of 8- inch layers. Provide compaction density at minimum 90 percent Standard Proctor ASTM D-698-78 density. Make at least one test per 500 cubic yards of embankment.

J. Prohibit equipment and vehicles from maneuver on areas outside of dedicated rights- of-way and easements for construction. Immediately repair damage to erosion and sedimentation control systems caused by construction traffic.

K. Do not damage existing trees intended to remain.

3.18 REMOVAL OF CONTROLS

A. Remove erosion and sediment controls when the site is finally stabilized or as directed by Engineer.

B. Dispose of sediments and waste products following Section 01 50 40 -Temporary Facilities and Controls.

END OF SECTION

01 57 50 STABILIZED CONSTRUCTION ACCESS

1.00 GENERAL

1.01 SECTION INCLUDES

A. Installation and removal of erosion and sediment control for stabilized construction access used during construction and prior to final development of site.

1.02 MEASUREMENT AND PAYMENT

A. Unit Price Contracts. If Contract is Unit Price Contract, payment for work in this Section will be based on the following:

1. Stabilized construction roads, parking areas, access and wash areas: per each location of aggregate/recycled concrete without reinforcing placed in 8-inch layers. No separate payment will be made for street cleaning necessary to meet TPDES requirements. Include cost of work for street cleaning under related Specification section.

B. Stipulated Price (Lump Sum) Contracts. If the Contract is a Stipulated Price Contract, include payment for work under this Section in the total Stipulated Price.

1.03 SUBMITTALS

A. Conform to requirements of Section 01 33 00 - Submittal Procedures.

B. Submit manufacturer's catalog sheets and other Product Data on geotextile fabric.

C. Submit sieve analysis of aggregates conforming to requirements of this Specification.

1.04 REFERENCES

A. ASTM D 4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.

B. Storm Water Quality Management Handbook For Construction Activities prepared by the City of Houston, Harris County and Harris County Flood Control District.

2.00 PART 2 P R O D U C T S

2.01 GEOTEXTILE FABRIC

A. Provide woven or non-woven geotextile fabric made of polypropylene, polyethylene, ethylene, or polyamide material.

B. Geotextile fabric: Minimum grab strength of 200 lbs in any principal direction (ASTM D-4632) and equivalent opening size between 50 and 140.

C. Geotextile and threads: Resistant to chemical attack, mildew, and rot and contain ultraviolet ray inhibitors and stabilizers to provide minimum of six months of expected usable life at temperature range of 0 to 120 degrees F.

D. Representative Manufacturers: Mirafi, Inc. or equal.

2.02 COARSE AGGREGATES

A. Coarse aggregate: Crushed stone, gravel, crushed blast furnace slag, or combination of these materials. Aggregate shall be composed of clean, hard, durable materials free from adherent coatings of, salt, alkali, dirt, clay, loam, shale, soft or flaky materials, or organic and injurious matter.

B. Coarse aggregates to consist of open graded rock 2” to 8” in size.

3.00 EXECUTION

3.01 PREPARATION AND INSTALLATION

A. Provide stabilized construction roads and access at construction, staging, parking, storage, and disposal areas to keep street clean of mud carried by construction vehicles and equipment. Construct erosion and sediment controls in accordance with Drawings and Specification requirements.

B. Do not clear grub or rough cut until erosion and sediment control systems are in place, unless approved by Engineer to allow soil testing and surveying.

C. Maintain existing construction site erosion and sediment control systems until acceptance of the Work or until removal of existing systems is approved by Engineer.

D. Regularly inspect, repair or replace components of stabilized construction access. Unless otherwise directed, maintain stabilized construction roads and access until the Engineer accepts the Work. Remove stabilized construction roads and access promptly when directed by Engineer. Discard removed materials off-site. Remove and dispose of sediment deposits at designated spoil site for Project. If a spoil site is not designated on Drawings, dispose of sediment off-site at a location not in or adjacent to stream or flood plain. Assume responsibility for off-site disposal.

E. Spread compacted and stabilized sediment evenly throughout site. Do not allow sediment to flush into streams or drainage ways. Dispose of contaminated sediment in accordance with existing federal, state, and local rules and regulations.

F. Prohibit equipment and vehicles from maneuvering on areas outside of dedicated rights-of-way and easements for construction. Immediately repair damage to erosion and sediment control systems caused by construction traffic.

G. Conduct construction operations in conformance with erosion control requirements of Specification 01 57 00 – Storm Water Pollution Control.

3.02 CONSTRUCTION MAINTENANCE

A. Provide stabilized access roads, subdivision roads, parking areas, and other on-site vehicle transportation routes where shown on Drawings.

B. Provide stabilized construction access and vehicle washing areas, when approved by Engineer, of sizes and at locations shown on Drawings or as specified in this Section.

C. Clean tires to remove sediment on vehicles leaving construction areas prior to entering public right-of-ways. Construct wash areas needed to remove sediment. Release wash water into drainage swales or inlets protected by erosion and sediment control measures.

D. Details for stabilized construction access are shown on Drawings. Construct other stabilized areas to same requirements. Maintain minimum roadway widths of 14 feet for one-way traffic and 20 feet for two-way traffic and of sufficient width to allow ingress and egress. Place geotextile fabric as a permeable separator to prevent mixing of coarse aggregate with underlying soil. Limit exposure of geotextile fabric to elements between laydown and cover to a maximum 14 days to minimize potential damage.

E. Grade roads and parking areas to provide sufficient drainage away from stabilized areas. Use sandbags, gravel, boards, or similar materials to prevent sediment from entering public right-of-ways, waterways or storm water conveyance systems.

F. Inspect and maintain stabilized areas daily. Provide periodic top dressing with additional coarse aggregates to maintain required depth. Repair and clean out damaged control systems used to trap sediment. Immediately remove spilled, dropped, washed, or tracked sediment from public right-of- ways.

G. Maintain lengths of stabilized areas as shown on Drawings or a minimum of 50 feet. Maintain a minimum thickness of 8 inches. Maintain minimum widths at all points of ingress or egress.

H. Stabilize other areas with the same thickness, and width of coarse aggregate required for stabilized construction access, except where shown otherwise on Drawings.

I. Stabilized areas may be widened or lengthened to accommodate truck washing areas when authorized by Engineer.

J. Clean street daily before end of workday. When excess sediments have tracked onto streets, Engineer may direct Contractor to clean street as often as necessary. Remove and legally dispose of sediments.

K. Use other erosion and sediment control measures to prevent sediment runoff during rain periods and non-working hours and when storm discharges are expected.

END OF SECTION

01 57 60 WASTE MATERIAL DISPOSAL

1.00 GENERAL

1.01 SECTION INCLUDES

A. Disposal of waste material and salvageable material.

1.02 SUBMITTALS

A. Conform to requirements of Section 01 33 00 - Submittal Procedures.

B. Obtain and submit disposal permits for proposed disposal sites, if required by local ordinances.

C. Submit copy of written permission from property owner, with description of property, prior to disposal of excess material adjacent to Project. Submit written and signed release from property owner upon completion of disposal work.

2.00 PRODUCTS - NOT USED

3.00 EXECUTION

3.01 SALVAGEABLE MATERIAL

A. Excavated Material: When indicated on Drawings, load, haul, and deposit excavated material at location or locations shown on Drawings outside limits of Project.

B. Other Salvageable Materials: Conform to requirements of individual Specification Sections.

C. Coordinate loading of salvageable material on Contractor provided trucks with Engineer.

3.02 EXCESS MATERIAL

A. Remove and legally dispose of vegetation, rubble, broken concrete, debris, asphaltic concrete pavement, excess soil, and other materials not designated for salvage from job site.

B. Excess soil may be deposited on private property adjacent to Project when written permission is obtained from property owner.

C. Verify flood plain status of any proposed disposal site. Do not dispose of excavated materials in area designated as within 100-year Flood Hazard Area unless “Development Permit” has been obtained. Remove excess material placed in "100-year Flood Hazard Area", at no additional cost to the Authority.

D. Remove waste materials from site daily, in order to maintain site in neat and orderly condition.

END OF SECTION

01 57 80 CONTROL OF GROUND AND SURFACE WATER

1.00 GENERAL

1.01 SECTION INCLUDES

A. Dewatering, depressurizing, draining, and maintaining trenches, shaft excavations, structural excavations and foundation beds in stable condition, and controlling ground water conditions for tunnel excavations.

B. Protecting work against surface runoff and rising floodwaters.

C. Trapping suspended sediment in the discharge from the surface and ground water control systems.

1.02 MEASUREMENT AND PAYMENT

A. UNIT PRICES

1. When noted, dewatering of trench or excavation during course of project shall be measured per linear foot and paid for at contract unit prices for dewatering, when directed to perform such work by Engineer. Dewatering must be fully detailed in submittal and submittal must be approved prior to performing dewatering work before payment will be made for dewatering. No payment will be made for work unless directed to perform work by Engineer.

2. Presence of a pump on project does not constitute dewatering for payment under bid item "Ground Water Control for Open Cut Construction."

3. Dewatering required during course of project to lower water table for other utility installation less than 24 inches in diameter, construction of structures, removal of standing water, surface drainage seepage, or to protect against rising waters or floods shall be considered incidental to Work unless otherwise noted.

4. No separate payment will be made for groundwater control associated with augering, tunneling or other method of trenchless casing installation. Include cost in unit price for auger or tunnel.

5. No separate payment will be made for control of surface water. Include cost to control surface water in unit price for work requiring controls.

6. Refer to Section 01 29 01 – Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum) Contract: If the Contract is a Stipulated Price Contract, include payment for work under this section in the total Stipulated Price.

1.03 REFERENCES

A. ASTM D 698 - Standard Test Methods for Laboratory Compaction of Soils Using Standard Effort (12,400 ft-lbf/ft3 (600kN-m/m3)

1. Federal Regulations, 29 CFR Part 1926, Standards-Excavation, Occupational Safety and Health Administration (OSHA).

2. Storm Water Management Handbook for Construction Activities prepared by City of Houston, Harris County and Harris County Flood Control District.

1.04 DEFINITIONS

A. Ground water control system: system used to dewater and depressurize water-bearing soil layers.

1. Dewatering: lowering the water table and intercepting seepage that would otherwise emerge from slopes or bottoms of excavations, or into tunnels and shafts; and disposing of removed water. Intent of dewatering is to increase stability of tunnel excavations and excavated slopes, prevent dislocation of material from slopes or bottoms of excavations, reduce lateral loads on sheeting and bracing, improve excavating and hauling characteristics of excavated material, prevent failure or heaving of bottom of excavations, and to provide suitable conditions for placement of backfill materials and construction of structures and other installations.

2. Depressurization: includes reduction in piezometric pressure within strata not controlled by dewatering alone, necessary to prevent failure or heaving of excavation bottom or instability of tunnel excavations.

B. Excavation drainage: includes keeping excavations free of surface and seepage water.

C. Surface drainage: includes use of temporary drainage ditches and dikes and installation of temporary culverts and sump pumps with discharge lines necessary to protect Work from any source of surface water.

D. Monitoring facilities for ground water control system: includes piezometers, monitoring wells and flow meters for observing and recording flow rates.

1.05 PERFORMANCE REQUIREMENTS

A. Conduct subsurface investigations to identify groundwater conditions and to provide parameters for design, installation, and operation of groundwater control systems. Submit proposed method and spacing of readings for review prior to obtaining water level readings.

B. Design ground water control system, compatible with requirements of Federal Regulations 29 CFR Part 1926 and Section 31 23 33 - Trench Safety Systems, to produce following results:

1. Effectively reduce hydrostatic pressure affecting:

    a. Excavations

    b. Tunnel excavation, face stability or seepage into tunnels

2. Develop substantially dry and stable subgrade for subsequent construction operations

3. Preclude damage to adjacent properties, buildings, structures, utilities, installed facilities and other work

4. Prevent loss of fines, seepage, boils, quick condition, or softening of foundation strata

5. Maintain stability of sides and bottom of excavations

C. Provide ground water control systems that include single-stage or multiple- stage well point systems, eductor and ejector-type systems, deep wells, or combinations of these equipment types.

D. Provide drainage of seepage water and surface water, as well as water from other sources entering excavation. Excavation drainage may include placement of drainage materials, crushed stone and filter fabric, together with sump pumping.

E. Provide ditches, berms, pumps and other methods necessary to divert and drain surface water from excavation and other work areas.

F. Locate ground water control and drainage systems so as not to interfere with utilities, construction operations, adjacent properties, or adjacent water wells.

G. Assume sole responsibility for ground water control systems and for any loss or damage resulting from partial or complete failure of protective measures and settlement or resultant damage caused by ground water control operations. Modify ground water control systems or operations if they cause or threaten to cause damage to new construction, existing site improvements, adjacent property, adjacent water wells, or potentially contaminated areas.

    1. Repair damage caused by ground water control systems or resulting from failure of system to protect property as required.

H. Install an adequate number of piezometers installed at proper locations and depths, necessary to provide meaningful observations of conditions affecting excavation, adjacent structures and water wells.

I. Install environmental monitoring wells at proper locations and depths necessary to provide adequate observations of hydrostatic conditions and possible contaminant transport from contamination sources into work area or ground water control system.

J. Control flow rate of discharged water to prevent overflow of drainage facilities.

1.06 SUBMITTALS

A. Conform to requirements of Section 01 33 00 - Submittal Procedures.

B. Submit Ground Water and Surface Water Control Plan for review by Engineer prior to start of excavation work. Include the following:

1. Results of subsurface investigations and description of extent and characteristics of water bearing layers subject to ground water control.

2. Names of equipment Suppliers and installation Subcontractors.

3. Description of proposed ground water control systems indicating arrangement, location, depth and capacities of system components, installation details and criteria and operation and maintenance procedures.

4. Description of proposed monitoring facilities indicating depths and locations of piezometers and monitoring wells, monitoring installation details and criteria, type of equipment and instrumentation with pertinent data and characteristics.

5. Description of proposed filters including types, sizes, capacities and manufacturer's application recommendations.

6. Design calculations demonstrating adequacy of proposed systems for intended applications. Define potential area of influence of ground water control operation near contaminated areas.

7. Operating requirements, including piezometric control elevations for dewatering and depressurization.

8. Excavation drainage methods including typical drainage layers, sump pump application and other means.

9. Surface water control and drainage installations.

10. Proposed methods and locations for disposing of removed water.

C. Submit following records upon completion of initial installation:

1. Installation and development reports for well points, eductors, and deep wells

2. Installation reports and baseline readings for piezometers and monitoring wells

3. Baseline analytical test data of water from monitoring wells

4. Initial flow rates

D. Submit the following records weekly during control of ground and surface water operations:

1. Records of flow rates and piezometric elevations obtained during monitoring of dewatering and depressurization. Refer to Paragraph 3.2, Requirements for Eductor, Well Points, or Deep Wells.

2. Maintenance records for ground water control installations, piezometers and monitoring wells

1.07 ENVIRONMENTAL REQUIREMENTS

A. Comply with requirements of agencies having jurisdiction.

B. Comply with Texas Commission on Environmental Quality regulations and Texas Water Well Drillers Association for development, drilling, and abandonment of wells used in dewatering system.

C. Obtain necessary permits from agencies with jurisdiction over use of groundwater and matters affecting well installation, water discharge, and use of existing storm drains and natural water sources. Since review and permitting process may be lengthy, take early action to obtain required approvals.

D. Monitor ground water discharge for contamination while performing pumping in vicinity of potentially contaminated sites.

E. Provide erosion control measures when discharging water to unlined or vegetation lined channels.

2.00 PRODUCTS

2.01 EQUIPMENT AND MATERIALS

A. Select equipment and materials necessary to achieve desired results for dewatering. Selected equipment and materials are subject to review by Engineer through submittals required in Paragraph 1.6, Submittals.

B. Use experienced contractors, regularly engaged in ground water control system design, installation, and operation, to furnish and install and operate educators, well points, or deep wells, when needed

C. Maintain equipment in good repair and operating condition.

D. Keep sufficient standby equipment and materials available to ensure continuous operation, where required.

E. Portable Sediment Tank System: Standard 55-gallon steel or plastic drums, free of hazardous material contamination.

1. Shop or field fabricate tanks in series with main inlet pipe, inter-tank pipes and discharge pipes, using quantities sufficient to collect sediments from discharge water.

3.00 EXECUTION

3.01 GROUND WATER CONTROL

A. Perform necessary subsurface investigation to identify water bearing layers, piezometric pressures and soil parameters for design and installation of ground water control systems. Perform pump tests, if necessary to determine draw down characteristics. Present results in the Ground Water and Surface Water Control Plan submittal.

B. Provide labor, material, equipment, techniques and methods to lower, control and handle ground water in manner compatible with construction methods and site conditions. Monitor effectiveness of installed system and its effect on adjacent property.

C. Install, operate, and maintain ground water control systems in accordance with the Ground Water and Surface Water Control Plan. Notify Engineer in writing of changes made to accommodate field conditions and changes to Work. Provide revised drawings and calculations with notification.

D. Provide continuous system operation, including nights, weekends, and holidays. Arrange appropriate backup if electrical power is primary energy source for dewatering system.

E. Monitor operations to verify systems lower ground water piezometric levels at rate required to maintain dry excavation resulting in stable subgrade for subsequent construction operations.

F. Depressurize zones where hydrostatic pressures in confined water bearing layers exist below excavations to eliminate risk of uplift or other instability of excavation or installed works. Define allowable piezometric elevations in the Ground Water and Surface Water Control Plan.

G. Removal of ground water control installations.

1. Remove pumping system components and piping when ground water control is no longer required.

2. Remove piezometers, including piezometers installed during design phase investigations and left for Contractor’s use, upon completion of testing.

3. Remove monitoring wells when directed by Engineer.

4. Grout abandoned well and piezometer holes. Fill piping that is not removed with cement-bentonite grout or cement-sand grout.

H. During backfilling, maintain water level a minimum of 5 feet below prevailing level of backfill. Do not allow the water level to cause uplift pressures in excess of 80 percent of downward pressure produced by weight of structure or backfill in place. Do not allow water levels to rise into cement-stabilized sand until at least 48 hour after placement.

I. Provide uniform pipe diameter for each pipe drain run constructed for dewatering. Remove pipe drains when no longer required. If pipe removal is impractical, grout connections at 50-foot intervals and fill pipe with cement- bentonite grout or cement-sand grout after removal from service.

J. The extent of ground water control for structures with permanent perforated underground drainage systems may be reduced, for units designed to withstand hydrostatic uplift pressure. Provide a means to drain affected portions of underground systems, including standby equipment. Maintain drainage systems during construction operations.

K. Remove systems upon completion of construction or when dewatering and control of surface or ground water is no longer required.

L. Compact backfill to not less than 95 percent of maximum dry density in accordance with ASTM D 698.

M. Foundation Slab: Maintain saturation line at least 3 feet below lowest elevations where concrete is to be placed. Drain foundations in areas where concrete is to be placed before placing reinforcing steel. Keep free from water for 3 days after concrete is placed.

3.02 REQUIREMENTS FOR EDUCTOR, WELL POINTS, OR DEEP WELLS

A. For aboveground piping in ground water control system, include a 12-inch minimum length of clear, transparent piping between each eductor well or well point and discharge header to allow visual monitoring of discharge from each installation.

B. Install sufficient piezometers or monitoring wells to show that trench or shaft excavations in water bearing materials are pre-drained prior to excavation. Provide separate piezometers for monitoring of dewatering and for monitoring of depressurization. Install piezometers and monitoring wells for tunneling as appropriate for selected method of work.

C. Install piezometers or monitoring wells at least one week in advance of the start of associated excavation.

D. Dewatering may be omitted for portions of under drains or other excavations, where auger borings and piezometers or monitoring wells show that soil is pre-drained by existing systems and that ground water control plan criteria are satisfied.

E. Replace installations that produce noticeable amounts of sediments after development.

F. Provide additional ground water control installations, or change method of control if, ground water control plan does not provide satisfactory results based on performance criteria defined by plan and by specifications. Submit revised plan according to Paragraph 1.6.B.

3.03 SEDIMENT TRAPS

A. Install sediment tanks as needed to prevent discharge of sediment into storm sewers and drainage ditches.

B. Inspect daily and clean out tank when one-third of sediment tank is filled with sediment.

3.04 SEDIMENT SUMP PIT

A. Install sediment sump pits as needed to prevent discharge of sediment into storm sewers and drainage ditches.

B. Construct standpipe by perforating 12 inch to 24-inch diameter corrugated metal or PVC pipe.

C. Extend standpipe 12 inches to 18 inches above lip of pit.

D. Convey discharge of water pumped from standpipe to sediment trapping device.

E. Fill sites of sump pits, compact to density of surrounding soil and stabilize surface when construction is complete.

3.05 EXCAVATION DRAINAGE

A. Use excavation drainage methods if well-drained conditions can be achieved. Excavation drainage may consist of layers of crushed stone and filter fabric, and sump pumping, in combination with sufficient ground water control wells to maintain stable excavation and backfill conditions.

3.06 MAINTENANCE AND OBSERVATION

A. Conduct daily maintenance and observation of piezometers or monitoring wells while ground water control installations or excavation drainage is operating at the site, or water is seeping into tunnels, and maintain systems in good operating condition.

B. Replace damaged and destroyed piezometers or monitoring wells with new piezometers or wells as necessary to meet observation schedules.

C. Cut off piezometers or monitoring wells in excavation areas where piping is exposed, only as necessary to perform observation as excavation proceeds. Continue to maintain and make specified observations

D. Remove and grout piezometers inside or outside of excavation area when ground water control operations are complete. Remove and grout monitoring wells when directed by Engineer.

3.07 MONITORING AND RECORDING

A. Monitor and record average flow rate of operation for each deep well, or for each wellpoint or eductor header used in dewatering system. Also, monitor and record water level and ground water recovery. Record observations daily until steady conditions are achieved and twice weekly thereafter.

B. Observe and record elevation of water level daily as long as ground water control system is in operation, and weekly thereafter until Work is completed or piezometers or wells are removed, except when Engineer determines more frequent monitoring and recording are required. Comply with Engineer's direction for increased monitoring and recording and take measures necessary to ensure effective dewatering for intended purpose.

3.08 SURFACE WATER CONTROL

A. Intercept surface water and divert it away from excavations through use of dikes, ditches, curb walls, pipes, sumps or other approved means. Requirement includes temporary works required to protect adjoining properties from surface drainage caused by construction operations.

B. Divert surface water and seepage water into sumps and pump it into drainage channels or storm drains, when approved by agencies having jurisdiction. Provide settling basins when required by agencies.

END OF SECTION

01 58 10 EXCAVATION IN PUBLIC WAY PERMIT SIGNS

1.00 GENERAL

1.01 SECTION INCLUDES

A. Project sign installation.

B. Maintenance and removal of Project sign.

1.02 SYSTEM DESCRIPTION

A. Sign Construction: Construct signs of new materials.

B. Appearance: Maintain signs to present a clean and neat look throughout the Contract duration or phase of construction.

C. Sign Placement: Place signs at each street entrance to street cut excavation.

1.03 SUBMITTALS

A. Submit Shop Drawings under provisions of Section 01 33 00 Submittal Procedures.

B. Show content, layout, lettering style, lettering size and colors. Make sign and lettering to scale, clearly indicating condensed lettering, if used.

2.00 PRODUCTS

2.01 SIGN LAYOUT

A. Conform to Texas Manual on Uniform Traffic Control Devices. Minimum size: 36 inches by 36 inches.

B. Lettering: Uppercase Helvetica Regular lettering.

C. Composition: Include on sign copy of street cut permit, title “West Harris County Regional Water Authority”, address, and emergency telephone number and Contractor’s name. Engineer will provide address, and emergency telephone number for preparation of sign.

3.00 EXECUTION

3.01 INSTALLATION

A. Install Project signs a minimum of 72 hours before commencement of pavement excavation in Public Way.

B. Position sign so it is fully visible and readable to general public.

C. Erect sign level and plumb.

D. Erect sign so that top edge of sign is at a nominal 8 feet above existing grade.

3.02 MAINTENANCE AND REMOVAL

A. Keep signs and supports clean. Repair deterioration and damage.

B. Remove signs, framing, supports and foundations to depth of at least 2 feet upon completion of the Work. Restore area to condition equal to or better than before construction.

END OF SECTION

01 60 00 PRODUCT REQUIREMENTS

Note to Specifier: Verify all references to: (1) paragraphs within this Section; (2) other Sections of the Specifications; and (3) any other applicable standards or sources of information.

PART 1 - GENERAL

1.01 SUMMARY

A. Provide products for this Project that comply with the requirements of this Section. Specific requirements of the detailed equipment specifications govern in the case of a conflict with the requirements of this Section.

B. Comply with applicable specifications and standards.

1.02 DOCUMENTATION

A. Provide documents in accordance with the Contract Documents.

1.03 QUALITY ASSURANCE

A. Design Criteria:

1. Provide products designed for structural stability and operational capability.

2. Provide members designed to withstand all loads imposed by installation, erection, and operation of the product without deformation, failure, or adversely affecting the operational requirements of the product. Size and strength of materials for structural members are specified as minimums only.

3. Design mechanical and electrical components for all loads, currents, stresses, and wear imposed by startup and normal operations of the equipment without deformation, failure, or adversely affecting the operation of the unit. Mechanical and electrical components specified for equipment are specified as the minimum acceptable for the equipment.

B. Coordination:

1. Provide coordination of the entire Project, including verification that structures, piping, and equipment components to be furnished and installed for this Project are compatible.

2. Determine that the equipment furnished for this Project is compatible with the requirements of the Contract Documents and with the equipment and materials furnished by others.

3. Provide electrical components for equipment that comply with all provisions of the Contract Documents.

4. Apply protective coatings and paints to equipment in the shop that are fully compatible with the final coatings to be field applied in accordance with the Contract Documents.

C. Adapting Substitute Products:

1. The Drawings and Specifications are prepared for the specified products. Make modifications to incorporate the products into the Project if a substitution is requested for a product is and approved in accordance with Section 01 26 00 “Change Management.”

2. Do not provide a product with a physical size that exceeds the available space. Consideration may be given to the acceptance of these products or equipment if the Contractor assumes all costs necessary to incorporate the item and the OPT approves such revisions.

3. Coordinate electrical requirements for the products to be installed in the Project, including revisions in electrical equipment components wiring and other elements necessary to incorporate the component.

1.04 STANDARDS

Note to Specifier: Add conflict language to the following paragraph to indicate that only the applicable provisions of the standards will apply if necessary.

A. The applicable industry standards referenced in the Specifications apply as if written here in their entirety.

B. Provide equipment manufactured using structural and miscellaneous fabricated steel conforming to the standards of the American Institute of Steel Construction, except where indicated otherwise.

1.05 WARRANTIES AND GUARANTEES

Note to Specifier: Modify the paragraph below if Section 01 78 36 “Warranties and Service Agreements” is not included in the Contract Documents.

A. Normal warranty provisions are as stated in the General Conditions and Section 01 78 36 “Warranties and Service Agreements.”

B. Correct Defective Work under the provisions of the General Conditions.

C. Provide warranties and guarantees for periods as defined in the Contract Documents. Individual Sections of the Specifications may have more stringent warranty requirements than stated in the General Conditions. The most stringent warranty will apply in the event of conflicts within the Contract Documents.

Note to Specifier: Verify that the 1-year period in the following paragraph is adequate for long lead items and delayed startup.

D. The Contract Documents may require special warranties that guarantee performance at a specified capacity, power consumption, efficiency, or other operating parameter. Correct defects that prevent products from meeting the specified performance parameters. The requirements of the special warranty that guarantee performance will be satisfied when the specified performance parameters have been met for a period of 1 calendar year of operation, unless Owner elects to accept Defective Work under the provisions of the General Conditions.

E. The Contract Documents may require special warranties for periods extending beyond the one-year correction period specified in the General Conditions. The full warranty provisions and requirements for correction of Defective Work stated in the General Conditions apply throughout the extended warranty period.

F. Provide a warranty bond to provide the same protection as the Contractor's performance bond for extended special warranties. The warranty bond will become effective on the day the performance bond expires which is 1 year after the date of final payment per the General Conditions. The warranty bond will remain in effect until the extended warranty period has expired.

G. In the event that products are repaired, modified, or replaced under the warranty bond, then the warranty period will continue on the date of completion of these repairs for a period of 6 months or until the end of the original warranty period, whichever is later. In no event will the warranty period extend more than 6 months beyond the end of the original warranty period.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Provide products according to normally accepted engineering and shop practices, except where a higher standard of quality is required by the Contract Documents.

B. Manufacture like parts of duplicate units to standard sizes and gages that are interchangeable.

C. Two or more items of the same kind are to be identical and made by the same Supplier.

D. Provide products suitable for the intended service.

E. Adhere to the equipment capacities, sizes, and dimensions indicated in the Contract Documents.

F. Do not use products for any purpose other than that for which they were designed.

G. Provide new products. Do not provide equipment that has been in service at any time prior to delivery except for testing in accordance with the Contract Documents.

H. Provide materials suitable for service conditions.

I. Provide iron castings that are tough, close grained gray iron free from blowholes, flaws, or excessive shrinkage and that conform to ASTM A48.

J. Design structural members for shock or vibratory loads.

K. Provide steel that is at least 1/4 inch thick for all elements that will be submerged or subject to splashing all or part of the time during normal operation of the equipment. Chamfer or grind all edges to eliminate sharp exposed edges.

Note to Specifier: Delete the "Electric Motors" Article if the electric motor requirements are specified in the technical specifications.

2.02 ELECTRIC MOTORS

A. Provide equipment with motors that comply with the following requirements unless the detailed equipment specifications have different requirements:

1. Provide motors designed in compliance with NEMA, ANSI, IEEE, and AFBMA standards and the NEC for the specific duty imposed by the driven equipment that are appropriate for the application per these same standards.
2. Provide motors designed for frequent starting duty equivalent to the duty service required by the driven equipment where frequent starting occurs.
3. Provide motors rated for continuous duty at 40 deg. C ambient unless recognized and defined by the standards and codes for intermittent duty as a standard industry practice. Provide motors for which motor temperature rise above 40 deg. C ambient does not exceed the NEMA limit when operating continuously at nameplate horsepower.
4. Provide motors designed to start with an appropriate starter or variable speed drive.
5. Provide motors designed for motor bearing life based upon the actual operating load conditions imposed by the driven equipment.
6. Provide motors sized for the altitude of the location where the equipment is to be installed.
7. Provide motors that meet the following service factor requirements:
    a. Maximum load of 87 percent of the nameplate horsepower for motors with a 1.0 service factor; and
    b. Maximum load of 100 percent of the nameplate horsepower for motors with a 1.15 service factor.
8. Provide motors that comply with the latest applicable provisions of NEMA MG1 and are manufactured using the following process when the detailed specifications call for encapsulated motor windings:
    a. Seal the stator assembly by vacuum pressure impregnation (VPI) with epoxy resin after stator assembly;
    b. Provide two VPI treatments for stator, with each treatment consisting of a dip followed by an oven bake; and
    c. Provide a final (third) coating of a durable epoxy varnish suitable for protection against dust, moisture, and chemical degradation after the final cure for the stator assembly.
9. Provide motors with a clamp type grounding terminals inside the motor conduit box.
10. Provide oversized conduit boxes for motors with external conduit boxes.
11. Provide motors with maximum starting current that meets NEMA MG1, Class H.

12. Provide motors with efficiencies that comply with NEMA MG1 for **[high] [premium]** efficiency motors.
13. Provide motors with minimum insulation Type F.
14. Provide motors that are random wound with copper coils.
15. Provide motors rated for the appropriate classification when motors are installed in a hazardous location.

B. Provide the manufacturer's standard motor on integrally constructed motor driven equipment such as appliances, hand tools, etc. if redesign of the complete unit would be required to provide a motor with the specified features.

C. Provide motors within the horsepower ranges indicated below that are rated and constructed as follows unless otherwise required by the detailed equipment specifications.

1. Below 1/2 hp:
    a. 115 volts, 60 Hertz, single phase;
    b. Dripproof in clean and dry locations; TEFP in all other locations;
    c. Permanently lubricated sealed bearings; and
    d. Built in manual reset thermal protector or furnished with integrally mounted stainless steel enclosed manual motor overload switch.
2. 1/2 to 1 hp:
    a. 230/460 volts, 60 Hertz, 3 phase;
    b. Dripproof in clean and dry locations, TEFC in all other locations; and
    c. Permanently lubricated sealed bearings.
3. 1-1/2 hp and above:
    a. **[230/460] [208]** volts, 60 Hertz, 3 phase;
    b. Dripproof in clean and dry locations, TEFC in all other locations;
    c. Oil or grease lubricated anti friction or oil lubricated sleeve bearings; and
    d. Vertical motors must have 15-year average life thrust bearings.

D. Provide space heaters operating on 120-volt single-phase service for motors with horsepower ratings of 15 hp or greater.

2.03 EQUIPMENT APPURTENANCES

A. Provide a safety guard covering all sides on belt or chain drives, fan blades, couplings, and other moving or rotating parts:

1. Fabricate safety guards from 16 US gauge or heavier galvanized or aluminum clad sheet steel or 1/2-inch mesh galvanized expanded metal;
2. Design guards for easy installation and removal;
3. Provide galvanized supports and accessories for each guard;
4. Provide stainless steel bolts and hardware; and

5. Provide safety guards designed to prevent the entrance of rain and dripping water in outdoor locations.

2.04 ANCHOR BOLTS

A. Provide suitable anchor bolts for each product.

B. Provide anchor bolts with templates or setting drawings in time to permit casting the anchor bolts in the concrete when concrete is placed.

C. Provide two nuts for each bolt.

D. Provide anchor bolts for products mounted on baseplates that are long enough to permit 1-1/2 inches of grout beneath the baseplate and to provide adequate anchorage into structural concrete. Bolts must be long enough to provide full nut engagement and leave three threads exposed. Housekeeping pads are not structural concrete.

E. Provide stainless steel anchor bolts, nuts, and washers.

2.05 SPECIAL TOOLS AND ACCESSORIES

A. Furnish tools, instruments, lifting and handling devices, and accessories necessary for proper maintenance and adjustment that are available only from the manufacturer or are not commonly available.

2.06 EQUIPMENT IDENTIFICATION PLAQUES

A. Provide a plaque for each piece of equipment in accordance with Section 40 05 53 “Identification for Process Piping and Equipment.”

2.07 LUBRICATION SYSTEMS FOR EQUIPMENT

A. Provide equipment lubricated by systems which:

1. Require attention no more frequently than weekly during continuous operation.

2. Do not require attention during startup or shut down.

3. Do not waste lubricants.

B. Provide lubricants to fill lubricant reservoirs and to replace lubricant consumed during testing, startup, and operation prior to acceptance of equipment by the Owner.

2.08 INSULATION OF PIPING

A. Insulate all piping on or related to equipment as required to prevent freezing under any condition. Insulate piping per the manufacturer’s written instruction or per Section 23 07 19 “HVAC Piping Insulation” whichever is more stringent.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install equipment including equipment pre-selected or furnished by the Owner. Assume responsibility for proper installation, startup, and making the necessary adjustments so

that the equipment is placed in proper operating condition per Section 01 75 00 “Starting and Adjusting.”

3.02 LUBRICATION

A. Lubricate all products provided or installed for this Project, including products furnished by the Owner, per the manufacturer’s written recommendations until the product is accepted by the Owner.

END OF SECTION

01 63 00 PRODUCT SUBSTITUTION PROCEDURES

1.00 GENERAL

1.01 SECTION INCLUDES

A. Options for making Product or process selections.

B. Procedures for proposing equivalent Products or processes, including pre-approved, pre-qualified, and approved Products or processes.

1.02 DEFINITIONS

A. Product: As defined in Document 00700 – General Conditions. Product does not include machinery and equipment used for production, fabrication, conveying, and erection of the Work. Products may also include existing materials or components designated for reuse.

B. Process: Any proprietary system or method for installing system components resulting in an integral, functioning part of the Work. For this Section, the word Products includes Processes.

1.03 SELECTION OPTIONS

A. Pre-approved Products: Construction products of certain manufacturers or Suppliers designated in Specifications as "pre-approved The Authority references the City of Houston list of pre-approved products for a comprehensive list of pre-approved products. Pre-approved Products for this Project are designated as pre-approved in Specifications. Products of other manufacturers or suppliers are not acceptable for this Project and will not be considered under the submittal process for approving alternate products.

B. Pre-qualified Products: Construction products of certain manufacturers or Suppliers designated in Specifications as "pre-qualified." Pre-qualified Products for this Project are designated as pre-qualified in Specifications. Products of other manufacturers or suppliers are not acceptable for this Project and will not be considered under the submittal process for approving alternate products.

C. Approved Products: Construction products of certain manufacturers or Suppliers designated in Specifications followed by words "or approved equal." Approval of alternate products not listed in Specifications may be obtained through provisions for product options and substitutions in Document 00700 - General Conditions, and by following submittal procedures specified in Section 01 33 00- Submittal Procedures. The procedure for approval of alternate products is not applicable to pre-approved or pre-qualified products.

D. Product Compatibility: To the maximum extent possible, provide Products that are of the same type or function from a single manufacturer, make, or source. Where more than one

choice is available, select Product that is compatible with other Products already selected, specified, or in use by the Authority.

E. Engineer may reject requests for substitution, and his decision will be final and binding on the parties.

1.04 CONTRACTOR'S RESPONSIBILITY

A. Investigate proposed product and determine that it meets or exceeds the quality level of the specified product.

B. Furnish information Engineer deems necessary to judge equivalency of alternate Product.

C. Pay for laboratory testing, as well as any other review or examination costs, needed to establish equivalency between products in order to obtain information upon which Engineer can base a decision.

D. If Engineer determines alternate product is not equal to that named in Specifications, Furnish one of the specified Products.

1.05 AUTHORITY REVIEW

A. Use alternate Products only when approved in writing by Engineer. Engineer's determination regarding acceptance of proposed alternate Product is final.

B. Alternate Products shall be accepted if Products are judged by Engineer to be equivalent to specified Product or to offer substantial benefit to the Authority.

C. The Authority retains the right to accept any Product deemed advantageous to the Authority, and similarly, to reject any product deemed not beneficial to Authority.

1.06 SUBSTITUTION PROCEDURE

A. Collect and assemble technical information applicable to the proposed Product to aid in determining equivalency as related to the approved Product specified.

B. Submit a written request for a construction Product to be considered as an alternate Product.

C. Submit Product information after the effective date of the Contract and within the time period allowed for substitution submittals given in Document 00700 - General Conditions. After the submittal period has expired, requests for alternate Products shall be considered only when specified Product becomes unavailable because of conditions beyond Contractor's control.

D. Electronically submit each request for alternate Product approval in WHCRWA FTP site. Include the following information:

1. Complete data substantiating compliance of proposed substitution with the Contract.
2. For Products:
    a. Product identification, including manufacturer's name and address.
    b. Manufacturer's literature with Product description, performance and test data, and reference standards.
    c. Samples, as applicable.
    d. Name and address of similar projects on which Product was used and date of installation. Include names of Owner, DPOR, and installing contractor.
3. For construction methods:
    a. Detailed description of proposed method.
    b. Drawings illustrating methods.
4. Itemized comparison of proposed substitution with Product or method specified.
5. Data relating to changes in Construction Schedule.
6. Relation to separate contracts, if any.
7. Accurate cost data on proposed substitution in comparison with Product or method specified.
8. Other information requested by Engineer.

E. Approved alternate Products will be subject to the same review process as the specified Product would have been for Shop Drawings, Product Data, and Samples.

2.00 PRODUCTS – NOT USED

3.00 EXECUTION – NOT USED

END OF SECTION

01 70 00 EXECUTION AND CLOSEOUT REQUIREMENTS

Note to Specifier: Verify all references to: (1) paragraphs within this Section; (2) other Sections of the Specifications; and (3) any other applicable standards or sources of information.

PART 1 - GENERAL

1.01 SUMMARY

A. Comply with requirements of the General Conditions and specified administrative procedures in closing out the Contract.

1.02 DOCUMENTATION

A. Submit affidavits and releases on forms provided by the Construction Manager **[through the PMIS]**.

1.03 SUBSTANTIAL COMPLETION

A. The following requirements must be met for the Project or a designated portion of the Work to be Substantially Complete per the General Conditions:

1. Work must be fully functional and able to operate in accordance with the Contract Documents without special or extraordinary efforts on the part of the Owner.

Note to Specifier: The subparagraph below should be used if it is desirable to expand the definition of Substantial Completion. Describe specific items that must be constructed or specific facilities that must be in operation before the Project can be determined to be Substantially Complete.

2. The following items of Work must be fully functional and able to operate in accordance with the Contract Documents:

a. **[Specify items of Work that must be completed before the Project can reach Substantial Completion.]**

Note to Specifier: As an option, the subparagraph below can be used to list those items that may remain incomplete and the Project still be considered Substantially Complete.

3. The following items may remain incomplete in accordance with the Contract Documents:

a. **[Specify items of Work that do not need to be completed before the Project can reach Substantial Completion.]**

Note to Specifier: The next two subparagraphs below should be used for projects that have equipment or systems that are to be started and operated for a period of time to prove performance criteria has been met.

4. Performance Acceptance Testing (PAT) must be complete and indicated compliance with the requirements of the Contract Documents.

5. Operation and maintenance manuals must be approved and operator training conducted to allow the Owner to assume responsibility for operations.

B. Conduct inspections with superintendent, Subcontractors, and Suppliers for the Work or a designated portion of the Work prior to calling for a Substantial Completion inspection by the OPT. Create a list of deficiencies in the Work that must be completed for the Project to qualify for Substantial Completion. Review the list with the Construction Manager or the designated member of the OPT. The Construction Manager or the designated member of the OPT may assist the Contractor with this effort; however, it is the Contractor's responsibility to create and manage this list of deficiencies until corrections are made.

C. Correct the identified deficiencies prior to calling for a Substantial Completion inspection.

D. Notify the Construction Manager that the Work or a designated portion of the Work is Substantially Complete per the General Conditions. Include a list of the items remaining to be completed or corrected before the Project will be considered for Final Completion.

E. OPT will visit the Site to observe the Work within a reasonable time after notification is received to determine the status of the Project.

F. Construction Manager will notify the Contractor that the Work is either Substantially Complete or that additional Work must be performed before the Project will be considered Substantially Complete.

1. Construction Manager will notify the Contractor of items that must be completed before the Project will be considered Substantially Complete.

2. Correct the noted deficiencies in the Work.

3. Notify the Construction Manager when the items of Work in the Construction Manager's notice have been completed.

4. OPT will revisit the Site and repeat the process.

5. Construction Manager will issue a Certificate of Substantial Completion to the Contractor when the OPT considers the Project to be Substantially Complete. The certificate will include a tentative list of items to be corrected before Final Payment will be recommended.

6. Review the list and notify the Construction Manager of any objections to items on the list within 10 days after receiving the Certificate of Substantial Completion.

1.04 TRANSFER OF UTILITIES

A. Transfer utilities to the Owner when the Certificate of Substantial Completion has been issued.

B. Submit final meter readings for utilities and similar data as of the date the Owner occupied the Work.

1.05 CLOSEOUT REQUIREMENTS

A. Provide the following before Final Completion:

1. Record Documents per Section 01 31 13 "Project Coordination";

2. Keys and keying schedule;

3. Warranties, bonds, and service agreements;

4. Equipment Installation Reports;
5. Shop Drawings, Product Data, operation and maintenance manuals, and other documentation required by the Contract Documents;
6. Specified spare parts and special tools;
7. Certificates of occupancy, operating certificates, or other similar releases required to allow the Owner unrestricted use of the Work and access to services and utilities;
8. Evidence of continuing insurance and bond coverage as required by the Contract Documents; and
9. Final videos and photographs per Section 01 33 06 “Graphic Documentation.”

1.06 WARRANTIES, BONDS, AND SERVICES AGREEMENTS

A. Provide warranties, bonds, and service agreements required by Section 01 33 00 “Document Management” or by the individual Sections of the Specifications.

B. The date for the start of warranties, bonds, and service agreements is established per the General Conditions.

C. Compile warranties, bonds, and service agreements and review these documents for compliance with the Contract Documents.
   1. Each document is to be signed by the respective Supplier or Subcontractor.
   2. Each document is to include:
      a. The product or Work item description;
      b. The firm name, with the name of the principal, address, and telephone number;
      c. Scope of warranty, bond, or services agreement;
      d. Date, duration, and expiration date for each warranty bond and service agreement;
      e. Procedures to be followed in the event of a failure; and
      f. Specific instances that might invalidate the warranty or bond.

D. Submit digital copies of the documents to the Construction Manager for review.

E. Submit warranties, bonds, and services agreements within 10 days after equipment or components placed in service.

1.07 FINAL COMPLETION

A. Conduct inspections with Superintendent, Subcontractors, and Suppliers prior to calling for a Final Completion inspection by the OPT. Create a list of deficiencies in the Work that must be completed for the Project to qualify for the Final Completion inspection. Review the list with the Construction Manager or the designated member of the OPT. The Construction Manager or the designated member of the OPT may assist the Contractor with this effort; however, it is the Contractor’s responsibility to create and manage this list of deficiencies until corrections are made.

B. Identify, list, and correct deficiencies prior to calling for a Final Completion inspection. The Project at the call for Final Completion represents the Contractor's interpretation of a project completed in conformance with the Contract Documents and reflects the Contractor's representation of a quality project meeting the Owner's expectations.

C. Notify the Construction Manager when:

1. Work has been completed and complies with the Contract Documents;
2. Equipment and systems have been tested per the Contract Documents and are fully operational;
3. Final operation and maintenance manuals have been provided to the Owner and all operator training has been completed;
4. Specified spare parts and special tools have been provided;
5. Work is complete and ready for final inspection;
6. Final documentation for all outstanding Modifications and Claims (other than those listed on the Certificate of Final Completion) have been processed and are ready for incorporation into the final Application for Payment; and
7. Closeout requirements in Paragraph **[1.05]** have been completed.

D. OPT will visit the Site to determine if the Project is complete and ready for final payment within a reasonable time after the notice is received.

E. Construction Manager will notify the Contractor that the Project is complete or will notify the Contractor that Work is Defective.

F. Take immediate steps to correct Defective Work. Notify the Construction Manager when Defective Work has corrected. OPT will visit the Site to determine if the Project is complete and the Work is acceptable. Construction Manager will issue a Certificate of Final Completion to the Contractor when the Project is complete or will notify the Contractor that Work is Defective.

G. Submit the request for final payment with closeout documentation described in Paragraph **[1.06]** if notified that the Project is complete and the Work is acceptable.

1.08 REINSPECTION FEES

A. Owner may impose a set-off against the Application for Payment in accordance with the General Conditions to compensate the OPT for additional visits to the Project if additional Work is required.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

01 72 50 FIELD SURVEYING

1.00 GENERAL

1.01 QUALITY CONTROL

A. Conform to State of Texas laws for surveys requiring licensed surveyors. Employ a surveyor acceptable to Engineer if required by the Contract.

1.02 MEASUREMENT AND PAYMENT

A. UNIT PRICES

1. No separate payment will be made for field surveying. Include cost in unit price for related items.

1.03 SUBMITTALS

A. Conform to requirements of Section 01 33 00 - Submittal Procedures.

B. Submit name, address, and telephone number of Surveyor to Engineer before starting survey work.

C. Submit documentation verifying accuracy of survey work on request.

D. Submit certificate signed by Surveyor, that elevations and locations of the Work are in conformance with the Contract.

1.04 PROJECT RECORD DOCUMENTS

A. Maintain a complete and accurate log of control and survey work as it progresses.

B. Prepare a certified survey setting forth dimensions, locations, angles, and elevations of construction and site work upon completion of foundation walls and major site improvements.

C. Submit record documents under provisions of Section 01 78 50 - Project Record Documents.

1.05 EXAMINATION

A. Verify locations of survey control points prior to starting the Work.

B. Notify Engineer immediately if any discrepancies are discovered.

1.06 SURVEY REFERENCE POINTS

A. The Authority will establish survey control datum as indicated on Drawings. Inform Engineer in Advance of time horizontal and vertical control points will be established so verification

deemed necessary by Engineer may be done with minimum inconvenience to the Authority or Contractor.

B. Locate and protect survey control points prior to starting site work; preserve permanent reference points during construction.

C. Notify Engineer a minimum of 48 hours before relocation of reference points is needed due to changes in grades or other reasons.

D. Promptly report loss or destruction of reference points to Engineer.

E. Reimburse the Authority for cost of reestablishment of permanent reference points disturbed by construction operations.

1.07 SURVEY REQUIREMENTS

A. Utilize recognized engineering survey practices.

B. Establish a minimum of two permanent benchmarks on site, referenced to established control points. Record horizontal and vertical location data on Project record documents.

C. Establish elevations, lines and levels to provide quantities required for measurement and payment and for appropriate controls for the Work. Locate and lay out the following with appropriate instruments:

1. Site improvements including grading, fill and topsoil placement, utilities, and footings and slabs

2. Grid or axis for structures

3. Building foundation, column locations, and ground floor elevations

D. Periodically verify layouts.

2.00 PRODUCTS – NOT USED

3.00 EXECUTION – NOT USED

END OF SECTION

01 73 10 CUTTING AND PATCHING

1.00 GENERAL

1.01 SECTION INCLUDES

A. Cutting, patching and fitting of the Work or work under construction.

1. Coordinating Installation or connection of the Work to existing facilities, or uncovering work for access, inspection or testing and related submittals.

1.02 MEASUREMENT AND PAYMENT

A. UNIT PRICES

1. No separate payment will be made for cutting and patching. Include cost in unit price for related items.

1.03 CUTTING AND PATCHING

A. Perform activities to avoid interference with facility operations and work of others in accordance with Document 00700 - General Conditions of Contract.

B. Execute cutting and patching, including excavation, backfill and fitting to:

1. Remove and replace defective work or work not conforming to Drawings and Specifications;

2. Take samples of installed work as required for testing;

3. Remove construction required to provide for specified alterations or additions to existing work;

4. Uncover work to allow inspection or reinspection by Engineer or regulatory agencies having jurisdiction;

5. Connect uninstalled work to completed work in proper sequence;

6. Remove or relocate existing utilities and pipes that obstruct work;

7. Make connections or alterations to existing or new facilities;

8. Provide openings, channels, chases and flues and cut, patch, and finish; if required; or

9. Provide protection for other portions of the Work.

C. Restore existing work to a condition equal to or better than that which existed prior to cutting and patching, and to standards required by Specifications.

D. Support, anchor, attach, match, trim and seal materials to work of others. Unless otherwise specified, Furnish and Install sleeves, inserts, and hangers required for execution of the Work.

E. Provide shoring, bracing and support necessary to maintain structural integrity and to protect adjacent work from damage during cutting and patching. Request written approval from Engineer, before cutting structural members such as beams, anchors, lintels, or other supports. Follow approved submittals, as applicable.

F. Match new materials to existing materials by bonding, lapping, mechanically tying, anchoring or other effective means in order to prevent cracks and to minimize evidence of patching. Conceal effects of demolition and patching by blending new construction to existing surfaces. Avoid obvious breaks, joints or changes of surface appearance unless shown on Drawings or authorized by Engineer.

1.04 SUBMITTALS

A. Conform to requirements of Section 01 33 00 - Submittal Procedures.

B. Submit a written request to Engineer for consent to proceed, before conducting cutting operations that might affect structural integrity, design function, Authority operations, or work of another contractor.

C. Include the following in submittal:

1. Identification of Project

2. Description of affected work

3. Necessity for cutting

4. Effect on other work and on structural integrity

5. Describe the proposed work including:

a. Scope of cutting and patching

b. Contractor, Subcontractor or Supplier who will execute the work

c. Proposed Products

d. Extent of refinishing

e. Schedule of operations

6. Alternatives to cutting and patching

D. When work conditions or schedules dictate the need for change of materials or methods, submit a written recommendation to Engineer that includes:

1. conditions necessitating the change;

2. recommendations for alternative materials or methods; and

3. submittals required for proposed substitutions

E. Notify Engineer in writing when work will be uncovered for observation. Do not begin cutting or patching operations until authorized by Engineer.

1.05 CONNECTIONS TO EXISTING FACILITIES

A. Perform construction operations necessary to complete connections and tie-ins to existing facilities. Keep existing facilities in continuous operation unless otherwise permitted in the Specifications or approved in writing by Engineer.

B. Coordinate interruption of service requiring connection to existing facilities with Engineer. Do not bypass wastewater or sludge to waterways. Provide temporary pumping facilities to handle wastewater if necessary. Use temporary bulkheads to minimize disruption. Provide temporary power and piping to facilitate construction where necessary.

C. Submit a detailed schedule of proposed connections, including shut-downs and tie-ins. Include proposed time and date as well as anticipated duration of work. Coordinate the connection schedule with the construction schedule.

1. Submit specific times and dates to Engineer at least 48 hours in advance of proposed work.

D. Procedures and Operations:

1. Operate existing pumps, valves and gates in required sequence under supervision of Engineer. Do not operate valves, gates or other items of equipment without Engineer's knowledge.

2. If possible, test equipment under operating conditions before making final tie-ins to connect equipment to existing facility.

3. Coordinate work and schedules. Notify Engineer at least 48 Hours before shutdowns or bypasses are required.

2.00 PRODUCTS - NOT USED

3.00 EXECUTION - NOT USED

END OF SECTION

01 73 20 PROCEDURE FOR WATER VALVE ASSISTANCE

1.00 GENERAL

1.01 SECTION INCLUDES

A. Operation of valves: Authority employees will operate existing valves. Contractor's employees may operate new valves included in the Project prior to acceptance by the Authority.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for this item. Include the cost of valve operation and valve assistance in Unit Price bid for valves and water mains.

1.03 PROCEDURE

A. Contractor to coordinate with Engineer, operator, and Resident Project Representatives for valve assistance.

1.04 SUBMITTALS

A. Submit request for work order planning meetings in accordance with Section 01 33 00 – Submittal Procedures.

1.05 CANCELLATION

A. The Authority may cancel a scheduled valve assistance appointment at no extra cost to either party. Cancellation may be caused by bad weather, preparation work taking longer than anticipated or unforeseen delays by one or more of the three parties.

2.00 PRODUCTS -NOT USED

3.00 EXECUTION -NOT USED

END OF SECTION

01 74 23 FINAL CLEANING

Note to Specifier: Verify all references to: (1) paragraphs within this Section; (2) other Sections of the Specifications; and (3) any other applicable standards or sources of information.

PART 1 - GENERAL

1.01 SUMMARY

A. Perform a thorough cleaning of the Site, buildings, or other structures prior to Owner occupancy of the buildings, and prior to Final Completion. Leave the Project clean and ready for occupancy.

1.02 DOCUMENTATION

A. Provide data for maintenance per Section 01 33 04 “Operation and Maintenance Data.”

1.03 QUALITY CONTROL

A. Use experienced workmen or professional cleaners for final cleaning.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Furnish the labor and products needed for cleaning and finishing as recommended by the manufacturer of the surface material being cleaned.

B. Use cleaning products only on the surfaces recommended by the Supplier.

C. Use only those cleaning products which will not create hazards to health or property and which will not damage surfaces.

PART 3 - EXECUTION

3.01 FINAL CLEANING

A. Thoroughly clean the entire Site and make ready for occupancy.

1. Remove construction debris, boxes, and trash from the Site.
2. Remove construction storage sheds and field offices.
3. Restore grade to match surrounding condition and remove excess dirt.
4. Sweep all drives and parking lots clean of dirt and debris. Use water trucks or hose down paved site to like new appearance.

B. Clean floors and inspect for damage.

1. Remove oil, grease, paint drippings, and other contaminants from floors, then mop repeatedly until thoroughly clean. Replace damaged flooring.

2. Clean resilient flooring with an approved cleaner and provide one coat of liquid floor polish as recommended by the flooring manufacturer. Polish to a buffed appearance with powered floor buffer.

3. Vacuum all carpets with powered floor sweeper to remove dirt and dust. Remove glue or other substances from nap of carpet.

C. Clean and polish inside and outside glass surfaces. Wash with window cleaner and water, apply a coat of high quality glass polish, and wipe clean. Do not scratch or otherwise mar glass surfaces.

D. Clean wall surfaces to remove dirt or scuff marks. Remove excess adhesive along top edges of wall base. Remove adhesive from surfaces of vinyl wall coverings.

E. Align ceiling tile to fit properly in grid and replace cracked or damaged tile. Remove smear marks and other dirt from tile and clean surface of grid system.

F. Spot paint nicks and other damage. Repaint the wall from inside corner to inside corner if spot-painting does not blend into the existing color and texture of the surrounding surfaces. Touch up damaged surfaces on factory finished equipment using special paint furnished by the manufacturer.

G. Clean plumbing fixtures, valves, and trim. Clean toilet seats and covers. Remove labels and adhesive from fixtures. Remove floor drains and clean baskets or buckets. Polish strainers and exposed chrome or brass.

H. Remove dirt, oil, grease, dust, and other contaminants from floors, equipment, and apparatus in mechanical and electrical rooms.

I. Clean and polish ceramic tile floors and wall surfaces to remove mildew or other stains. Tuck point defective joints.

J. Inspect exterior painted surfaces. Spot paint any damaged surfaces.

K. Clean permanent filters and replace disposable filters on heating, ventilating, and air conditioning systems. Clean ducts, blowers, and coils if units were operated without filters during construction.

L. Clean roof areas of debris; flush roof drainage systems with water until clear.

M. Broom clean exterior paved surfaces and rake clean other surfaces of the grounds.

N. Clean and polish all electrical equipment and exposed conduits. Remove paint overspray. Provide a blemish free appearance on all exposed equipment and conduits.

END OF SECTION

01 75 00 STARTING AND ADJUSTING

Note to Specifier: Verify all references to: (1) paragraphs within this Section; (2) other Sections of the Specifications; and (3) any other applicable standards or sources of information.

PART 1 - GENERAL

1.01 SUMMARY

A. Provide step-by-step procedures for starting provided systems, including equipment, pumps, and processes.

B. Provide pre-startup inspections by equipment manufacturers.

C. Place each system in service and operate the system to prove performance and to provide for initial correction of defects in workmanship, calibration, and operation.

D. Provide for initial maintenance and operation.

E. Include costs for starting and adjusting provided by manufacturer's representative in the Cost of Work for the equipment package.

F. Owner will provide chemicals, if any, required for continued operations.

1.02 STANDARDS

A. Comply with the specified standards associated with the testing or startup of equipment.

1.03 DOCUMENTATION

A. Provide the following documents in accordance with Section 01 33 00 "Document Management":

1. A Plan of Action for testing, checking, and starting equipment as Product Data per Section 01 31 13 "Project Coordination."

2. Equipment Installation Reports on the form provided by the Construction Manager certifying that the equipment and related appurtenances have been thoroughly examined and approved for startup and operation.

3. Operation and maintenance manuals per Section 01 33 04 "Operation and Maintenance Data." Preliminary operation and maintenance data must be approved before installation, testing, and initial operation of equipment or providing training required by Section 01 79 00 "Training of Operation and Maintenance Personnel."

1.04 SPECIAL JOB CONDITIONS

A. Do not start or test any equipment until the complete unit has been installed and thoroughly checked.

B. Provide the services of a qualified representative of the manufacturer to attend the tests and startup procedures as required by this Section.

C. Do not start or test any equipment until the preliminary operation and maintenance manual per Section 01 33 04 "Operation and Maintenance Data" has been approved.

PART 2 - PRODUCTS

2.01 TESTING INSTRUMENTATION

A. Provide new instrumentation and testing devices needed to conduct tests for maintenance and operation as recommended in the operation and maintenance manuals. This equipment is to become the property of the Owner and transferred in good working order as a spare part at Substantial Completion. This equipment is to be calibrated and ready for use during the startup procedure and for training provided in accordance with Section 01 79 00 “Training of Operation and Maintenance Personnel.”

PART 3 - EXECUTION

3.01 SERVICES OF MANUFACTURER’S REPRESENTATIVES

A. Provide the services of experienced and technically competent representatives of the manufacturer for inspections, tests, supervision of installation, training, and assistance with placing equipment in operation.

B. Perform installation, adjustment, and testing of the equipment under the direct supervision of the manufacturer’s representative where specified. Certify that the equipment and related appurtenances have been thoroughly examined and approved for startup and operation in the Equipment Installation Reports.

C. Provide on-site services as necessary for proper and trouble free operation of the equipment.

3.02 INSPECTION AND STARTUP

A. Inspect equipment prior to placing any equipment or system into operation. Make adjustments as necessary for proper operation. Do not start or test any apparatus until the complete unit has been installed and thoroughly checked.

1. Check for adequate and proper lubrication.
2. Determine that parts or components are free from undue stress from structural members, piping, or anchorage.
3. Adjust equipment for proper balance and operations.
4. Determine that vibrations are within acceptable limits.
5. Determine that equipment operates properly under full load conditions.
6. Determine that the equipment is in true alignment.
7. Ensure that the proper procedure is employed in startup of systems.

3.03 STARTING REQUIREMENTS

A. Refer to the individual Specification Sections for specific startup procedures or other requirements.

3.04 INITIAL OPERATION

A. Start, test, and place equipment and systems into operation for 30 days to allow the OPT to observe the operation and overall performance of the equipment and to determine that controls function as intended.

B. Operate equipment which is used on a limited or part-time basis in the presence of the OPT for a period long enough to demonstrate that controls function as specified.

C. Perform acceptance test as specified in individual Specification Sections. Demonstrate that equipment and systems meet the specified performance criteria.

D. Equipment and systems may be considered as substantially complete at the end of this initial operation period if the equipment is placed in continuous beneficial use by the Owner, unless specifically stated otherwise in the individual equipment Specifications.

3.05 INITIAL MAINTENANCE

A. Maintain equipment in accordance with the operation and maintenance manuals until Project is substantially complete and provisions have been made by the Owner for accepting responsibility for equipment operation in accordance with the General Conditions.

B. Service equipment in accordance with the operation and maintenance manuals immediately before releasing the equipment to the Owner.

END OF SECTION

01 78 36 WARRANTIES AND SERVICE AGREEMENTS

Notes to Specifier:

1. **Include this Section when equipment or materials are pre-purchased or pre-selected, when service agreements are to be provided, or extended or special warranties are required. Delete the "Warranties and Guarantees" and "Service Agreements" paragraphs in Section 01 33 02 "Shop Drawings" and Section 01 33 03 "Product Data" if this Section is included in the Contract Documents.**
2. **Verify all references to: (1) paragraphs within this Section; (2) other Sections of the Specifications; and (3) any other applicable standards or sources of information.**

PART 1 - GENERAL

1.01 WARRANTY REQUIREMENTS

A. Provide products for this Project that comply with the requirements of this Section.

1.02 WARRANTIES AND GUARANTEES

A. Guarantee and warrant products furnished by the Contractor against:

1. Faulty or inadequate design;
2. Improper assembly or erection;
3. Defective workmanship or materials; and
4. Leakage, breakage, or other failure.

B. Guarantee and warrant the products installed under this Contract, including Goods furnished by the Owner, against leakage, breakage, or other failure due to improper assembly or erection and against improper installation of the equipment. The correction period is as defined in the General Conditions. Individual Specification Sections may have more stringent warranty requirements than those stated in the General Conditions. The most stringent warranty will be provided in the event of conflicts.

C. Provide all required warranties, guarantees, and related documents with the Shop Drawing. The effective date of warranties and guarantees will be the date of Substantial Completion.

D. Include an additional copy of equipment warranties in operation and maintenance manuals.

E. Provide a copy of all warranties in a separate document in accordance with Section 01 70 00 "Execution and Closeout Requirements."

1.03 EXTENDED WARRANTIES

A. Extended Warranties are defined as any guarantee of performance for the product or system beyond the one-year correction period described in the General Conditions.

B. Issue the warranty certificate in the name of the Owner.

C. Provide a warranty bond for Extended Warranties as required by the individual Specification Sections.

1.04 SERVICE AGREEMENTS

A. Provide Extended Service Agreements (ESA) and related documents with the Shop Drawing. An Extended Service Agreement is a contract between the Owner and an approved Subcontractor or Supplier to provide service and or maintenance beyond that required to fulfill requirements for warranty repairs or to perform routine maintenance for a definite period beyond the one-year correction period specified in the General Conditions.

B. Requirements for the Extended Service Agreement are described in the Specification Sections for each piece of equipment or system requiring an Extended Service Agreement.

C. Enter into a contract with the service provider and assign the service contract to the Owner on the date of Substantial Completion. Once assigned to the Owner, Contract requirements for the Extended Service Agreement will be complete and will not extend the Contract between the Owner and Contractor.

D. Owner may require that a performance bond be provided for the Extended Service Agreement. Provide a separate bond meeting the same requirements as those for the Contractor's performance bond if required. The bond will be in the amount of the Extended Service Agreement.

E. Include an additional copy of Extended Service Agreements in operation and maintenance manuals.

F. Provide a copy of Extended Service Agreements in a separate document in accordance with Section 01 70 00 "Execution and Closeout Requirements."

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

01 78 50 PROJECT RECORD DOCUMENTS

1.00 GENERAL

1.01 SECTION INCLUDES

A. Maintenance and Submittal of Record Documents and Samples.

1.02 MAINTENANCE OF DOCUMENTS AND SAMPLES

A. Maintain one record copy of documents at site in accordance with the Supplemental Conditions of the Contract.

B. Store Record Documents and samples in field office when field office is required by Contract, or in secure location. Provide files, racks, and secure storage for Record Documents and samples.

C. Label each document “PROJECT RECORD” in neat, large, printed letters.

D. Maintain Record Documents in clean dry and legible condition. Do not use Record Documents for construction purposes.

E. Keep Record Documents and Samples available for inspection by Project Representative.

F. Bring Record Documents to progress review meetings for viewing by Project Representative. After each progress review meeting, update Contract Drawings using owner provided document management system and save update as “Project Record Drawing” on (insert date).

1.03 RECORDING

A. Record information concurrently with construction progress. Do not conceal Work until required information is recorded.

B. Contract Drawings and Shop Drawings: On actual documents and on Project Record Drawing, legibly mark each item to record actual construction, or “as built” conditions, including:

1. Measured depths of elements of foundation in relation to finish first floor datum

2. Measured horizontal locations and elevations of underground utilities and appurtenances, referenced to permanent surface improvements

3. Elevations of underground utilities referenced to bench mark utilized for Project

4. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of construction

5. Field changes of dimension and detail

6. Changes made by modifications

7. Details not on original Contract Drawings

8. References to related shop drawings and modifications

9. Locations, elevation and station of other utilities not shown on contract drawings and encountered during construction.

C. Maintain on site at all times an instrument for accurately measuring elevations. Survey every joint of water main at time of construction and record on drawings water main invert elevation, including elevation top of manway and centerline horizontal location relative to baseline.

D. Record information with red felt-tip marking pen on set of construction drawings.

E. For large diameter water mains, legibly mark specifications and addenda to record:

1. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.

2. Changes made by change order or field order.

3. Other matters not originally specified.

F. Legibly annotate shop drawings to record changes made after review.

G. In addition to record drawings, at Contract Closeout, make all as-built comments and changes to contract drawings and submit to owner provided document management system in *.PDF format.

1.04 SUBMITTALS

A. At Contract closeout, input Project Record Documents into owner provided document management system in *.PDF format and deliver original Documents to Engineer.

2.00 PRODUCTS (NOT USED)

3.00 EXECUTION (NOT USED)

END OF SECTION

01 79 00 TRAINING OF OPERATION AND MAINTENANCE PERSONNEL

Note to Specifier: Verify all references to: (1) paragraphs within this Section; (2) other Sections of the Specifications; and (3) any other applicable standards or sources of information.

PART 1 - GENERAL

1.01 SUMMARY

A. Provide services of Supplier's operation and maintenance training specialists to instruct Owner's personnel in recommended operation and maintenance procedures for equipment furnished. Details for training may be established in the specifications for that equipment.

B. Provide a combination of classroom and hands on training.

C. Training may be conducted at Contractor's or Supplier's facilities provided Contractor pays for travel, lodging, and per diem costs of the Owner.

D. Record training sessions on video and submit to the Owner on DVD disk in MPEG-4 format for Owner's later use in instructing Owner's personnel. Include this recording as part of the final operation and maintenance manual. Provide legal releases or pay additional fees required to allow training by the manufacturer to be recorded.

E. Include the cost for training and startup in the Cost of the Work for each equipment package.

1.02 DOCUMENTATION

A. Provide documentation in accordance with Section 01 33 00 "Document Management" and include:

1. Equipment Installation Reports in accordance with Section 01 75 00 "Starting and Adjusting" on forms provided by the Construction Manager;

2. A lesson plan for training in accordance with Paragraph **[3.01.C]**;

3. Credentials of Supplier's proposed operation and maintenance instructors demonstrating compliance with requirements of Paragraph **[1.04]**; and

4. Operation and maintenance manuals per Section 01 33 04 "Operation and Maintenance Data." Preliminary operation and maintenance data must be approved before installation, testing, and initial operation of equipment or providing training required by the Section.

1.03 SCHEDULING OF TRAINING

A. Coordinate training services with startup and initial operation of equipment on days and times Owner is available.

B. Training may be required outside of normal business hours to accommodate schedules of operation and maintenance personnel.

C. Provide training of Owner's personnel after acceptable preliminary operation and maintenance manuals have been approved.

D. Coordinate training with equipment startup and testing and availability of Owner's personnel.

E. Provide a proposed training schedule for review and acceptance by OPT showing all training required in the Contract Documents. Demonstrate compliance with specified training requirements relative to number of hours of training, number of training sessions, and scheduling.

F. Submit initial training schedule at least 60 days before scheduled start of first training session. Submit final training schedule, incorporating revisions in accordance with OPT's comments, no later than 30 days prior to starting the first training session.

G. Owner reserves the right to modify personnel availability for training in accordance with process or emergency needs.

H. Schedule for training is to be approved by Owner.

1. Schedule training and startup operations for no more than one piece of equipment or system at a time.

2. Owner may require re-scheduling of training if operations personnel are not available for training on a scheduled date.

3. Provide a minimum of 2 weeks' notice if training must be rescheduled.

4. Training is to be limited to 24 hours per week.

5. Time required for training is to be included in the development of the Project schedule.

I. Schedule and coordinate training for equipment or systems which depend upon other equipment or systems for proper operation so that trainees can be made familiar with the operation and maintenance of the entire operating system.

1.04 SERVICES OF SUPPLIER'S REPRESENTATIVE

A. Supplier's instructors must be factory-trained by the equipment manufacturer.

B. Instructors must have knowledge of the theory of operation and practical experience with the equipment or system.

C. Instructors must be proficient and experienced in conducting training of the type required and must have successfully conducted similar training courses.

D. Qualifications of instructors are subject to acceptance by OPT. Provide services of replacement instructor with acceptable qualifications if OPT does not accept qualifications of proposed instructor. Include each instructor's résumé and specific details of instructor's operating, maintenance, and training experience relative to the specific equipment for which instructor will provide training to demonstrate their qualifications.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 OPERATOR TRAINING

A. Provide classroom and hands-on training of the care and operation of the equipment to the Owner's personnel.

B. Provide training in adequate detail to ensure that the trainees who complete the program will be qualified and capable of operating and maintaining the equipment, products, and systems provided.

C. Provide a training plan that indicates the schedule and sequence of the training programs. The training plan is to include for each course:

1. Number of hours for the course;
2. Agenda and narrative description, including the defined objectives for each lesson;
3. Draft copy of training handbooks;
4. A descriptive listing of suggested reference publications;
5. Audio-visual equipment required for training; and
6. Type and number of tools or test equipment required for each training session.

D. Provide and use training aids to complement the instruction and enhance learning.

1. Provide training handbooks for use in both the classroom and the hands-on phases of training for each course.
2. Instructional materials must include references to the operation and maintenance manuals and identify and explain the use of the manual.
3. Provide a copy of all audio/visual training materials used in the presentations to the Owner.

E. Operations training is to include:

1. Orientation to provide an overview of system/subsystem configuration and operation;
2. Terminology, nomenclature, and display symbols;
3. Operations theory;
4. Equipment appearance, functions, concepts, and operation;
5. Operating modes, practices, and procedures under normal, diminished, and emergency conditions;
6. Startup and shutdown procedures;
7. Safety precautions;
8. On-the-job operating experience for monitoring functions, supervisory, or command activities. Include functions and activities associated with diminished operating modes, failure recognition, and responses to system/subsystem and recovery procedures; and

9. Content and use of operation and maintenance manuals and related reference materials.

F. Provide training for performing on-site routine, preventive, and remedial maintenance of the equipment or system. Maintenance training is to include:

1. Orientation to provide an overview of system/subsystem concept, configuration, and operation;
2. Operations theory and interfaces;
3. Instructions necessary to ensure a basic theoretical and practical understanding of equipment appearance, layout, and functions;
4. Safety precautions;
5. Use of standard and special tools and test equipment;
6. Adjustment, calibration, and use of related test equipment;
7. Detailed preventive maintenance activities;
8. Troubleshooting, diagnostics, and testing;
9. Equipment assembly and disassembly;
10. Repair and parts replacement;
11. Parts ordering practices and storage;
12. Failure and recovery procedures;
13. Cabling and/or interface connectors;
14. Content and use of operation and maintenance manuals and related reference materials;
15. Procedures for warranty repairs;
16. Lubrication; and
17. Procedures, practices, documentation, and materials required to commence system maintenance.

G. Provide training for the equipment listed in the table below. The table indicates the minimum acceptable training time. Provide additional hours of training if required to meet the training objectives described in this Section.

Specification Section	Equipment/System Description	Min. Hours

END OF SECTION

DIVISION 3

CONCRETE

03 11 00 CONCRETE FORMING

1.00 GENERAL

1.01 WORK INCLUDED

A. Furnish material and labor to form, tie, brace and support wet concrete, reinforcing steel and embedded items until the concrete has developed sufficient strength to remove forms.

1.02 QUALITY ASSURANCE

A. Design Criteria: Forms shall be designed for the pressure exerted by a liquid weighing 150 pounds per cubic foot. The rate of placing the concrete, the temperature of the concrete, and all other pertinent factors shall be taken into consideration when determining the depth of the equivalent liquid. An additional design live load of 50 pounds per square foot shall be used on horizontal surfaces.

B. Alignment Control:

1. True alignment of walls and other vertical surfaces having straight lines or rectangular shapes shall be controlled and checked by the following procedures:

a. Forming shall be arranged with provisions for adjusting the horizontal alignment of a form, after the form has been filled with concrete to grade, using wedges, turn buckles, or other adjustment methods. Establish a transit line or other reference so that adjustments can be made to an established line while the concrete in the top of the form is still plastic.

b. Adjusting facilities shall be at intervals which permit adjustments to a straight line. Concrete shall not be placed until adequate adjusting facilities are in place.

C. Tolerances: Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

1.03 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00 “Submittal Procedures” and shall include:

1. Record Data.

a. Manufacturers’ literature for specified products.

1.04 STANDARDS

A. The applicable provisions of the following standards shall apply as if written here in their entirety:

1. American Concrete Institute (ACI) Specifications:

ACI 117	Specifications for Tolerances for Concrete Construction and Materials
ACI 301	Specifications for Structural Concrete
ACI 318	Building Code Requirements for Structural Concrete

2. American Institute of Steel Construction (AISC) Publication:
    a. AISC Manual of Steel Construction.
3. American Iron and Steel Institute (AISI) Publication:
    a. AISI Cold Formed Steel Design Manual.
4. American Plywood Association (APA) Standards:
    a. APA Design/Construction Guide: Concrete Forming.

1.05 DELIVERY AND STORAGE

A. Lumber for forms shall be stacked neatly on platforms raised above ground.

1.06 JOB CONDITIONS

A. The Contractor shall notify the Engineer upon completion of various portions of the work required for placing concrete so that compliance with the plans and specifications may be monitored. The Engineer will authorize the Contractor to proceed with the placement after this has been completed and corrections, if required, have been made.

B. In hot weather, both sides of the face forms may be required to be treated with oil to prevent warping and to secure tight joints.

2.00 PRODUCTS

2.01 MATERIALS

A. Lumber: Properly seasoned and of good quality; free from loose or unsound knots, knot holes, twists, shakes, decay, splits, and other imperfections which would affect its strength or impair the finished surface of the concrete.

B. Fiber Board Form Lining: Hardboard finished smooth on one side; minimum thickness of 3/16 inch thoroughly wet with water at least 12 hours before using.

C. Plywood Form Lining: Conforming to APA HDO; exterior exposure waterproof adhesive, 3/8 inch thick.

D. Form Oil: Light, clear oil; shall not discolor or injuriously affect the concrete surface, subsequent coatings, or delay or impair curing operations.

2.02 FABRICATIONS

A. Lumber: Lumber for facing or sheathing shall be surfaced on at least one side and two edges, and sized to uniform thickness. Lumber of nominal 1-inch thickness or plywood of 3/4-inch thickness shall be permitted for general use on structures, if backed by a sufficient number of studs and wales.

B. Special Form Lumber:

1. Molding for chamfer strips or other uses shall be made of redwood, cypress, or pine materials of a grade that will not split when nailed, and which can be maintained to a true line without warping. The form shall be mill cut and dressed on all faces. Fillet forms at sharp corners, both inside and outside and at edges, with triangular chamfer

strips at all non-contiguous edges exposed to view. Thoroughly oil chamfer strips before installation on forms.

2. Construct forms for railings and ornamental work to standards equivalent to first class mill work.

3. All moldings, panel work, and bevel strips shall be straight and true with neatly mitered joints, and designed so that the finished work shall be true, sharp and clean cut.

C. Forms:

1. Forms shall be built mortar tight and of material sufficient in strength to prevent bulging between supports.

2. Reused forms or form lumber shall be maintained clean and in good condition as to accuracy, shape, strength, rigidity, tightness, and smoothness of surface.

3. All forms shall be so constructed as to permit removal without damage to the concrete. Exercise special care in framing forms for copings, offsets, railing and ornamental work, so that there will be no damage to the concrete when the forms are removed.

D. Metal Forms:

1. The specifications for “Forms” regarding design, mortar tightness, filleted corners, beveled projections, bracing, alignment, removal, re use, oiling, and wetting shall apply equally to metal forms.

2. The metal used for forms shall be of such thickness that the forms will remain true to shape. Bolt and rivet heads on the facing sides shall be countersunk. Clamps, pins, or other connecting devices shall be designed to hold the forms rigidly together and to allow removal without injury to the concrete.

3. Metal forms which do not present a smooth surface or line up properly shall not be used. Exercise special care to keep metal free from rust, grease, or other foreign material that discolors the concrete.

E. Form Linings:

1. Timber forms for exposed concrete surfaces which are to be given a rubbed finish shall be face-lined with an approved type of form lining material.

2. If plywood is used for form lining, it shall be made with waterproof adhesive and have a minimum thickness of 3/4 inch. It shall preferably be oiled at the mill and then re-oiled or lacquered on the job before using.

3. If fiber board is used, apply water to the screen side on the board. Stack the boards screen side to screen side. Use the smooth hard face as the contact surface of the form. Such surfaces may be formed with 3/4-inch thick plywood made with waterproof adhesive if backed with adequate studs and wales. The greatest strength of the outer plies should be at right angles to the studding. In this case, form lining will not be required.

4. Carefully align edges and faces of adjacent panels and fill the joints between panels with patching plaster or cold water putty to prevent leakage. Lightly sand with No. 0 sandpaper to make the joints smooth.

5. Forms which are reused shall have all unused form tie holes filled and smoothed as specified above.

F. Form Ties:

1. Metal form ties shall be used to hold forms in place and to provide easy metal removal. The use of wire for ties shall not be permitted.

2. Leave no metal or other material within 1-1/2 inches of the surface, when removing form tie assemblies which are used inside the forms to hold the forms in correct alignment. The assembly shall provide cone-shaped depressions in the concrete surface at least 1 inch in diameter and 1-1/2 inches deep to allow filling and patching. Such devices, when removed, shall leave a smooth depression in the concrete surface without undue injury to the surface from chipping or spalling.

3. Burning off rods, bolts, or ties shall not be permitted.

4. Metal ties shall be held in place by devices attached to wales. Each device shall be capable of developing the strength of the tie.

5. Metal and wooden spreaders which are separate from the forms shall be wired to top of form and shall be entirely removed as the concrete is placed.

6. In the construction of basement or water bearing walls, the portion of a single rod tie that is to remain in the concrete shall be provided with a tightly fitted washer at midpoint to control seepage. Multi-rod ties do not require washers. The use of form ties which are tapered on encased in paper or other material to allow the removal of complete tie, and which leave a hole through the concrete structure, shall not be permitted.

G. Falsework:

1. Falsework shall be designed and constructed so that no excessive settlement or deformation occurs. Falsework shall provide necessary rigidity.

2. Timber used in falsework centering shall be sound, in good condition and free from defects which impair its strength.

3. Steel members shall be of adequate strength and shape for the intended purpose.

4. Timber piling used in falsework may be of any wood species which satisfactorily withstands driving and which adequately supports the superimposed load.

5. When sills or timber grillages are used to support falsework columns, unless founded on solid rock, shale or other hard materials, place them in excavated pits. Backfill to prevent the softening of the supporting material from form drip or from rains that may occur during the construction process. Sills or grillages shall be of ample size to support the superimposed load without settlement.

6. Falsework not founded on a satisfactory spread footing shall be supported on piling, which shall be driven to a bearing capacity to support the superimposed load without settlement.

3.00 EXECUTION

3.01 PREPARATION

A. Before placing concrete, insure that embedded items are correctly, firmly and securely fastened into place. Embedded items shall be thoroughly clean and free of oil and other foreign material. Anchor bolts shall be set to the correct location, alignment and elevation by the use of suitable anchor bolt templates.

3.02 INSTALLATION

A. Pre-Placement:

1. During the elapsed time between building the forms and placing the concrete, maintain the forms to eliminate warping and shrinking.

2. Treat the facing of forms with suitable form oil before concrete is placed. Apply oil before the reinforcement is placed. Wet form surfaces which will come in contact with the concrete immediately before the concrete is placed.

3. At the time of placing concrete, the forms shall be clean and entirely free from all chips, dirt, sawdust, and other extraneous matter at the time. Forms for slab, beam and girder construction shall not have tie wire cuttings, nails or any other matter which would mar the appearance of the finished construction. Clean forms and keep them free of foreign matter during concrete placement.

B. Placement:

1. Set and maintain forms to the lines designated, until the concrete is sufficiently hardened to permit form removal. If, at any stage of the work, the forms show signs of bulging or sagging, immediately remove that portion of the concrete causing this condition. If necessary, reset the forms and securely brace against further movement.

2. Provide adequate cleanout openings where access to the bottom of the forms is not otherwise readily attainable.

3. Carefully and accurately place and support reinforcement in concrete structures.

C. Removal: Remove forms so that the underlying concrete surface is not marred or damaged in any way. Forms shall not be removed until the concrete has attained sufficient strength to safely carry the dead load, but in no case less than the number of curing days set forth in the following table:

Forms for concrete of minor structural load carrying importance	1 day
Forms for walls, columns, sides of drilled shafts, massive structural components and other members not resisting a bending moment during curing	1 day
Forms and falsework under slabs, beams and girders where deflections due to dead load moment may exist (for spans < or = 10 feet)	7 days
Forms and falsework under slabs, beams and girders where deflections due to dead load moment may exist (for spans > 10 feet and < or = 20 feet)	14 days

END OF SECTION

03 21 00 REINFORCING STEEL

1.00 GENERAL

1.01 WORK INCLUDED

A. Furnish labor and reinforcing materials required to cut, bend, tie, splice, place and support the reinforcement in the material grades, sizes, quantities and locations specified.

1.02 QUALITY ASSURANCE

A. Tolerances:

1. Reinforcement shall be placed where specified, with the following maximum tolerances, plus or minus:

a. Concrete Cover: 1/4 inch.

b. Rebar Spacing: 1/4 inch in 12 inches.

1.03 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00 “Submittal Procedures” and shall include:

1. Shop Drawings:

a. Reinforcing bar layout drawing with bar lists clearly marked and referenced to the Drawings.

2. Record Data:

a. Manufacturers’ literature for specified products.

3. Certified Test Reports:

a. Certification of steel quality, size, grade and manufacturer’s origin.

1.04 STANDARDS

A. The applicable provisions of the following standards shall apply as if written here in their entirety:

1. American Society for Testing and Materials (ASTM) Standards:

ASTM A1064	Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM A615	Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

2. American Concrete Institute (ACI) Publications:

ACI 301	Specification for Structural Concrete
ACI SP-66	ACI Detailing Manual
ACI 318	Building Code Requirements for Structural Concrete

3. Concrete Reinforcing Steel Institute (CRSI) Publications:

CRSI	Manual of Standard Practice

1.05 DELIVERY AND STORAGE

A. Store steel reinforcement above the surface of the ground upon platform skids or other supports. Protect from mechanical and chemical injury and surface deterioration caused by exposure to conditions producing rust. When placed in the Work, steel reinforcement shall be free from dirt, scale, dust, paint, oil and other foreign material. Tag and store steel reinforcement for ease of correlation with Shop Drawings.

1.06 JOB CONDITIONS

A. Proposed deviations from reinforcing indicated on the Drawings or Specifications shall be approved in writing by the Engineer prior to fabrication.

B. Lap lengths shall be of the length shown on the Drawings or noted in lap and embedment table, and shall be in compliance with ACI 318.

C. Specified cover for reinforcing shall be maintained throughout construction. Bars shall be cut to lengths necessary to allow for proper clearances. Cover of concrete shall be measured from face of forms to outside face of reinforcement.

D. Stirrups shall be hooked.

2.00 PRODUCTS

2.01 MATERIALS

A. Steel Reinforcing Bars: Billet-Steel bars for concrete reinforcement conforming to ASTM A615; Grade 60, with minimum yield strength of 60,000 psi. Steel reinforcing bars shall be produced in the United States of America.

B. Welded Wire Fabric: Cold-drawn steel wire conforming to ASTM A1064; flat sheets fabricated in accordance with ASTM A1064.

C. Supports (Chairs): Bar supports shall be of the proper type for the intended use. Bar supports shall be uniform high density polyethylene (plastic) or fiberglass reinforced plastic (FRP) conforming to CRSI Class 1, Maximum Protection.

D. Spacers: Precast mortar blocks with a 28-day compressive strength that is greater than the specified concrete strength in which the blocks are being placed.

E. Mechanical Bar Splices: Cadweld splices as manufactured by Erico Products, Inc., or approved equal, installed in strict accordance with the manufacturer's instructions and recommendations. The mechanical devices shall develop at least 125 percent of the specified yield of the spliced bars.

F. Mechanical Threaded Splices: Mechanical threaded connections shall utilize a metal coupling sleeve with internal threads which engage threaded ends of the bars to be spliced and shall develop in tension or compression 125 percent of the specified yield strength of the bar.

2.02 FABRICATIONS

A. Bending: Reinforcement shall be bent cold by machine to shapes indicated on the Drawings; true to shapes indicated; irregularities in bending shall be cause for rejection. Unless otherwise noted, all hook and bend details and tolerances shall conform to the requirements of ACI SP-66 and ACI 318.

3.00 EXECUTION

3.01 PREPARATION

A. Before any concrete is placed, all mortar blocks to be used for holding steel in position adjacent to formed surfaces shall be cast in individual molds, after which time the blocks shall be immersed in water for the remainder of at least a 4-day curing period. The blocks shall be cast with the sides beveled and in such a manner that the size of the block increases away from the surface to be placed against the forms. Blocks shall be in the form of a frustum of a cone or pyramid. Suitable tie wires shall be provided in each block for anchoring the block to the reinforcing steel, and to avoid displacement when placing the concrete. The size of the surface to be placed adjacent to the forms shall not exceed 2-1/2 inches square or the equivalent thereof when circular or rectangular areas are provided. Blocks shall be accurately cast to the thickness required, and the surface to be placed adjacent to the forms shall be a true plane free of surface imperfections.

3.02 INSTALLATION

A. General: Place the reinforcement carefully and accurately in the concrete structures. Rigidly tie and support the reinforcement. Welding of any type of reinforcement shall not be permitted.

B. Splices:

1. Splicing of bars, except where indicated on the Drawings, shall not be permitted unless approved by the Engineer prior to fabrication. Splices shall be kept to a minimum. Splices shall preferably occur at points of minimum stress. Lap splices which are permitted shall have a lap in accordance with ACI 318. Rigidly clamp or wire the bars at all splices, in accordance with ACI. Overlap sheets of wire fabric sufficiently to maintain a uniform strength and securely fasten.

2. Welding of reinforcing steel splices shall not be permitted.

3. Make mechanical splices where shown on the Drawings using Cadweld splices or approved equal, installed in accordance with the manufacturer's instructions and recommendations. The mechanical device shall develop at least 125 percent of the specified yield strength of the bar.

C. Placement:

1. Place steel reinforcement, as indicated on the Drawings with the specified tolerances. Hold securely in place during the placing of the concrete. The minimum clear distance between bars shall be per ACI 318 unless noted otherwise. Always pass vertical stirrups around the main tension members and securely attach thereto. Wire reinforcing together at a sufficient number of intersections to produce a sound, sturdy mat or cage

of reinforcement that will maintain the reinforcement in correct positions when the concrete is placed.

2. Hold the reinforcing steel in concrete slabs firmly in place with wire supports or “chairs.” Sizing and spacing of the chairs shall be sufficient to properly support the steel, and shall be in accordance with CRSI Publications “Manual of Standard Practice in.”
3. Space the reinforcing steel in concrete walls the proper distance from the face of the forms, as indicated on the Drawings:
    a. For wall surfaces exposed to view, use chairs.
    b. For wall surfaces not exposed to view, use chairs or precast mortar blocks.
4. Where reinforcing conflicts with location of anchor bolts, inserts, etc., submit prompt notifications so that revisions can be made before concrete is placed. No cutting of reinforcing shall be permitted without the prior approval of the Engineer.
5. Welded wire shall be fabricated flat sheets, in longest practical lengths. Lap joints one mesh. Do not locate end laps over beams of continuous structures or midway between supporting beams. Offset end laps of adjacent widths to prevent continuous lap. Fasten ends and sides of welded wire fabric at 48 inches O.C. with tie wire.
6. Reinforcing shall extend through construction joints.

3.03 FIELD QUALITY CONTROL

A. Concrete shall not be placed until the Engineer has observed the final placing of the reinforcing steel, and has given permission to place concrete.

END OF SECTION

03 30 00 CAST-IN-PLACE CONCRETE

1.00 GENERAL

1.01 SUMMARY

A. Furnish labor, materials, mixing and transporting equipment and incidentals necessary to proportion, mix, transport, place, consolidate, finish, and cure concrete in the structure.

1.02 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.03 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00 “Submittal Procedures” and shall include:

1. Shop Drawings for:

a. Mix design: For each concrete mix, complete the form “Concrete Mix Design” and one of the following forms: “Documentation of Required Average Strength – Field Strength Test Record” or “Documentation of Average Strength – Trial Mixtures.”

b. Submit a schedule to the Owner’s representative which shows the sequence of concrete placements.

2. Certified Test Reports for:

a. Materials used in the trial mix design.

b. Water: Verification that all potable mix water and curing water sources do not exceed the non-potable water limits listed in ASTM C1602 Table 2.

c. Aggregate, conforming to ASTM C33, including the test reports for soundness and abrasion resistance.

d. Aggregate:

1). Verification that aggregate is not “potentially reactive” per ASTM C1260.

2). Or a cement chemical analysis indicating that the total alkali content is acceptable per Paragraph 2.02.A.

3). When mix water exceeds 50 percent of the chloride limit indicated in ASTM C1602 Table 2, then all aggregate sources shall be tested for chloride content in accordance with ASTM C1524.

e. 7-day and 28-day compressive strength tests results.

1). When more than 15, 28-day compressive tests results are available from the current Project for a given class of concrete, include the 15-test running average compressive strength versus the required average compressive strength (based on the previous 15 tests) in graphical form.

f. If the sum total of chlorides in mix water and aggregates exceeds 80 percent of the specified limit for hardened concrete, then prior to use of concrete, test mix design to verify acceptable chloride ion concentrations in accordance with ASTM C1218.

3. Record Data for:

a. Manufacturer's literature on specified materials.

b. Documentation indicating conformance with ASTM C94 requirements.

c. Documentation of supplier's National Ready Mixed Concrete Association certification.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed concrete work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Manufacturer Qualifications:

1. A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C94 requirements for production facilities and equipment.

2. Manufacturer must be certified according to the National Ready Mixed Concrete Association's Certification of Ready Mixed Concrete Production Facilities.

C. Testing Agency Qualifications:

1. An independent testing agency, acceptable to authorities having jurisdiction and the Engineer, qualified according to ASTM C1077 and ASTM E329 to conduct the testing indicated.

2. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver cement in bulk or bags which are plainly marked with the brand and manufacturer's name. Immediately upon receipt, store cement in a dry, weather-tight, and properly ventilated structure which excludes moisture. Storage facilities shall permit easy access for inspection and identification. Cement not stored in accordance with the requirements shall not be used.

B. Sufficient cement shall be in storage to complete placement of concrete started. In order that cement may not become unduly aged after delivery, maintain records of delivery dates. Use cement which has been stored at the Site for 60 days or more before using cement of lesser age. No cement shall be used which is lumped, caked, stored more than 90 days, or whose temperature exceeds 170 F.

Note to Specifier: The paragraphs below are for on-Site batch plants only.

C. Handle and store concrete aggregate in a manner which prevents the admixture of foreign materials. If the aggregates are stored on the ground, grub the Sites for the stockpiles, clear weeds and grass and level. Do not disturb the bottom layer of aggregate or use without re-cleaning.

D. Store different types and gradations of aggregates in a manner which prevents intermixing. Handle materials in stockpiles in a manner which prevents segregation of materials in the pile. Build in layers not over 3 feet in depth. Should segregation occur, remix the aggregates to conform to grading requirements. Stockpile fine aggregates at least 24 hours before mixing to reduce the free moisture content.

1.06 STANDARDS

A. Mixing, sampling, placing, curing and testing of concrete, and the materials used shall be in compliance with the latest revisions of the following standards, unless otherwise noted in the Contract Documents. The Contractor shall maintain one copy of each of the applicable standards at the construction field office.

1. American Society for Testing and Materials (ASTM) Standards:

ASTM Standards	
ASTM C31	Standard Practice for of Making and Curing Concrete Test Specimens in the Field
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C39	Standard Specification Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C42	Standard Specification Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C87	Standard Specification Test Method for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar
ASTM C94	Standard Specification of Ready Mixed Concrete
ASTM C109	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars
ASTM C125	Terminology Relating to Concrete and Concrete Aggregates
ASTM C143	Standard Test Method for Slump of Hydraulic Cement Concrete
ASTM C150	Standard Specification for Portland Cement
ASTM C156	Standard Test Method for Water Retention by Concrete Curing Materials
ASTM C171	Standard Specification for Sheet Materials for Curing Concrete
ASTM C172	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C173	Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C191	Standard Test Method for Time of Setting of Hydraulic Cement by Vicat Needle
ASTM C192	Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory

ASTM Standards	
ASTM C231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C293	Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Center-Point Loading)
ASTM C309	Standard Specification for Liquid Membrane Forming Compounds for Curing Concrete
ASTM C494	Standard Specification for Chemical Admixtures for Concrete
ASTM C579	Standard Test Methods for Compressive Strength of Chemical Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes
ASTM C580	Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes
ASTM C595	Standard Specification for Blended Hydraulic Cements
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C806	Standard Test Method for Restrained Expansion of Expansive Cement Mortar
ASTM C827	Standard Test Method for Change in Height at Early Stages of Cylindrical Specimens of Cementitious Mixtures
ASTM C845	Standard Specification for Expansive Hydraulic Cement
ASTM C878	Standard Test Method for Restrained Expansion of Shrinkage Compensating Concrete
ASTM C881	Standard Specification for Epoxy Resin Base Bonding Systems for Concrete
ASTM C1240	Standard Specification for Silica Fume used in Cementitious Mixtures
ASTM C1260	Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C1524	Standard Test Method for Water-Extractable Chloride in Aggregate (Soxhlet Method)
ASTM C1602	Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
ASTM D570	Standard Test Method for Water Absorption of Plastics
ASTM D638	Standard Test Method for Tensile Properties of Plastics
ASTM D746	Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
ASTM D994	Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)
ASTM D1752	Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction

ASTM Standards	
ASTM D2240	Standard Test Method for Rubber Property Durometer Hardness
ASTM D6690-07	Standard Specification for Joint and Crack Sealant, Hot Applied, for Concrete and Asphalt Pavements
ASTM E96	Standard Test Methods for Water Vapor Transmission of Materials

2. American Concrete Institute (ACI) Standards:

ACI Standards	
ACI 211.1	Standard Practice for Selecting Proportions for Normal, Heavy-weight, and Mass Concrete
ACI 214	Recommended Practice for Evaluation of Strength Test Results
ACI 223	Standard Practice for Use of Shrinkage Compensating Concrete
ACI 301	Specification for Structural Concrete
ACI 304	Guide for Measuring, Mixing, Transporting & Placing Concrete
ACI 304.2R	Placing Concrete by Pumping Methods
ACI 305.1	Hot Weather Concreting
ACI 306.1	Cold Weather Concreting
ACI 308.1	Standard Practice for Curing Concrete
ACI 309	Guide for Consolidation of Concrete
ACI 318	Building Code Requirements for Structural Concrete
ACI 350	Code Requirements for Environmental Engineering Concrete Structures

3. Corps of Engineers, Department of the Army Specification:
    a. CRD C621 83 - Corps of Engineers Specification for Non-Shrink Grout.
4. Federal Specification:
    a. TT S 00227E - Type II, Class A or B, Expansion Joint Sealant.
5. Concrete Plant Manufacturers Bureau (CPMB) Standards:
    a. Concrete Plant Standards.

2.00 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Products: Subject to compliance with requirements, provide one of the products specified.

3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 CONCRETE MATERIALS

A. Cementitious Material; General: If the fine and/or coarse aggregates test "Potentially Reactive", in accordance with ASTM C1260, then a low alkali cementitious material shall be used. A low alkali cementitious material shall be such that, the total alkali content calculated as the percentage of sodium oxide (Na2O) plus 0.658 times the percentage of potassium oxide (K2O) shall not exceed 0.6 percent of the total cementitious material content.

B. Cement; Type:

1. Type I or I/II Portland cement, conforming to ASTM C150; used for all concrete, unless noted otherwise.

C. Fly Ash/Pozzolans: Conforming to ASTM C618, Class F fly ash; used in all classes of concrete. A supplier's certificate of the analysis and composition of the fly ash shall be supplied.

D. Coarse Aggregate:

1. Crushed stone or gravel conforming to ASTM C33, in the gradation size specified.

a. Aggregate shall have a coefficient of thermal expansion (CoTE) of 4.5 microstrain per degree Fahrenheit.

2. For gradation size number 467, a maximum aggregate size of 1-1/2 inches is:

Sieve Size	Percent Retained	Percent Passing
2"	0	100
1-1/2"	0-5	95-100
3/4"	30-65	35-70
3/8"	70-90	10-30
No. 4	95-100	0-5

3. For gradation size number 57, the maximum aggregate size of 1 inch is:

Sieve Size	Percent Retained	Percent Passing
1-1/2"	0	100
1"	0-5	95-100
1/2"	40-75	25-60
No. 4	90-100	0-10
No. 8	95-100	0-5

4. For gradation size number 67, the maximum aggregate size of 3/4 inch is:

Sieve Size	Percent Retained	Percent Passing
1”	0	100
3/4”	0-10	90-100
3/8”	45-80	20-55
No. 4	90-100	10-10
No. 8	90-100	0-5

5. For gradation size number 8, the maximum aggregate size of 3/8 inch is:

Sieve Size	Percent Retained	Percent Passing
1”	0	100
3/8”	0-15	85-100
No. 4	70-90	10-30
No. 8	90-100	0-10
No. 16	95-100	0-5

E. Fine Aggregate:

1. Washed and screened natural sands or sands manufactured by crushing stones; conforming to ASTM C33. The gradation in ASTM C33 for air entrained concrete is:

Sieve Size	Percent Retained	Percent Passing
3/8”	0	100
#4	0-5	95-100
#8	0-20	80-100
#16	15-50	50-85
#30	40-75	25-60
#50	70-90	10-30

2. Fine aggregate shall have not more than 45 percent retained between any two consecutive sieves. Its fineness modulus, as defined in ASTM C125, shall be not less than 2.3 nor more than 3.1.

F. Water: Potable and complying with ASTM C1602 and ASTM C1602 Table 2.

2.03 ADMIXTURES

A. Air Entraining Admixture: Conforming to ASTM C260.

B. Water Reducing Admixtures: Conforming to ASTM C494; Types “A” or “D” only; accurately measured and added to the mix according to the manufacturer’s recommendations.

C. Set Retarding Admixtures: Conforming to ASTM C494; Types “B” and “D” only; accurately measured and added to the mix in according to the manufacturer’s recommendations.

D. Water Reducing Admixtures - High Range (HRWR): High Range Water Reducer shall comply with ASTM C494, Type F or G. HRWR shall be accurately measured in accordance with the manufacturer's recommendations. HRWR shall be added to the concrete mix at the concrete batch plant. HRWR may not be added at placement site except to redose a batch and only after approval of the HRWR manufacturer. The high range water reducing admixture shall be able to maintain the plasticity range without significant loss of slump or rise in concrete temperature for 2 hours. Other admixtures may only be used with the HRWR if approved by the HRWR manufacturer. A representative of the HRWR manufacturer shall be present during any large placement, placement of slabs, or during times of unusual circumstance which may require changes to the product formulation.

1. Manufacturers:
    a. BASF Corporation.
    b. W. R. Grace & Co.
    c. Sika Corporation.

2.04 WATERSTOPS

A. Thermoplastic Elastomeric Rubber (TPER / TPV) Waterstops: A fully vulcanized Synthetic rubber with high resistance to wide range of oils, solvents and chemicals, for use in concrete joints subjected to acids, bases, alcohols, fuels, oils, solvents or other chemicals. Factory fabricate corners, intersections, and directional changes. Unless indicated otherwise, provide the following configurations.

1. Construction Joints:
    a. Profile: Ribbed without center bulb.
    b. Width: 6 inches.
    c. Minimum thickness: 3/8 inch.
2. Expansion Joint:
    a. Profile: Ribbed with center bulb.
    b. Width: 9 inches.
    c. Minimum thickness: 3/8 inch.
3. Manufacturers:
    a. Sika: Westec Envirostop
    b. J P Specialties: Earth Shield TPV

B. Flexible PVC Waterstops: CE CRD-C 572, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes. Unless indicated otherwise, provide the following configurations.

1. Construction Joints:
    a. Profile: Ribbed without center bulb.
    b. Width: 6 inches.

c. Minimum thickness: 3/8 inch.

2. Expansion Joint:

a. Profile: Ribbed with center bulb.

b. Width: 9 inches.

c. Minimum thickness: 3/8 inch.

3. Manufacturers:

a. Greenstreak.

b. Meadows: W. R. Meadows, Inc.

c. Murphy: Paul Murphy Plastics Co.

d. Progress Unlimited Inc.

e. Sternson Group.

f. Durajoint® Waterstop.

g. Vinylex Corporation.

h. Westec Barrier Technologies; Div. of Western Textile Products, Inc.

C. Self-Expanding Strip Waterstops (Hydrophilic): Self-expanding strip waterstops shall be used only where specifically indicated. Manufactured rectangular or trapezoidal strip, sodium bentonite or other hydrophylic material for adhesive bonding to concrete.

1. Products:

a. Swellseal Joint; De Neef Construction Chemicals (U.S.) Inc.

b. Adeka Ultra Seal; Mitsubishi International Corporation.

c. Sika Hydrotite; Sika Corporation – U.S.

2.05 VAPOR RETARDERS

A. Plastic Vapor Retarder: ASTM E1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.

1. Available Products:

a. Fortifiber Corporation; Moistop Ultra A.

b. Raven Industries Inc.; Vapor Block 15.

c. Reef Industries, Inc.; Griffolyn Type-105.

d. Stego Wrap (15-mil) Vapor Barrier; STEGO INDUSTRIES LLC.

2.06 CURING MATERIALS

A. Sheet Curing Material: Conforming to ASTM C171.

1. Waterproof paper.

2. Polyethylene film.

3. White burlap - polyethylene film.

B. Membrane Curing Compounds: Membrane curing compound conforming to ASTM C309; having a color to indicate coverage when applied; non-staining; applied according to the manufacturer's recommendations. No curing compound shall be used on walls which are to receive a plaster mix finish. When tested according to ASTM C156, the curing compound shall provide a film which has retained, within the specimen, the following percentages of moisture present when the curing compound was applied:

1. At least 97 percent at the end 24 hours.
2. At least 95 percent at the end of 3 days.
3. At least 91 percent at the end of 7 days.

C. Concrete Curing and Sealing Compound:

1. Where a sealer is necessary, use a concrete curing and sealing compound. Application of this product shall be in accordance with the manufacturer's recommendations.
2. MasterKure CC 200 WB by BASF Corporation at interior concrete surfaces.
3. MasterKure CC 1315 WB by BASF Corporation at exterior concrete surfaces.
4. MasterKure HD 200 WB by BASF Corporation at disinfection facility.

D. Finishing Aid: Spraying material designed to form a monomolecular film on fresh concrete that reduces the rate of evaporation of surface moisture prior to finishing; conforming to Confilm, as manufactured by Master Builders, Inc. This material is not a curing compound. Concrete must be cured as specified.

2.07 RELATED MATERIALS

A. Joint Materials for Water-Retaining Structures:

1. Pre-molded, resilient, non-bituminous expansion joint filler conforming to ASTM D1752, Type "II", in the thickness specified.
2. Joint sealer conforming to ASTM D6690.
3. Expansion joint sealant for non-potable water shall be a two-component, non-sag, polysulfide-base, elastomeric sealing compound. The material shall conform to Federal Specification TT S 00227E, Type "II", Class B; installed according to the manufacturer's recommendations. Backing material for sealant shall be a rod of a diameter and composition recommended by the sealant manufacturer.
4. Expansion joint sealant for potable water shall be a two-component, non-sag, polysulfide sealant containing no lead or mercury; conforming to Fed. Spec. TT S 00227E, Type "II", Class A; applied according to the manufacturer's specifications. Backing material for sealant shall be a rod of a diameter and composition recommended by the sealant manufacturer.
5. Where surface is to receive a swept in grout topping, a 3-inch wide, 1-mil polyethylene strip shall be placed above the joint sealant and held in place with 1-inch wide polyethylene tape spaced at 12-inch centers (maximum).

B. Joint Materials for Non-Water-Retaining Structures:

1. Bituminous-type, preformed, expansion joint filler; conforming to ASTM D994.

2. Pre-molded, resilient, non-bituminous expansion joint filler conforming to ASTM D1752, Type "II", in the thickness specified.

C. Bonding Agents: Install according to the manufacturer's recommendations and written instructions.

1. Bonding agent shall be Sika Armatec 110 EpoCem by Sika Corporation.

D. Non-Shrink Grout:

1. General: Non-shrink grout for grouting of pump, motor, and equipment baseplates or bedplates, column baseplates, other miscellaneous baseplates, piping block outs and other uses of grout. Grout shall meet the following requirements, as verified by independent laboratory tests:

a. No shrinkage from the time of placement, or expansion after set, under ASTM C827 and CRD C621 83 (Corps of Engineers). When non-shrink grouts are tested under CRD C621 83, the grout shall be tested in a fluid state. A fluid state shall be defined as flowing through a flow cone at a rate of 20 seconds, plus or minus 5 seconds.

b. An initial set time of not less than 45 minutes under ASTM C191.

2. Non-Shrink Non Metallic Grout: Pre mixed, non-staining, non-shrink grout; minimum 28-day compressive strength of 5000 psi.

a. Do not use for vibrating equipment.

b. Products:

1). Masterflow 713 Plus by BASF The Chemical Company.

2). Five Star Grout by Five Star Products, Inc.

3). SikaGrout 212 by Sika Corporation.

3. Non-Shrink Epoxy Structural Grouts: Furnished in two components from the factory and mixed on the Site; conforming to ASTM C579, ASTM C580, and ASTM C827; chemical resistant, water resistant and a minimum 7-day compressive strength of 12,000 psi.

a. Use for vibrating equipment.

b. Products:

1). Sikadur 42, Grout-Pak by Sika Corporation.

2). Five Star HP Epoxy Grout by Five Star Products, Inc.

3). Masterflow 648 CP by BASF The Chemical Company.

E. Normal Shrinkage Grout: 1 part Portland cement, Type I, to 3 parts of clean, first quality sand; proportioning on a volumetric basis; used for non-structural applications for grouting areas as shown on the Drawings which do not require non-shrink grout.

F. Foundation Waterproofing: Foundation coating shall be used only on the exterior of concrete walls not exposed to view where indicated on the Drawings.

1. MasterSeal 581 (Thoroseal) as manufactured BASF Corporation.
2. Approved Equal.

G. Zinc Rich Primer: Aluminum surfaces which contact or are embedded in concrete shall be coated with zinc rich primer. Primer shall be Tneme-Zinc.

2.08 REPAIR MATERIALS

A. Structural Concrete Repair Material: Low-shrink, non-slump, non-metallic, quick setting patching mortar; as approved by the manufacturer for each application and applied accordance with the manufacturer's recommendations.

1. Products:

a. Sikatop 123 by Sika Corporation.

b. Sikatop 122 by Sika Corporation.

c. Five Star Structural Concrete by Five Star Products, Inc.

2.09 CONCRETE MIXTURES

A. Design Criteria:

1. Provide a mix design for each concrete application indicated. This may necessitate multiple mix designs for each class of concrete depending on HRWR, entrained air, and other requirements.
2. All Concrete shall be normal weight concrete composed of Portland cement, fine aggregate, coarse aggregate, admixtures, and water, as specified.
3. ACI 211.1 shall be the basis for selecting the proportions for concrete made with aggregates of normal and high density and of workability suitable for usual cast in place structures.
4. The workability of any mix shall be as required for the specific placing conditions and the method of placement. The concrete shall have the ability to be worked readily into corners and around reinforcing steel without the segregation of materials or the collection of free water on the surface. Compliance with specified slump limitations shall not necessarily designate a satisfactory mix.
5. In no case shall the amount of coarse material produce harshness in placing or honeycombing in the structure, when forms are removed.
6. The maximum amount of coarse aggregate (dry loose volume) per cubic foot of finished concrete shall not exceed 0.82 cubic feet.
7. In calculating water-cement ratio: The water content shall include the amount of water batched or to be added later, plus the free water in the aggregate, and minus the water content at SSD conditions.
8. No allowance shall be made for the evaporation of water after batching. If additional water is required to obtain the desired slump, a compensating amount of cement shall also be added. In no case shall the maximum water cement ratio exceed the specified maximum or that of the approved mix design.

9. Air Entrainment: Provide the percent air entrainment in each concrete mix design as recommended by ACI 318 and ACI 350 for "Moderate Exposure" (Class F1), unless otherwise specified/restricted:
    a. Do not provide air-entrainment in drilled shafts unless placed underwater.
    b. Do not provide air-entrainment and entrapped air shall not exceed 3 percent for the following applications:
        1). Interior slabs.
        2). Slabs on composite metal decks.
10. When job conditions dictate, water-reducing and set-controlling admixtures may be used. Only specified admixtures shall be used. Admixtures shall be batched at the batch plant.
11. High Range Water Reducer (HRWR): Provide HRWR in mix designs as indicated for specified applications. Slump of concrete with the addition of HRWR may be increased to 8 inches (+/- 1 inch).
    a. Drilled shafts, footings, walls, columns, and beams.
    b. Interior of building curbs which are not cast monolithically with slabs.
    c. Precast concrete.
    d. Do not provide HRWR in slabs and pavement (a water reducer is permitted provided performance requirements are met).
12. If fly ash is to be used in place of cement, no more than 25 percent of the cement may be replaced.
13. Concrete shall be capable of developing two-thirds of the required 28-day compressive strength in 7 days.
14. Maximum water-soluble chloride ion content in concrete, by percent weight of concrete, shall not exceed ACI 318 and ACI 350 limits for Exposure Class C1.

B. Concrete Classifications:

Class	Min. 28-Day Compressive Strength (psi)	Max. Size Aggregate (inches)	Max. Water: Cement Ratio	Slump +/- 1 (inches)	Min. Sacks of Cement Per Cubic Yard **
A	4000	1.5 Size No. 467	0.45	3 (8*)	5.75
B	3000	1.5 Size No. 467	0.47	3	5.75
C	4000	1.0 Size No. 57	0.45	4 (8*)	5.75
D	5000	0.75 Size No. 67	0.47	4	6.00
E	1500	1.5 Size No. 467	0.70	4	4.00

Class	Min. 28-Day Compressive Strength (psi)	Max. Size Aggregate (inches)	Max. Water: Cement Ratio	Slump +/- 1 (inches)	Min. Sacks of Cement Per Cubic Yard **
F	4000	0.375 Size No. 8	0.47	3	6.50
* Slump shown is with HRWR ** Provide one additional sack of cement per cubic yard if concrete must be deposited in standing water.					

C. Concrete Usage:

Class	Usage
Class A Use	Footings and slabs, and other unless noted otherwise
Class B Use	Pavement, gutters, and sidewalks
Class C Use	Walls, columns, beams, drilled shafts
Class D Use	Precast concrete and precast panels
Class E Use	Cradling, Blocking, mud slab, lean concrete backfill
Class F Use	Stair Pans and Landings, interior building curbs.

D. Required Average Compressive Strength:

1. All concrete is required to have an average compressive strength greater than the specified strength. The required average compressive strength shall be established according to the requirements of ACI 301, 4.2.3.3.

2. Standard Deviation: If the production facility has records of field tests performed within the past 12 months and spanning a period of not less than 60 calendar days for a class of concrete within 1000 psi of that specified for the Work, calculate a standard deviation and establish the required average strength fcr' in accordance with ACI 301, 4.2.3.2 and 4.2.3.3.a. If field test records are not available, select the required average strength from ACI 301, Table 4.2.3.3.b.

E. Documentation of Required Average Compressive Strength:

1. Documentation indicating the proposed concrete proportions will produce an average compressive strength equal to or greater than the required average compressive strength, shall consist of field strength records or trial mixture.

2. Field Strength Records: Document field strength records according to ACI 301, 4.2.3.4.a and including the following:

   a. Field test data shall not be older than 1 year.

   b. If field test data are available and represent a single group of at least 10 consecutive strength tests for one mixture, using the same materials, under the same conditions, and encompassing a period of not less than 60 days, verify that the average of the field test results equals or exceeds fcr'. Submit for acceptance the mixture proportions along with the field test data.

c. If the field test data represent two groups of compressive strength tests for two mixtures, plot the average strength of each group versus the water-cementitious materials ratio of the corresponding mixture proportions and interpolate between them to establish the required mixture proportions for fcr'.

3. Trial Mixtures:

   a. Establish trial mixture proportions according to ACI 301, 4.2.3.4.b and including the following.

      1). Make at least three trial mixtures complying with performance and design requirements. Each trial mixture shall have a different cementitious material content. Select water-cementitious materials ratios that will produce a range of compressive strengths encompassing the required average compressive strength fcr'.

      2). Submit a plot of a curve showing the relationship between water-cementitious materials ratio and compressive strength.

      3). Establish mixture proportions so that the maximum water-cementitious materials ratio is not exceeded when the slump is at the maximum specified.

   b. Laboratory Samples shall be taken in accordance with the trial mix designs for laboratory testing purposes.

   c. The fresh concrete shall be tested for Slump (ASTM C143) and Air Content (ASTM C173 and ASTM C231). Strength test specimens shall be made, cured, and tested for 7-day and 28-day strength in accordance with ASTM C192, ASTM C39, and ASTM C293.

   d. Suitable facilities shall be provided for readily obtaining representative Samples of aggregate from each of the weigh batchers for test purposes and for obtaining representative Samples of concrete for uniformity tests. The necessary platforms, tools, and equipment for obtaining Samples shall be furnished. Aggregates shall be tested in accordance with ASTM C1260.

   e. The cement contents specified are minimum values. If additional quantities are required to obtain the specified strengths, supply the cement at no additional cost to the Owner.

   f. A trial mix shall be designed by an independent testing laboratory, retained and paid by the Contractor and approved by the Owner. The testing laboratory shall submit verification that the materials and proportions of the trial concrete mix design meet the requirements of the Specifications.

   g. From these trial mix tests, the ratios between 7-day and 28-day strengths shall be established. The 7-day strength which corresponds to the required 28-day strength shall be determined.

   h. The final results of the trial mix design shall be submitted to the Engineer at least 10 days prior to the scheduled beginning of concrete placement and shall be approved by the Engineer prior to the placement of any concrete.

4. Revisions to concrete mixtures:

    a. When less than 15 compressive strength tests results for a given class of concrete are available from the current Project:

        1). If any of the following criteria are met, take immediate steps to increase average compressive strength of the concrete.

            a). A 7-day compressive strength test result multiplied by 1.5 falls below the required 28-day compressive strength.

            b). A 28-day compressive strength test result is deemed not satisfactory.

    b. When at least 15 compressive strength test results for a given class of concrete become available from the current Project:

        1). Calculate the actual average compressive strength, standard deviation and required average compressive strength using the previous 15 consecutive strength tests. Submit results in graphical form with each 28-day test result for that class of concrete.

        2). If any of the following criteria are met, take immediate steps to increase average compressive strength of the concrete.

            a). A 7-day compressive strength test result multiplied by the average job-to-date ratio of 7-day to 28-day compressive strength falls below the required 28-day compressive strength.

            b). A 28-day compressive strength test result is deemed not satisfactory.

            c). The average compressive strength falls below the required average compressive strength.

    c. When revisions to the mix design are required, notify the Engineer in writing of the corrective actions taken.

2.10 OFF-SITE BATCH PLANT

A. Batch plants shall be an established concrete batching facility meeting the requirements of the Concrete Plant Standards of the Concrete Plant Manufacturers Bureau.

3.00 EXECUTION

3.01 PREPARATION

A. Notify the Owner's representative upon completion of various portions of the work required for placing concrete, so that inspection may be made as early as possible. Keep the Owner's representative informed of the anticipated concrete placing schedules.

B. All items, including lines and grades, forms, waterstops, reinforcing, inserts, piping, electrical, plumbing and the Contractor's concreting materials and equipment shall be in compliance with the Contract Documents before proceeding.

C. Do not place any concrete until formwork and the placing reinforcement in that unit is complete. Place no concrete before the completion of all adjacent operations which might prove detrimental to the concrete.

D. Brilliantly light the Site so that all operations are plainly visible when concrete mixing, placing, and finishing, continues after daylight. Whenever possible, concrete finishing shall be completed in daylight hours.

E. When placing concrete, the forms shall be clean and entirely free from all chips, dirt, sawdust and other extraneous matter. Forms for slab, beam and girder construction shall not have tie wire cuttings, nails, or any other matter which would mar the appearance of the finished construction. Clean forms and keep them free of any foreign matter during concrete placing.

F. The concrete shall be mixed in quantities required for immediate use. Any concrete which is not in place within the time limits specified shall not be used. Concrete shall not be re-tempered.

G. Concrete shall not be placed if impending weather conditions would impair the quality of the finished Work.

H. Unless otherwise provided, the following requirements shall govern the time sequence on which construction operations shall be carried.

1. Forms for walls or columns shall not be erected on concrete footings until the concrete in the footing has cured for at least 2 curing days. Concrete may be placed in a wall or column as soon as the forms and reinforcing steel placements are approved.

2. Steel beams or forms and falsework for superstructures shall not be erected on concrete substructures until the substructure concrete has cured for at least 4 curing days. Falsework required for superstructures shall not be erected until the substructure has cured for 4 curing days, and shall not be removed until the superstructure has cured.

3.02 EMBEDDED ITEMS

A. Where aluminum anchors, aluminum shapes, or aluminum electrical conduits are embedded in concrete, paint aluminum contact surfaces with zinc rich primer. Allow the paint to thoroughly dry before placing the aluminum in contact with the concrete.

Note to Specifier: Coordinate with Section 09 96 00.01 "High-Performance Coatings."

B. Paint steel or other ferrous metal to be mounted on or placed in contact with dry/cured concrete, and coat in accordance with Section 09 96 00.01 "High-Performance Coatings" prior to installation.

3.03 VAPOR RETARDERS

A. Place, protect, and repair vapor-retarder sheets according to ASTM E1643 and manufacturer's written instructions.

B. Granular fill below the vapor retarder shall be smoothed and free of protrusions that might damage or rupture the polyethylene film. Completely cover porous fill with film. Lap film not less than six inches at all joints, with the top placed in the direction of concrete spreading. Use pressure-sensitive tape at all laps of vapor barrier. Lap reinforcement directly over film before placing concrete, taking precautions to prevent film punctures. Carefully cut film around pipes and wiring outlets, and then apply pressure sensitive tape around these protrusions to insure maximum barrier effectiveness.

3.04 JOINTS

A. Expansion Joints and Devices:

1. Workmanship: Exercise careful workmanship in joint construction to separate the concrete sections by an open joint or by the joint materials, and make the joints true to the outline indicated.

2. Expansion Joints: Construct expansion joints and devices to provide expansion and contraction. Construct joints which are to be left open or filled with poured joint material with forms which are adaptable for loosening or early removal. In order to avoid jamming by the expansion action of the concrete and the consequent likelihood of injuring adjacent concrete, remove or loosen these forms as soon as possible after the concrete has initially set. Make provisions for loosening the forms to permit free concrete expansion without requiring full removal.

3. Armored Joints: Carefully construct armored joints to avoid defective anchorage of the steel and porous or honeycombed concrete adjacent to same. Anchor pre-molded materials to the concrete on one side of the joint with approved adhesive. Anchor so that the material does not fall out of the joint.

B. Construction Joints:

1. Construction joints are formed by placing plastic concrete in direct contact with concrete which has attained its initial set. When concrete is specified as monolithic, the term shall be interpreted as the manner and sequence of concrete placement so that construction joints do not occur.

   a. Unless noted otherwise, the maximum horizontal spacing of construction joints shall be 40 feet.

   b. For slabs on grade, the maximum spacing between two construction joints or between a construction joint and a control joint shall be 15 feet, unless noted otherwise.

   c. Unless noted otherwise or approved by the Engineer, the maximum vertical spacing of construction joints shall be 15 feet. If not detailed on the Drawings, construction joint details and locations shall be submitted to the Engineer for approval.

2. Additional horizontal and vertical construction joints, when submitted and approved by the Engineer, may have an impact on reinforcing details. Revise reinforcing details to reflect additional joints.

3. Unless otherwise provided, construction joints shall be square and normal to the forms. Provide bulkheads in the forms for all joints except horizontal joints.

4. At the proper time, clean horizontal construction joints for receiving the succeeding lift using air water cutting. The surface shall be exposed sound, clean aggregate. The air pressure supply to the jet shall be approximately 100 lb. per square inch, and the water pressure sufficient to bring the water into effective influence of the air pressure. After cutting, wash the surface until there is no trace of cloudiness in the wash water.

5. In areas where air water cutting cannot be satisfactorily accomplished, or in areas where it is undesirable to disturb the surface of the concrete before it has hardened, prepare the surface for receiving the next lift by wet sand blasting to immediately remove all

laitance and unsound concrete prior to placing of the next lift. Thoroughly wash the surface of the concrete after sand blasting to remove all loose material.

6. Provide construction joints with concrete keyways, reinforcing steel dowels, and waterstops. The method of forming keys in keyed joints shall permit the easy removal of forms without chipping, breaking, or damaging the concrete.

C. Existing Hardened Concrete: Where new concrete or grout is to be placed in contact with existing hardened concrete, texture the existing surface by chipping or other means so that an irregular surface having a height variance of not less than 1/4 inch is created. The existing concrete shall then be coated with a bonding agent and new concrete or grout placed.

3.05 WATERSTOPS

A. TPV and PVC Waterstops: Install in construction joints as indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of Work.

1. At formed surfaces, a split form shall be used. The split form shall have a tight fit which prevents misalignment and concrete leakage.

2. The embedded flange of the waterstop must be secured prior to concrete placement. The flange shall be secured at 12 inches on-center by factory installed hog rings or grommets at the outermost rib. Never place nails or screws through the body of the waterstop.

3. All fittings and changes in direction shall be factory fabricated. Only straight butt splices shall be made in the field. Field splices shall be according to the manufacturer's written instructions and as follows:

a. Cut adjoining ends square to form matching edges.

b. Uniformly melt the ends at 380 F using a thermostatically controlled, Teflon coated splicing iron.

c. When a 1/8-inch diameter melt bead develops on each waterstop end, remove the splicing iron and firmly press the two ends together in proper alignment. Hold until the material has fused and cooled. Allow the splice to cool naturally; do not quench.

B. Self-Expanding Strip Waterstops:

1. Install in construction joints and at other locations indicated, according to manufacturer's written instructions, bonding or mechanically fastening and firmly pressing into place.

a. Waterstop shall be bonded to the substrate using a continuous bead of swelling sealant or adhesive as recommended by the manufacturer.

1). ADEKA Ultra Seal P-201.

2). Sika Leakmaster.

2. Install in longest lengths practicable.

3. Protect from moisture, oil, dirt, and sunlight prior to the placement of concrete. Coordinate with manufacturer for additional requirements.

C. Steel Waterstops:

1. Splices shall be factory made, where possible. Splices shall be water-tight, with ends of joined pieces in true alignment.

2. Install waterstops to form a continuous watertight diaphragm in each joint.

3. Correctly position waterstops in the forms and adequately support forms to prevent movement or disturbance during the placing of concrete.

3.06 CONCRETE PLACEMENT

A. Cold Weather:

1. If air temperature has fallen to, or is expected to fall below 40 F during the protection period (a minimum of 48 hours unless longer time frame is recommended by ACI 306R), then cold weather concreting shall be performed in accordance with ACI 306.1.

2. In cases where the temperature drops below 40 F after the concreting operations have been started, sufficient canvas and framework or other type of housing shall be furnished to enclose and protect the structure, in accordance with the requirements of ACI 306R. Sufficient heating apparatus to provide heat shall be supplied, and heating source and protection from combustion gas shall be in accordance with ACI 306.1. The concrete shall be protected when placed under all weather conditions. Should concrete placed under such conditions prove unsatisfactory, remove and replace the concrete at no cost to the Owner.

3. When the air temperature is above 30 F:

a. The minimum concrete temperature at the time of mixing shall be 60 F unless other requirements of ACI 306.1 are met, which may allow for a lower mix temperature.

b. The minimum concrete temperature at the time of placement and during the protection period shall be 55 F unless other requirements of ACI 306.1 are met, which may allow for a lower temperature.

4. The means used to heat a concrete mix shall be in accordance with ACI 306.1.

5. Salts, chemicals, or other foreign materials shall not be mixed with the concrete to preventing freezing. Calcium chloride is not permitted.

B. Hot Weather:

1. Hot weather is defined as any combination of high air temperature, low relative humidity, and wind velocity that impairs the quality of the concrete. Hot weather concreting shall be in accordance with ACI 305.1. Concrete shall be placed in the forms without the addition of any more water than that required by the design (slump). No excess water shall be added on the concrete surface for finishing. Control of initial set of the concrete and extending the time for finishing operations may be accomplished with the use of approved water reducing and set retarding admixture, as specified.

2. Maximum time intervals between the addition of mixing water and/or cement to the batch, and the placing of concrete in the forms shall not exceed the following (excluding HRWR admixture use):

Concrete Temperature	Maximum time From Water Batch to Placement
Non-Agitated Concrete	
Up to 80 F	30 Minutes
Over 80 F	15 Minutes
Agitated Concrete	
Up to 75 F	90 Minutes
75 F to 89 F	60 Minutes

   a. The use of an approved set-retarding admixture will permit the extension of the above time maximums by 30 minutes, for agitated concrete only.

   b. The use of an approved high range water reducing (HRWR) admixture will allow placement time extensions as determined by the manufacturer.

3. The maximum temperature of concrete shall not exceed 90 F at the time the concrete is placed. The temperatures of the mixing water shall be reduced by the use of chilled water or ice.

4. The maximum temperature of concrete with high range water reducing admixture shall not exceed 100 F at the time concrete is placed.

5. Under extreme heat, wind, or humidity conditions, concreting operations may be suspended if the quality of the concrete being placed is not acceptable.

C. Handling and Transporting:

1. Delivery tickets shall be required for each batch and shall be in accordance with ASTM C94, Section 16. Each delivery ticket must show plainly the amount of water, in gallons that can be added to the mixer truck at the Site without exceeding the maximum water cement ratio approved for that mix design. Amount of water added must be in proportion to contents of truck.

2. Arrange and use chutes, troughs, or pipes as aids in placing concrete so that the ingredients of the concrete are not segregated. They shall be steel or steel lined. When steep slopes are necessary, equip the chutes with baffles or make in short lengths that reverse the direction of movement. Extend open troughs and chutes, if necessary, inside the forms or through holes left in the forms. Terminate the ends of these chutes in vertical downspouts.

3. Keep chutes, troughs, and pipes clean and free from coatings of hardened concrete by thoroughly flushing with water before and after placement. Discharge water used for flushing away from the concrete in place.

4. Concrete pumping is permitted and shall comply with ACI 304.2R.

5. Carting or wheeling concrete batches on completed concrete floor slab shall not be permitted until the slab has aged at least 4 curing days. Unless pneumatic tired carts

are used, wheel the carts on timber planking so that the loads and impact are distributed over the slab. Curing operations shall not be interrupted for the purpose of wheeling concrete over finished slabs.

D. Depositing:

1. The method and manner of placing shall prevent segregation or separation of the aggregate or the displacement of the reinforcement. Use drop chutes of rubber or metal when necessary. Prevent the spattering of forms or reinforcement bars if the spattered concrete dries or hardens before it is incorporated into the mass.
2. Fill each part of the forms by directly depositing concrete as near its final position as possible. Work the coarse aggregate back from the face and force the concrete under and around the reinforcement bars without displacing them. Depositing large quantities at one point in the forms, then running or working it along the forms shall not be permitted.
3. After the concrete has taken initial set, the forms shall not be jarred. No force or load shall be placed upon projecting reinforcement.
4. Deposit the concrete through vertical drop chutes of rubber or metal of satisfactory size when operations involve placing concrete from above, such as directly into an excavated area, or through the completed forms, particularly in walls, piers, columns, and similar structures. Drop chutes shall be made in sections or provided in several lengths so that the outlet may be adjusted to proper heights during placing.
5. Except for drilled shafts, concrete shall not be dropped free more than 10 feet when HRWR admixture is used or 5 feet without HRWR. Place in continuous horizontal layers with a depth of from 1 to 3 feet, depending upon the wall thickness. Each layer shall be soft when a new layer is placed upon it. No more than 1 hour shall elapse between the placing of successive concrete layers in any portion of the structures included in continuous placement.
6. Place required sections in one continuous operation to avoid additional construction joints.
7. If excessive bleeding causes water to form on the surface of the concrete in tall forms, make the mix dryer to reduce the bleeding. In tall walls, place the concrete to a point about 1 foot below the top of the wall and allow to settle for 1 to 2 hours. Resume and complete concreting before set occurs.
8. For slopes greater than two percent, start concrete placement at low end and proceed upslope.

E. Consolidating:

1. Compact each layer of concrete and flush the mortar to the surface of the forms by continuous-working mechanical vibrators. Vibrators which operate by attachment to forms shall not be used. Apply the vibrator to the concrete immediately after deposit. Move vibrator throughout the layer of the newly placed concrete, several inches into the plastic layer below. Thoroughly work the concrete around the reinforcement, embedded fixtures and into the corners and angles of the forms until it is well-compacted.

2. Mechanical vibrators shall not be operated so that they penetrate or disturb previously placed layers which are partially set or hardened. They shall not be used to aid the flow of concrete laterally. The vibration shall be of sufficient duration to completely compact and embed reinforcement and fixtures, but not to an extent causing segregation.

3. Keep vibrators constantly moving in the concrete and apply vertically at points uniformly spaced, not farther apart than the radius over which the vibrator is visibly effective. The vibrator shall not be held in one location longer than required to produce a liquified appearance on the surface.

4. When submerged in concrete, internal vibrators shall maintain a frequency of not less than 6000 impulses per minute for spuds with diameters greater than 5 inches and 10,000 impulses for smaller spuds. The vibration intensity (amplitude) shall be sufficient to produce satisfactory consolidation.

5. Provide one vibrator (powered pneumatically or electrically) for each 10 cubic yards of concrete per hour being placed. Provide at least one vibrator, which may be of the gasoline powered type, as a standby for each two vibrators in service. To produce satisfactory consolidation, and based upon the observed performance, the Owner's representative may require the use of a larger sized and powered vibrator.

6. Check vibrators intended for regular service or standby service before beginning concreting operations.

F. Placement in Water:

1. Deposit concrete in water only when dry conditions cannot be obtained. The forms, cofferdams, or caissons shall be sufficiently tight to prevent any water flowing through the space where concrete is to be deposited. Pumping of water shall not be permitted while the concrete is being placed, nor until it has set for at least 36 hours.

2. Carefully place the concrete compact mass using a tremie, closed bottom dumping bucket, or another approved method which does not permit the concrete to fall through the water without protection. The concrete shall not be disturbed after being deposited. Regulate depositing to maintain horizontal surfaces.

3. When a tremie is used, it shall consist of a tube constructed in sections having water-tight connections. The means of supporting the tremie shall permit the movement of the discharge end over the entire top surface of the work, and shall allow the tremie to be rapidly lowered to retard the flow. The number of times it is necessary to shift the location of the tremie shall be held to a minimum for any continuous placement of concrete. During the placing of concrete, keep the tremie tube full to the bottom of the hopper. When a batch is dumped into the hopper, slightly raise the tremie, but not out of the concrete at the bottom, until the batch discharges to the level of the bottom of the hopper. Stop the flow by lowering the tremie. Continue placing operations until the work is completed.

4. When concrete is placed by means of the bottom dump bucket, the bucket shall have a capacity of not less than 1/2 cubic yard. Lower the bucket gradually and carefully until it rests upon the concrete already placed. Raise it very slowly during the discharge travel to maintain still water at the point of discharge and to avoid agitating the mixture.

5. Use a sump or other approved method to channel displaced fluid and concrete away from the shaft excavation. Recover slurry and dispose of it as approved. Do not discharge displaced fluids into or in close proximity to streams or other bodies of water.

G. Placement in Slabs:

1. Allow concrete in columns, walls and deep beams or girders to stand for at least 1 hour to permit full settlement from consolidation, before concrete is placed for slabs they are to support. Haunches are considered as part of the slab and shall be placed integrally with them.
2. When monolithic slabs are placed in strips, the widths of the strips, unless otherwise specified or indicated, shall insure that concrete in any one strip is not allowed to lie in place for more than 1 hour before the adjacent strips are placed.
3. Immediately before placing concrete, thoroughly dampen the earthen cushion to receive concrete to prevent moisture absorption from the concrete.
4. As soon as concrete placing is complete for a slab section of sufficient width to permit finishing operations, level the concrete, strike off, tamp and screed. The screed shall be of a design adaptable to the use intended, shall have provision for vertical adjustment and shall be sufficiently rigid to hold true to shape during use.
5. The initial strike off shall leave the concrete surface at an elevation slightly above grade so that, when consolidation and finishing operations are completed, the surface of the slab is at grade elevation.
6. Continue tamping and screeding operations until the concrete is properly consolidated and free of surface voids. Bring the surface to a smooth, true alignment using longitudinal screeding, floating, belting, and/or other methods.
7. When used, templates shall be of a design which permits early removal so satisfactory finishing at and adjacent to the template is achieved.
8. While the concrete is still plastic, straightedge the surface using a standard 10-foot metal straightedge. Lap each straightedge pass one-half of the preceding pass. Remove high spots and fill depressions with fresh concrete and re-float. Continue to check with a straightedge during the final finishing operation, until the surface is true to grade and free of depressions, high spots, voids, or rough spots.
9. Check the final surface with a straightedge. Ordinates measured from the face of the straightedge to the surface of the slab shall not exceed 1/16 inch per foot from the nearest point of contact. The maximum ordinate shall be 1/8 inch per 10 feet.
10. Unless noted otherwise, where floor drains or hub drains are shown in slabs of buildings, vaults, or treatment basin units and sloping the slab is not indicated, slope slab to drain on a grade of 1/16 inch per foot with a maximum total slope of 1-1/4 inches. The thickness of slab at floor or hub drain shall be the thickness of slab, as indicated on the Drawings.

H. Placement in Foundations: Place concrete in deep foundations so that segregation of the aggregates or displacement of the reinforcement is avoided. Provide suitable chutes or vertical pipes. When footings can be placed in dry foundation pits without the use of cofferdams or caissons, forms may be omitted and the entire excavation filled with concrete

to the elevation of the top of footing. The placing of concrete bases above seal courses is permitted after the forms are free from water and the seal course cleaned. Execute necessary pumping or bailing during concreting from a suitable sump located outside the forms.

3.07 FINISHING FORMED SURFACES

A. Forms for walls, columns, and sides of beams and girders shall be removed as specified in Section 03 11 00 "Concrete Forming." Patch, repair, finish, and clean concrete after form removal. Finish concrete within 7 days of form removal. Cure concrete as finishing progresses.

B. Air voids, for all types of finishes, are defects and shall be removed by rubbing or patching.

C. Finish Schedule:

Type of Finish	Location
No Finish	Surfaces which are not visible from the inside or outside of the completed structure or more than 12" below finish grade (i.e. back of retaining walls below embankment, etc.)
Smooth Finish	Surfaces exposed to view and areas below to a point 12" below grade

D. No Finish: After forms are removed, repair or patch-tie holes and defects. Otherwise, no additional finish is required.

E. Smooth Finish: Unless otherwise shown on the schedule above, provide smooth form finish for concrete surfaces to be exposed to view. Surfaces to receive a rubbed finish shall have a smooth form finish. The form facing material shall produce a smooth, hard, uniform texture on the concrete. The arrangement of the facing material shall be orderly and symmetrical with a minimum number of seams. Patch tie holes and defects and remove fins flush with the adjacent surface.

3.08 FINISHING FLOORS AND SLABS

A. General: Comply with recommendations in ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Finish slabs, platforms, and steps monolithically and apply as indicated on the Drawings and the following schedule of finishes:

Type of Finish	Location
Rough Finish	Floors that receive grout topping and slabs which receive additional concrete toppings.
Trowel Finish	Slab surfaces exposed to view or to be covered with resilient flooring, carpet, and ceramic or quarry tile set over a cleavage membrane, paint, or another thin film-finish coating system.
Broom Finish	Exterior concrete slabs, platforms, steps, and ramps and interior concrete slabs at pump station and disinfection facility.

1. Rough Finish: Provide a rough surface by screeding only without further finish.

2. Float Finish: Finish surfaces using a float to a true, even plane with no coarse aggregate visible. In the initial floating, while the concrete is plastic, use sufficient pressure on the float to bring excess moisture to the surface for removal. Apply a final "light float" finish to the surface as the concrete hardens. The surface shall have a uniform granular texture and shall meet the straightness requirements.

3. Trowel Finish:

   a. After applying float finish, apply first trowel finish and consolidate concrete by hand or power-driven trowel. Continue troweling passes and re-straighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

   b. Finish and measure surface so gap at any point between concrete surface and an unleveled freestanding 10-foot long straightedge, resting on two high spots and placed anywhere on the surface, does not exceed the following:

      1). 1/4 inch.

4. Broom Finish: Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

C. Give sidewalks a brush finish, unless noted otherwise. Score sidewalks at a spacing equal to the width of the walk and edge on each side using a tool with a radius of approximately 1/4 inch.

D. Finishing in Hot, Dry Weather: During periods of high temperature and/or low humidity, take extreme care in finishing the slabs to eliminate initial shrinkage cracks. Following the initial set of concrete, but while the concrete is still "green" continue to finish as required to remove shrinkage cracks which may occur. In hot, dry weather, keep a cement finisher on the job following normal finishing operations for a sufficient length of time to insure the removal of initial shrinkage cracks.

3.09 MISCELLANEOUS CONCRETE ITEMS

A. Normal Shrinkage Grouting:

1. Prior to grout application, thoroughly clean the surface of all foreign matter and wet down. Thoroughly clean the foundation and the forms set in place and securely anchor, with holes or cracks in forms caulked with rags, cotton waste or dry sand mixture to prevent the loss of grout. The necessary materials and tools shall be on hand before starting grouting operations. Concrete shall be damp when the grout is poured, but shall not have excess water to dilute the grout.

2. After wetting and just prior to grouting, sprinkle the surface lightly with cement to improve the bond between the grout and the surface.

3. After mixing, quickly and continuously place the grout to avoid overworking, segregation and breaking down of the initial set. Mix and place the grout according to the manufacturer's recommendations. Cure grout using wet curing method for concrete. Grout shall receive a steel trowel finish.

B. Non-Shrink Grout:

1. Obtain field technical assistance from the Grout manufacturer, as required, to insure that grout mixing and installation comply with the manufacturer's recommendations and procedures.

2. Saturate the foundation for non-shrink grouts 24 hours before installation and clear of excess water. Free baseplates or bedplates of oil, grease, laitance and other foreign substances.

3. Place grout according to the manufacturer's directions so that spaces and cavities below the top of the baseplates and bedplates are completely filled. Provide forms where structural components of the baseplates or bedplates do not confine the grout. Where necessary and acceptable under the manufacturer's procedures, a round head pencil vibrator, 3/4-inch maximum diameter may be used to consolidate the grout.

4. Steel trowel finish the non-shrink grout where the edge of the grout is exposed to view and after the grout has reached its initial set. Cut off the exposed edges of the grout at a 45-degree angle to the baseplate, bedplate, member, or piece of equipment.

5. Wet curing should occur for at least 3 days, unless specified by manufacturer, with wet rags, wet burlap or polyethylene sheets. Keep cloths constantly wet for the curing cycle.

6. Clean and dry the foundation, baseplate or other surface of epoxy grouts prior to installation. Dry curing is acceptable for epoxy grouts.

7. Use epoxy non-shrink grout under all machinery, pumps, equipment, and where chemicals are present that would abate cementitious non-shrink grouts.

8. Mix, install, cure, and finish epoxy grouts according to the manufacturer's recommendations. Install grout in recommended lifts to prevent excess heat.

3.10 CONCRETE PROTECTION AND CURING

A. General: Give careful attention to proper concrete curing. The curing methods shall be wet curing, sheet materials conforming to ASTM C171, or membrane curing compound conforming to ASTM C309. Membrane curing is not permitted on surfaces to be rubbed or on surfaces to which additional concrete, plaster mix mortar, or terrazzo is to be applied. Unless the curing method is specified otherwise, select the appropriate curing method.

B. Length of Curing Period:

1. A "curing day" shall be any day on which the atmospheric temperature taken in the shade, or the air temperature adjacent to the concrete, remains above 50 F for at least 18 hours.

2. Cure concrete for a period of 7 consecutive days. In cold weather, when curing may be retarded, extend this period to 7 "curing days", up to a limit of 14 consecutive days.

C. Wet Curing:

1. Immediately following the finishing operations, cover concrete slabs, including roof slabs, with wet cotton mats or with a temporary covering of canvas or burlap. Keep thoroughly wet for a period of 4 curing days after the concrete is placed. The covering shall be held in direct contact with the concrete. A temporary covering shall be required

when the size of slab, size of mats, or other factors dictate that the mats cannot be placed immediately after the finishing operations without marring the finishing of the slab.

2. Water used for curing shall be free from injurious amounts of oil, acid, alkali, salt, or other deleterious substances.

3. Canvas or burlap covering material shall weigh not less than 12 ounces per square yard. Place the sections with a lap at the edges of at least 8 inches. Saturate cover material with water previous to placing. Keep saturated as long as it remains in place. Use care in the placing of the cover material to prevent marring the concrete surface.

4. When temporary coverings are used, keep them in place only until the slab has sufficiently hardened so that a cotton mat covering can be substituted without marring or disturbing the slab finish. Thoroughly saturate cotton mats before placing and keep the mats on the slab in a saturated condition for a period of at least 4 curing days.

D. Sheet Curing: Sheet materials shall conform to ASTM C171. They shall be in contact with the entire concrete surface and applied according to the manufacturer's recommendations. Patch all holes. Where pedestrian traffic is unavoidable, provide suitable walkways to protect the sheet material.

E. Membrane Curing:

1. Membrane curing shall not be used on surfaces which receive paint, floor hardener, or plaster mix finish or other finish which would be hindered by the use of the curing compound.

2. Cover the surface of the concrete with a continuous, uniform, water-impermeable coating, conforming to ASTM C309 "Liquid Membrane Forming Compounds for Curing Concrete" and apply according to ACI 308.

3. Immediately after the removal of the side and end forms, apply a coating to the sides and ends of all concrete. Apply the solution under pressure with a spray nozzle so that the entire exposed surface is completely covered with a uniform film. The rate of application shall insure complete coverage, but the area covered shall not exceed 150 square feet per gallon of curing compound.

4. The coating shall be sufficiently transparent and free of permanent color to not result in a pronounced color change from that of the natural concrete at the conclusion of the curing period. The coating shall, however, contain a dye of color strength to render the film distinctively visible on the concrete for a period of at least 4 hours after application.

5. After application and under normal conditions, the curing compound shall be dry to touch within 1 hour and shall dry thoroughly and completely within 4 hours. When thoroughly dry, it shall provide a continuous flexible membrane free from cracks or pinholes and shall not disintegrate, check, peel, or crack during the required curing period.

6. If the seal is broken during the curing period, immediately repair it with additional sealing solution.

3.11 CONCRETE SURFACE REPAIRS

A. After the tie rods are broken back or removed, thoroughly clean the holes to remove grease and loose particles. Patch holes with structural concrete repair material. After the holes are completely filled, strike off flush excess mortar and finish the surface to render the filled hole inconspicuous.

B. If the surface of the concrete is bulged, uneven, or shows honeycombing or form marks, which in the Engineer's opinion cannot be repaired satisfactorily, remove and replace the entire section.

C. Patch honeycomb and minor defects in all concrete surfaces with structural concrete repair material. Cut back each defective area with a pneumatic chipping tool as deep as the defect extends, but in no case less than 1/2 inch. Prepare the existing concrete according to the recommendations of patching material manufacturer's. Apply repair material according to the manufacturer's recommendations. Finish the surface of the patches to match finish on surrounding concrete.

3.12 FIELD QUALITY CONTROL

A. Testing:

1. General:

   a. Tests shall be required throughout the Work to monitor the quality of concrete. Samples shall be taken in accordance with ASTM C172.

   b. The Engineer may waive these requirements on concrete placements of ten cubic yards or less. However, evidence shall be furnished showing a design mix which meets the Specifications.

   c. Unless noted otherwise, testing of the materials, ready mix, transit mix, or central plant concrete will be by an independent testing agency. **[The Owner will select and pay for this service.] [The independent testing agency will be approved by the Owner and paid by the Contractor.]** A summary of all tests performed will be available. No concrete shall be placed without a representative present at either the plant or at the Site.

   d. Unless the Owner's laboratory is on the Site, provide housing for the curing and storage of test specimens and equipment.

2. Slump Test: Slump tests, in accordance with ASTM C143, shall be used to indicate the workability and consistency of the concrete mix from batch to batch. Generally, a slump test shall be made at the start of operations each day, at regular intervals throughout a working day, and at any time when the appearance of the concrete suggests a change in uniformity.

3. Air Content Test: Tests for the concrete's air content shall be made in accordance with ASTM C231 or ASTM C173, at the point of delivery of concrete, prior to placing in forms. The test shall be made frequently to monitor a proper air content uniform from batch to batch.

4. Temperature Test: Test for the concrete's temperature in accordance with ASTM C1064 and as follows: the temperature of the concrete to be placed shall be taken with a

thermometer immediately before placement, with the point of measurement being in the chute or bucket. Temperature test shall be performed for each truck. Record temperatures on batch ticket.

5. Compression Test:

    a. Compression test specimens shall be 6-by-12-inch concrete cylinders made and cured in accordance with ASTM C31. If the maximum aggregate size is no larger than 1 inch, 4-by-8-inch concrete cylinders are acceptable. No fewer than two 6-by-12-inch or three 4-by-8-inch specimens shall be made for each test Sample. Samples shall be taken at a minimum of every 50 cubic yards of concrete for each class placed. At least one set of test specimens per day shall be made for each class of concrete used that day. Specimens shall be cured under laboratory conditions specified in ASTM C31. Additional concrete cylinders may be required for curing on the job under actual job curing conditions. These Samples could be required when:

        1). There is a possibility of the air temperature surrounding the concrete falling below 40 F, or rising above 90 F.

        2). The curing procedure may need to be improved and/or lengthened.

        3). It is necessary to determine when the structure may be put into service.

    b. Compression strength tests shall be made on the laboratory-cured and job-cured concrete cylinders at 7 and 28 days, in accordance with ASTM C39. The value of each test result shall be the average compressive strength of all of the cylinders in the test Sample. All cylinders within a test Sample shall be taken at the same time from the same batch of concrete. For the 28-day cylinders, the strength level shall be satisfactory if the averages of all sets of three consecutive strength test results exceed the required design compressive strength, and no individual strength test result falls below the required compressive strength by more than 500 psi.

6. High Early Strength Concrete Test: When Type “III” High Early Strength Portland cement is used instead of Type “I” Portland cement, the minimum allowable 28-day strength for Type “I” Portland cement concrete shall be at 7 days. The ages at time of test for Type “III” shall be 3 days and 7 days, instead of 7 days and 28 days, respectively, for Type “I.”

7. Failure to Meet Requirements:

    a. Should the 7-day strengths shown by the test specimens fall below the required values, additional curing shall be performed on those portions of the structures represented by the test specimens at the Contractor’s expense. Test cores shall be obtained and tested in accordance with ASTM Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete, Designation C 42. If additional curing does not give the strength required, the Owner reserves the right to require strengthening, replacement of those substandard portions of the structure, or additional testing, at the Contractor’s expense.

    b. Upon receipt of the Contractor’s written request, substandard concrete work may be reexamined in place by nondestructive testing methods or core Samples, in accordance with ACI 301. The services of an independent testing laboratory shall be retained and all expenses paid without compensation from the Owner. Laboratory

results shall be evaluated by the Engineer, who shall make the final decision on acceptability of the concrete in question. Core Sample holes shall be repaired.

B. The Owner may withhold payment for any section of concrete which does not meet the requirements of the Specifications. Withheld payment shall be based upon the unit prices established for concrete and reinforcing steel. Payment shall be withheld until the unacceptable concrete has been refinished, removed and replaced or otherwise brought into conformance with the Specifications.

C. TPV and PVC Waterstops: Waterstops shall be observed by the Owner's representative prior to concrete placement. Unacceptable splicing defects include:

1. Misalignment of center bulb, ribs, and end bulbs greater than 1/16 inch.
2. Bond failure at joint deeper than 1/16 inch.
3. Misalignment which reduces waterstop cross-section more than 15 percent.
4. Bubble or visible porosity in the weld.
5. Visible signs of splice separation when a cooled splice is bent by hand at a sharp angle.
6. Charred or burnt material.

END OF SECTION

Concrete Mix Design

Project Name: _____

FNI Project Number: _____

Project Location: _____

Owner: _____

General Contractor: _____

Mix Number / Class: _____

A. Mix Design:

Cement	=	_____	lb/yd³
Fly Ash	=	_____	lb/yd³
Other Cementitious Material: _____	=	_____	lb/yd³
Fine Aggregate	=	_____	lb/yd³
Course Aggregate	=	_____	lb/yd³
Water	=	_____	lb/yd³
Water Reducing Admixture	=	_____	oz/yd³
High Range Water Reducer	=	_____	oz/yd³
Air Entraining Admixture	=	_____	oz/yd³
Other Admixture: _____	=	_____	oz/yd³
Slump	=	_____	inches
Gross Weight	=	_____	lb/yd³
Air Content	=	_____	percent
Water/Cement Ratio	=	_____	

B. Materials:

	Source	ASTM	Type	Remarks
Cement				
Fly Ash				
Other Cementitious Material: _____				
Fine Aggregate				
Coarse Aggregate				
Water				
Water Reducer				
High Range Water Reducer				
Air Entraining				

	Source	ASTM	Type	Remarks
Other Admixture: _____				

C. Determination of Average Strength Required (fcr'):

1. Test Records Available:

A. Summary of Test Records (Provide Supporting Documentation):

Test Group No.	No. of Consecutive Tests	Specified Strength (psi)	Standard Deviation (psi)
Average Standard Deviation:			

B. Standard Deviation Modification Factor (ACI 30 1, Table 4.2.3.3.a): ____.

C. Standard Deviation Used: ____.

D. Average Compressive Strength Required: ____.

2. Test Records Not Available:

A. Average Compressive Strength Required (ACI 30 1, Table 4.2.3.3.b, if required): ____.

D. Documentation of Required Average Compressive Strength (Check One):

1. Field Strength:

a. Field Strength Test Records (ACI 30 1, Table 4.2.3.3.a): ____. *Complete Attachment A.

2. Trial Mixtures:

a. Trial Mixtures (ACI 301, Table 4.2.3.3.b, if required): ____. *Complete Attachment B.

I, _____ certify that the above information is correct and all gradations, cement certifications, and test results are located at our place of business for review by the Engineer.

Name: _____ Date: _____

Title: _____

Company: _____

Address: _____

_____

_____

Attachment A

Documentation of Required Average Strength – Field Strength Records

(ACI 301, 4.2.3.4.a)

A. Summary of Test Records (Provide Supporting Documentation):

Test Record No.	No. of Tests in Record	Duration of Record (days)	Water-Cementitious Materials Ratio	Average Strength (psi)

B. Interpolation used? _____.

1. Provide an interpolation calculation or plot of strength versus proportions.

C. Submit the following data for each mix:

1. Brand, type, and amount of cement.
2. Brand, type, and amount of each admixture.
3. Source of each material used.
4. Amount of water.
5. Proportions of each aggregate material per cubic yard.
6. Gross weight per cubic yard.
7. Measured slump.
8. Measured air content.
9. Results of consecutive strength tests.

Attachment B

Documentation of Required Average Strength – Trial Mixtures

(ACI 301, 4.2.3.4.b)

A. Summary of Test Record(s):

Trial Mix No.	7-Day Tests		28-Day Tests		Water-Cementitious Materials Ratio	Slump (in)	Air Content (percent)	Temperature (F)
	No. of Test Cylinders	Strength (psi)	No. of Test Cylinders	Strength (psi)				

B. Maximum water-cementitious materials ratio _____.

1. Provide an interpolation calculation or plot of strength versus water-cementitious materials ratio.

C. Submit the following data for each mix:

1. Brand, type, and amount of cement.
2. Brand, type, and amount of each admixture.
3. Amount of water used in trial mixes.
4. Proportions of each aggregate material per cubic yard.
5. Gross weight per cubic yard.
6. Measured slump.
7. Measured air content.
8. Compressive strength developed at 7 days and 28 days, from not less than three test cylinders cast for each 7-day and 28-day test.

END OF ATTACHMENTS

03 45 14 PRECAST CONCRETE WALL PANELS

1.00 GENERAL

1.01 WORK INCLUDED

A. Furnish labor, materials, equipment and incidentals necessary to fabricate at precasting plant, transport, and erect job cast concrete panels.

B. Furnish and install reinforcing steel, steel anchor plates, weld plates, anchors, reglets, and lifting devices cast into concrete units.

1.02 QUALITY ASSURANCE

A. Design Criteria: Concrete shall be ClassA concrete as specified in Section 03 30 00 “Cast-In-Place Concrete” having a minimum strength at 28 days of 5000 psi. Maximum slump shall be 4 inches. Air entrainment shall be 2 to 5 percent.

B. Trial Mixes: Trial mix shall be in accordance with ACI 211.1. An independent testing laboratory, retained by the Contractor and approved by the Owner’s Representative shall determine the materials and proportions for trial concrete mix. The laboratory trial concrete mix shall be submitted for the Owner’s Representative’s approval before the 7-day strength tests are made. Make 7-day and 28-day compressive tests for three Samples from the trial mix.

C. Contractor’s Testing:

1. Testing shall be in accordance with ASTM C172.

2. The Contractor shall retain an independent testing laboratory, subject to the Owner’s Representative’s approval, to make tests of concrete placed at the job Site. The Contractor shall make one set of test cylinders for every 10 yards of concrete placed each day. These cylinders shall be tested at 28 days and two copies of the test reports shall be sent to the Contractor and Owner’s Representative. In addition, the Contractor may make other tests as he feels necessary for determining required strength for lifting. The Contractor shall pay for these tests.

D. Owner’s Testing: The Owner shall have the option of retaining an independent testing laboratory to make concrete test cylinders during the concrete placement. The testing laboratory shall make a minimum of one set of cylinders for every 25 yards of concrete used for wall panels, or two sets of cylinders for every day concrete is poured, whichever is greater. These cylinders shall be from different batches and will be broken at 28 days only. These tests will be paid for by the Owner.

E. Inspection:

1. Reinforcing steel must be approved prior to concrete placement. Notify Owner’s Representative when observation is required.

2. Concrete work shall be subject to the Owner’s inspection. The Contractor shall provide a work schedule showing dates the panels will be in the various stages of fabrication. The Contractor shall notify the Owner’s Representative 24 hours in advance of each concrete placement.

F. Casting Tolerances: Panels shall be subject to the following manufacturing tolerances (plus or minus):

Position of Cast-In-Place Items	Tolerance
Inserts, bolts, pipe sleeves	3/8”
Flashing reglets	1/4”
Glazing reglets	1/8”
Electrical outlets, pipe sleeves	3/4”
Reinforcement Placement	**Tolerance**
Reinforcement Placement	1/2”
Casting Tolerance	**Tolerance**
Overall height or width	1/8”
Angular deviation of plane of side mold	1/16” per 6” depth
Thickness	1/4”
Openings	1/4”
Squareness (difference of two diagonal dimensions)	1/4”
Finished Product	**Tolerance**
Bowing or warping (no intermediate support)	1/240 of panel dimension
Bowing or warping (intermediate support	1/360 of panel dimension
Squareness	1/8” per 6’ out of square
Average Compressive Strength	
The average of three consecutive cylinder strength tests shall equal or exceed the compressive specified strength at 28 days.	

1.03 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide precast structural concrete wall panels and connections capable of withstanding design loads indicated on the drawings within limits and under conditions indicated.

1.04 SUBMITTALS

A. Submittal shall be in accordance with Section 01 33 00 “Submittal Procedures” and shall include the following:

1. Shop Drawings showing panel dimensions, reinforcement size and placement, and location of anchor plates, embed plates, inserts, and details of fabrication.

    a. Comprehensive engineering analysis signed and sealed by the qualified professional engineer responsible for its preparation.

2. Product data sheet and specifications for accessories, reinforcing, anchors and inserts.

3. Wall panel Samples in accordance with the following:

a. Submit three pairs of panels 12 inches by 12 inches, each pair having a variation of sand, gravel, and degree of finish. Upon review of Sample panels, the Owner's Representative may select one pair as an approved panel, or request additional pairs of panels using some other mixture of sand, gravel, and finish to achieve the desired effect.

b. Upon approval, one approved Sample will be returned to the manufacturer. One will be retained by the Owner's Representative for comparison with units produced at the Site.

B. Submit mix design showing materials, laboratory test and manufacturer's qualifications for cement and admixtures.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed precast structural concrete work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Fabricator Qualifications: A firm that complies with the following requirements and is experienced in manufacturing precast structural concrete units similar to those indicated for this Project and with a record of successful in-service performance.

1. Assumes responsibility for engineering precast structural concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

2. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of precast structural concrete that are similar to those indicated for this Project in material, design, and extent.

3. Participates in PCI's Plant Certification program and is designated a PCI-certified plant for Group C, Category C1.

4. Has sufficient production capacity to produce required units without delaying the Work.

C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 to conduct the testing indicated, as documented according to ASTM E548.

D. Design Standards: Comply with ACI 318 (ACI 318M) and the design recommendations of PCI MNL 120, "PCI Design Handbook--Precast and Prestressed Concrete."

E. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and camber and dimensional tolerances for types of units required, comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products."

1.06 STANDARDS

A. The applicable provisions of the following standards shall apply as if written here in their entirety:

1. American Concrete Institute (ACI) Publications:

ACI 211.1	Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 301	Specification for Structural Concrete for Buildings
ACI 304R	Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 315	Details and Detailing on Concrete Reinforcement
ACI 318	Building Code Requirements for Reinforced Concrete
ACI 551	Tilt-Up Concrete Structures

2. Concrete Reinforcing Steel Institute (CRSI) Publication:

CRSI	Manual for Standard Practice for Reinforced Concrete

3. American Society for Testing and Materials (ASTM) Standards:

ASTM A82	Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM A123	Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A185	Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A307	Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A385	Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
ASTM A615	Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A767	Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
ASTM C31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33	Specification for Concrete Aggregates
ASTM C39	Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C40	Test Method for Organic Impurities in Fine Aggregates for Concrete
ASTM C88	Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C150	Specification for Portland Cement
ASTM C156	Test Method for Water Retention by Concrete Curing Materials
ASTM C171	Specification for Sheet Materials for Curing Concrete
ASTM C172	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C192	Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C260	Specification for Air-Entraining Admixtures for Concrete

ASTM C309	Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C494	Specification for Chemical Admixtures for Concrete

4. American Welding Society (AWS) Standards:

AWS D1.1	Structural Welding Code - Steel
AWS D1.4	Structural Welding Code – Reinforcing Steel

1.07 DELIVERY, HANDLING AND STORAGE

A. Wherever possible, lift panels from storage area to proper position in the building to avoid re-handling. Store panels off grade with wood runners and protect surfaces with quilted pads, cushions, or other protective coverings. Protect special shapes, fins or other features with special built frames.

B. Use cranes with multi-point lifting slings to raise panels to vertical position.

C. Handle panels in as nearly a vertical plane as possible at all times. Use lifting inserts and multi-point lifting slings for handling panels.

1.08 JOB CONDITIONS

A. Reinforcing shown in wall panels are for walls in place only. The Contractor shall be responsible for all loads and forces imposed during casting and erection. Provide temperature and lifting reinforcement. Reinforce each panel to correspond to imposed stresses. Compute lift points and provide suitable means of lifting and guying panels.

1.09 OPTIONS

A. Concrete panels shall be precast by an acceptable precast concrete manufacturer and shipped to the Site.

2.00 PRODUCTS

2.01 MATERIALS

A. Cement: Portland cement conforming to ASTM C150, Type I.

B. Fine Aggregate: Clean, hard natural sand or manufactured sand, or a combination of both; conforming to ASTM C33.

C. Coarse Aggregate: Crushed stone or gravel conforming to ASTM C33; gradation size number 67; the maximum size of 0.75 inch.

D. Water: Clean, free of deleterious amounts of acids, alkalis or organic material.

E. Reinforcing Steel: New billet steel conforming to ASTM A615, Grade 60. Reinforcing bars shall be identified by permanent mill imprinted markings to show producer, bar size, and type of steel.

F. Metal Accessories: Includes all spacers, chairs, bolsters, ties and other devices necessary for properly placing, spacing, supporting and fastening reinforcement in place, fabricated of plastic or galvanized steel.

G. Admixtures: Concrete shall contain air-entrainment admixtures. When job conditions dictate, water-reducing and set-controlling admixtures may be used. Only specified admixtures shall be used. Admixtures shall be added at the batch plant. Refer to Section 03 30 00 “Cast-In-Place Concrete.”

H. Curing Materials: In accordance with Section 03 30 00 “Cast-In-Place Concrete.”

I. Form Release Agent: A chemical type, non-staining releasing agent which does not affect the bonding of plants, paint, water-proofing or other materials to concrete; Nox-Crete Co. “Nox-Crete” Form Coating; Symone Mfg. Co. “Majic Kote”; Industrial Synthetics Corp. “Synthex”, or equal.

J. Shrinkage Compensating Grout:

1. Shrinkage compensating grout for grouting of precast concrete panels. Grout shall meet the following requirements, as verified by independent laboratory tests:

a. No shrinkage from the time of placement, or expansion after set, under ASTM C827 and CRD-C621-83 (Corps of Engineers). When non-shrink grouts are tested under CRD-C621-83, the grout shall be tested in a fluid state. A fluid state shall be defined as flowing through a flow cone at the rate of 20 seconds, plus or minus 5 seconds.

b. A 24-hour compressive strength in a trowelable mix of not less than 8000 psi under ASTM C109, unless otherwise specified.

c. An initial set time of not less than 45 minutes under ASTM C191.

2. Non-Shrink Non-Metallic Grout: Pre-mixed, non-staining, non-shrink grout; “Masterflow 928” grout by Master Builders, Inc., or equal.

K. Embedded Anchors: Embedded components such as anchor plates, lifting devices, brackets or connectors shall be non-ferrous, or shall be galvanized after fabrication. Galvanizing shall be in accordance with ASTM A123.

L. Structural Concrete Repair Material: Non-shrink, non-slump, non-metallic, quick-setting patching mortar; Sika Corp. “Sikatop 123”; U.S. Grout Corp. “Five Star Structural Concrete”; or equal as approved by the manufacturer for each application and applied in accordance with the manufacturer’s recommendation.

M. Wire Fabric: Cold drawn steel wire conforming to ASTM A82 and fabricated to conform to ASTM A185.

N. Cleaning Solution: ProSuCo Inc. “SureKlean” or equal.

2.02 MIXES

A. Concrete mixture shall remain consistent during all concrete placement.

2.03 FABRICATIONS

A. Special fabricated inserts manufactured for the precast industry may be used as anchor and lifting devices. Such items shall be stainless steel, or shall be galvanized after fabrication,

and shall be complete with washers, bolts, nuts, spacers, straps and accessories compatible with the insert type. The Owner's Representative shall approve of insert type and usage.

B. Provide reglets in forms as required. Fasten securely to forms to prevent displacement. Place concrete carefully around reglets to prevent displacement and to assure proper embedment. After casting, inspect panels and assure that reglets are straight and true and will align from one panel to the next in long, straight, parallel lines.

C. Wall panels must be reinforced with deformed steel reinforcing bars, or a combination of reinforcing bars and welded wire mesh. Steel fabric alone will not be accepted as primary panel reinforcement.

2.04 FORMS

A. Forms shall be true to pattern and free of warps or other defects affecting the finished wall panel. Details shall be sharp and crisp. Curved surfaces shall be true radius curves blending into flat planes without breaks in the surface. Forms shall be impervious, waterproof, completely rigid, properly sealed to withstand high hydraulic pressures resulting from high frequency vibration without movement or leakage.

B. Steel forms shall be fabricated of 3/16-inch thick minimum material with braces spaced at not over 12 inches center. Forms shall have minimum weld and camber deflection. Joints shall be welded continuous and ground smooth.

C. Fiberglass forms shall be fabricated of Thixotropic isophthalic resin containing not less than 25 percent fiberglass. Faces shall be covered with alkali resistant gelcoat approved for use with concrete.

D. Inspect and repair forms if used more than once. Do not reuse forms which have damage affecting the strength, integrity, or finish of the precast units. Chamfer strips, corner strips and rustication insert may be polyvinyl chloride, fiberglass, or steel; compatible with form type.

E. Wire mesh shall be of the size noted lapped no less than one mesh on the sides and two meshes at end splices. Securely tie overlapping meshes together.

2.05 IDENTIFICATION

A. Each precast concrete unit shall be identified by a unique mark which identifies the unit and its location within the structure. This mark shall be the same one used for Shop Drawings.

2.06 CURING

A. Units shall be adequately protected from injurious actions by the sun, snow, rain and mechanical injury. Units shall not be allowed to dry out from the time the concrete is placed until the expiration of the minimum curing time. Accomplish this by keeping the surfaces continuously damp, or by preventing the evaporation of the mixing water by means of waterproof coverings, or steam applied to the surface as soon as possible after removal of forms or after free water has disappeared from the surface. Curing period shall be continued for not less than 5 days after the units have been removed from the forms. Units shall not be shipped to the job Site until they have been allowed to dry at least 5 days subsequent to curing operations.

2.07 PANEL FINISHES

A. Panel finishes shall conform to the following:

1. Inside panel face, unexposed: Wood float or light broom finish.

2. Inside panel face, exposed: Steel trowel or sandblast finish as scheduled or otherwise indicated on the Drawings.

3. Exterior panel face, exposed: Medium to heavy sandblast.

2.08 SANDBLAST FINISH

A. Visible surfaces of finished units shall have abrasive blasted finish to match the approved Samples. Begin finishing not less than 14 nor more than 28 days after casting of the units. Use a blasting nozzle of either tungsten carbide or Norbide, 3/8 to 3/4 inch in diameter, a constant uniform nozzle pressure of 80 to 100 psi, a rotary type compressor, and graded blasting sand or another type abrasive that will not affect the color of the finished surface. Select gradation, size and sharpness to produce surfaces to match the approved Sample. After the nozzle size, air pressure and abrasive have been selected to produce the surface, none shall be varied without specific approval.

2.09 COLORED CONCRETE

A. Concrete panels shall be cast with integrally colored concrete. Use same sand, cement and aggregate proportions and same brand of materials for all colored concrete. Concrete shall be the product of a single concrete batch plant and shall be carefully controlled. Color shall be added to batch by weight, and mixing time shall be controlled. All mixing and batching shall be in accordance with the manufacturer's printed instructions. The maximum dose shall not exceed 10 percent of cement weight.

B. Curing procedures shall follow the manufacturer's directions. The color shall be selected by the Owner's Representative. The Contractor shall submit 12 inches by 12 inches or larger concrete Samples to act as quality control for job cast concrete.

3.00 EXECUTION

3.01 WALL PANEL INSTALLATION

A. After panels have reached a minimum of 3500 psi and/or after 7 days have elapsed after placement, lift, tilt, or otherwise position the panels into place and adequately brace. Provide temporary braces for wall panels to "dead-man" anchors, which shall be left in place until supporting structure is complete.

B. Lift each panel into place and adjust to proper alignment and spacing. Panels shall be level and plumb, true to alignment and shimmed as necessary. Secure anchors and weld connection anchor plates so that the entire work is rigidly in place, forming a complete integrated structure. Panels shall be installed in accordance with the shop drawings, under the direct supervision of the precast concrete manufacturer's field representative.

C. The Contractor shall be responsible for all inserts cast into panels, including shear plates, connection plates, lifting inserts, reglets, and reveals, as well as special anchoring devices.

The Contractor shall coordinate the Work to ensure that anchors, plates, brackets, lugs or other anchoring devices are provided at corresponding point at the building structure.

3.02 FIELD WELDING

A. Welding shall conform to the American Welding Society (AWS) procedures and be performed by qualified welders. After erection, touch up welds in galvanized surfaces with cold galvanizing compound, zinc solder in accordance with ASTM A780. Welding shall conform to AWS D1.1 and AWS D1.4.

3.03 FIELD QUALITY CONTROL

A. Panels shall be erected to the following tolerances:

Erection Tolerances (plus or minus)	
Panel to joint, 10-foot panels	3/16”
Panel to joint, 10- to 20-foot panels	1/4”
Joint taper	1/4” per 10’
Panel alignment of edge	1/4”

B. Damaged or stained panels must be approved by Owner’s Representative prior to erection. Panels having structural cracks shall not be erected, but shall be replaced with new panels at the Contractor’s expense. Panels having non-structural damage may be erected provided damage can be repaired to the Owner’s Representative’s satisfaction. Repairs to exposed surfaces must be repaired in a manner to be undetectable from the ground level. Prepare a Sample of patching showing techniques to be used and result to be expected.

3.04 CLEAN AND ADJUST

A. Repair spalls, holes, honeycombs, and other defects in all exposed surfaces. Chip away loose material and clean areas to be patched. Brush on a thick coat of Larsen’s “Weld’-Crete” and patch with a 1:2 mortar mix with acrylic admixture and color as necessary to match panels. Prepare Sample for approval.

B. Remove braces and fill in all holes left by temporary fastening devices with non-shrink grout.

C. Clean panels after erection. Remove concrete splashes, fins, projections, or other defects. Wash with clear water and stiff fiber brushes. Rinse with clear water.

D. Provide sand blasting, water blasting, or other means where required to clean up stained panels or to make panels equal in appearance.

END OF SECTION

DIVISION 4

MASONRY

04 22 00 CONCRETE UNIT MASONRY

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Decorative concrete masonry units.
3. Mortar and grout.
4. Steel reinforcing bars.
5. Masonry-joint reinforcement.
6. Embedded flashing.
7. Miscellaneous masonry accessories.
8. Cavity-wall insulation.

B. Products Installed but not Furnished under This Section:

1. Cast-stone trim in concrete unit masonry.

C. Related Requirements:

1. Section 051200 "Structural Steel Framing" for installing anchor sections of adjustable masonry anchors for connecting to structural steel frame.
2. Section 071900 "Water Repellents" for water repellents applied to unit masonry assemblies.

3. Section 076200 "Sheet Metal Flashing and Trim" for sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

1.03 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.

2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315.

3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Initial Selection:

1. Colored mortar.

2. Weep holes/vents.

D. Samples for Verification: For each type and color of the following:

1. Decorative CMUs.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Material Certificates: For each type and size of the following:

1. Masonry units.

    a. Include data on material properties and material test reports substantiating compliance with requirements.

2. Integral water repellant used in CMUs.

3. Cementitious materials. Include name of manufacturer, brand name, and type.

4. Mortar admixtures.

5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.

6. Grout mixes. Include description of type and proportions of ingredients.

7. Reinforcing bars.

8. Joint reinforcement.

9. Anchors, ties, and metal accessories.

C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

    1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.

    2. Include test reports, according to ASTM C1019, for grout mixes required to comply with compressive strength requirement.

D. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to TMS 602/ACI 530.1/ASCE 6.

E. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.06 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C1093 for testing indicated.

B. Sample Panels: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.

1. Build sample panels for each type of exposed unit masonry construction in sizes approximately 48 inches (1200 mm) long by 48 inches (1200 mm) by full thickness.

2. Build sample panels facing south.

3. Protect approved sample panels from the elements with weather-resistant membrane.

4. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.

a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless Architect specifically approves such deviations in writing.

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups for typical exterior wall in sizes approximately 72 inches (1800 mm) long by 72 inches (1800 mm) high by full thickness, including face and backup wythes and accessories.

a. Include a sealant-filled joint at least 16 inches (400 mm) long in each mockup.

b. Include lower corner of window opening at upper corner of exterior wall mockup. Make opening approximately 12 inches (300 mm) wide by 16 inches (400 mm) high.

c. Include through-wall flashing installed for a 24-inch (600-mm) length in corner of exterior wall mockup approximately 16 inches (400 mm) down from top of mockup, with a 12-inch (300-mm) length of flashing left exposed to view (omit masonry above half of flashing).

2. Protect accepted mockups from the elements with weather-resistant membrane.

3. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.

    a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.

    b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.08 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches (600 mm) down both sides of walls, and hold cover securely in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.

2. Protect sills, ledges, and projections from mortar droppings.

3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.

4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

2.00 PRODUCTS

2.01 MANUFACTURERS

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.02 PERFORMANCE REQUIREMENTS

A. Provide unit masonry that develops indicated net-area compressive strengths at 28 days.

1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to TMS 602/ACI 530.1/ASCE 6.

2.03 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6 except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.04 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.

2. Provide square-edged units for outside corners unless otherwise indicated.

B. Integral Water Repellent: Provide units made with integral water repellent for exposed units.

1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E514/E514M as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) ACM Chemistries.

2) BASF Corporation.

3) Euclid Chemical Company (The); an RPM company.

4) GCP Applied Technologies Inc.

C. CMUs: ASTM C90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi (19.3 MPa).

2. Density Classification: Normal weight unless otherwise indicated.

3. Size (Width): Manufactured to dimensions 3/8 inch (10 mm) less-than-nominal dimensions.

4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.

5. Faces to Receive Plaster: Where units are indicated to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.

D. Decorative CMUs: ASTM C90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi (19.3 MPa).

2. Density Classification: Lightweight.

3. Size (Width): Manufactured to dimensions specified in "CMUs" Paragraph.

4. Pattern and Texture:

    a. Standard pattern, ground-face finish. Match Architect's samples.

    b. Standard pattern, split-face finish. Match Architect's samples.

5. Colors: As indicated by manufacturer's designations.

2.05 MASONRY LINTELS

E. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.06 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C91/C91M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cemex S.A.B. de C.V.

b. Essroc.

c. Holcim (US) Inc.

d. Lafarge North America Inc.

E. Colored Cement Products: Packaged blend made from masonry cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.

1. Colored Portland Cement-Lime Mix:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Essroc.

2) Holcim (US) Inc.

3) Lafarge North America Inc.

2. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.

3. Pigments shall not exceed 10 percent of portland cement by weight.

F. Aggregate for Mortar: ASTM C144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.

2. For joints less than 1/4 inch (6 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.

3. White-Mortar Aggregates: Natural white sand or crushed white stone.

4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

G. Aggregate for Grout: ASTM C404.

H. Epoxy Pointing Mortar: ASTM C395, epoxy-resin-based material formulated for use as pointing mortar for glazed or pre-faced masonry units (and approved for such use by manufacturer of units); in color indicated or, if not otherwise indicated, as selected by Architect from manufacturer's colors.

I. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. BASF Corporation.

b. Euclid Chemical Company (The); an RPM company.

J. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ACM Chemistries.

b. BASF Corporation.

c. Euclid Chemical Company (The); an RPM company.

K. Water: Potable.

2.07 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60 (Grade 420).

B. Masonry-Joint Reinforcement, General: Ladder type complying with ASTM A951/A951M.

1. Interior Walls: Hot-dip galvanized carbon steel.

2. Exterior Walls: Hot-dip galvanized carbon steel.

3. Wire Size for Side Rods: 0.187-inch (4.76-mm) diameter.

4. Wire Size for Cross Rods: 0.187-inch (4.76-mm) diameter.

5. Spacing of Cross Rods: Not more than 16 inches (407 mm) o.c.

6. Provide in lengths of not less than 10 feet (3 m), with prefabricated corner and tee units.

2.08 TIES AND ANCHORS

A. General: Ties and anchors shall extend at least 1-1/2 inches (38 mm) into masonry but with at least a 5/8-inch (16-mm) cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A153/A153M, Class B-2 coating.

2. Galvanized-Steel Sheet: ASTM A653/A653M, Commercial Steel, G60 (Z180) zinc coating.

C. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- (6.35-mm-) diameter, hot-dip galvanized steel wire.

2. Tie Section: Triangular-shaped wire tie made from 0.25-inch- (6.35-mm-) diameter, hot-dip galvanized steel wire.

D. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:

a. Structural Performance Characteristics: Capable of withstanding a 100-lbf (445-N) load in both tension and compression without deforming or developing play in excess of 0.05 inch (1.3 mm).

2. Contractor's Option: Unless otherwise indicated, provide any of the following types of anchors:

3. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie and a metal anchor section.

a. Products: Subject to compliance with requirements, provide one of the following:

1) Dayton Superior Corporation, Dur-O-Wal Division.

2) Heckmann Building Products Inc.

3) Hohmann & Barnard, Inc.

4) Wire-Bond.

b. Anchor Section: Rib-stiffened, sheet metal plate with screw holes top and bottom, 2-3/4 inches (70 mm) wide by 3 inches (76 mm) high; with projecting tabs having slotted holes for inserting vertical legs of wire tie specially formed to fit anchor section.

c. Anchor Section: Sheet metal plate, 1-1/4 inches (32 mm) wide by 6 inches (152 mm) long, with screw holes top and bottom and with raised rib-stiffened strap, 5/8 inch (16 mm) wide by 5-1/2 inches (140 mm) long, stamped into center to provide a slot between strap and plate for inserting wire tie.

d. Fabricate sheet metal anchor sections and other sheet metal parts from 1.05-inch- (2.66-mm-) thick, steel sheet, galvanized after fabrication.

e. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from 0.25-inch- (6.35-mm-) diameter, hot-dip galvanized steel wire.

E. Partition Top Anchors: 0.105-inch- (2.66-mm-) thick metal plate with a 3/8-inch- (9.5-mm-) diameter metal rod 6 inches (152 mm) long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.

2.09 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.016 inch (0.40 mm) thick.

2. Fabricate continuous flashings in sections 96 inches (2400 mm) long minimum, but not exceeding 12 feet (3.7 m). Provide splice plates at joints of formed, smooth metal flashing.

3. Fabricate through-wall metal flashing embedded in masonry from stainless steel, with ribs at 3-inch (76-mm) intervals along length of flashing to provide an integral mortar bond.

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Cheney Flashing Company.

      2) Hohmann & Barnard, Inc.

4. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.

5. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.

6. Fabricate metal expansion-joint strips from stainless steel to shapes indicated.

B. Flexible Flashing: Use the following unless otherwise indicated:

1. Copper-Laminated Flashing: 7-oz./sq. ft. (2-kg/sq. m) copper sheet bonded between two layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Advanced Building Products Inc.

2) Hohmann & Barnard, Inc.

3) Wire-Bond.

C. Application: Unless otherwise indicated, use the following:

1. Where flashing is indicated to receive counterflashing, use metal flashing.

2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.

3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge.

4. Where flashing is fully concealed, use metal flashing.

D. Solder and Sealants for Sheet Metal Flashings:

1. Solder for Stainless Steel: ASTM B32, Grade Sn60, with acid flux of type recommended by stainless steel sheet manufacturer.

E. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.10 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane or PVC.

B. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).

C. Weep/Vent Products: Use the following unless otherwise indicated:

1. Vinyl Weep Hole/Vent: One-piece, offset, T-shaped units made from flexible PVC, designed to fit into a head joint and consisting of a louvered vertical leg, flexible wings

to seal against ends of masonry units, and a top flap to keep mortar out of the head joint; in color selected by Architect.

a. Products: Subject to compliance with requirements, provide one of the following:

1) Hohmann & Barnard, Inc.; #343 Louvered Weep Hole.

2) Williams Products, Inc.; Williams-Goodco Brick Vent.

3) Wire-Bond; Louvered Weepholes.

D. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Advanced Building Products Inc.; Mortar Break.

b. Archovations, Inc.; CavClear Masonry Mat.

c. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.

d. Mortar Net USA, Ltd.; Mortar Net.

2. Provide one of the following configurations:

a. Strips, full-depth of cavity and 10 inches (250 mm) high, with dovetail shaped notches 7 inches (175 mm) deep that prevent clogging with mortar droppings.

2.11 CAVITY-WALL INSULATION

A. Polyisocyanurate Board Insulation: ASTM C 1289, Type I (aluminum-foil-faced), Class 2 (glass-fiber-reinforced).

1. Thickness: 2 inches.

B. Adhesive: Type recommended by insulation board manufacturer for application indicated.

2.12 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Diedrich Technologies, Inc.

b. EaCo Chem, Inc.

c. ProSoCo, Inc.

2.13 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.

2. Use portland cement-lime mortar unless otherwise indicated.

3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

1. For masonry below grade or in contact with earth, use Type S.

2. For reinforced masonry, use Type S.

3. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.

4. For interior non-load-bearing partitions, Type O may be used instead of Type N.

D. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.

1. Mix to match Architect's sample.

2. Application: Use colored aggregate mortar for exposed mortar joints with the following units:

a. Rockface CMU.

b. Groundface CMU.

c. Cast stone trim units.

E. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.

2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi (14 MPa).

3. Provide grout with a slump of 8 to 11 inches (203 to 279 mm) as measured according to ASTM C 143/C 143M.

3.00 EXECUTION

3.01 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.

2. Verify that foundations are within tolerances specified.

3. Verify that reinforcing dowels are properly placed.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

1. Mix units from several pallets or cubes as they are placed.

3.03 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).

2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).

3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.

2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.

3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.

4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.

5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.

6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.

7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.5 mm) except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).

2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).

3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).

4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm). Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3 mm).

5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch (1.5 mm) from one masonry unit to the next.

3.04 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in bond indicated on drawings; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches (50 mm). Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

H. Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.

2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch (13-mm) clearance between end of anchor rod and end of tube. Space anchors 48 inches (1200 mm) o.c. unless otherwise indicated.

3. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.

4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Division 07 Section "Fire-Resistive Joint Systems."

3.05 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.

2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.

3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.

4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.

1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.

2. Allow cleaned surfaces to dry before setting.

3. Wet joint surfaces thoroughly before applying mortar.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.06 CAVITY WALLS

A. Bond wythes of cavity walls together using one of the following methods:

1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 1.77 sq. ft. (0.16 sq. m) of wall area spaced not to exceed 16 inches (406 mm) o.c. horizontally and 16 inches (406 mm) o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches (305 mm) of openings and space not more than 36 inches (915 mm) apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches (610 mm) o.c. vertically.

a. Where bed joints of wythes do not align, use adjustable (two-piece) type ties.

b. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type ties to allow for differential movement regardless of whether bed joints align.

2. Masonry Joint Reinforcement: Installed in horizontal mortar joints.

a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.

b. Where bed joints of wythes do not align, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties.

c. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties to allow for differential movement regardless of whether bed joints align.

3. Header Bonding: Provide masonry unit headers extending not less than 3 inches (76 mm) into each wythe. Space headers not over 8 inches (203 mm) clear horizontally and 16 inches (406 mm) clear vertically.

4. Masonry Veneer Anchors: Comply with requirements for anchoring masonry veneers.

B. Bond wythes of cavity walls together using bonding system indicated on Drawings.

C. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

D. Apply air barrier to face of backup wythe to comply with Division 07 Section "Fluid-Applied Membrane Air Barriers."

E. Installing Cavity-Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches (300 mm) o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.

1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

3.07 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).

1. Space reinforcement not more than 16 inches (406 mm) o.c.

2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.

3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.08 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:

1. Provide an open space not less than 1 inch (25 mm) wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.

2. Anchor masonry with anchors embedded in masonry joints and attached to structure.

3. Space anchors as indicated, but not more than 24 inches (610 mm) o.c. vertically and 36 inches (915 mm) o.c. horizontally.

3.09 ANCHORING MASONRY VENEERS

A. Anchor masonry veneers to concrete and masonry backup with masonry-veneer anchors to comply with the following requirements:

1. Fasten anchors to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.

2. Insert slip-in anchors in metal studs as sheathing is installed. Provide one anchor at each stud in each horizontal joint between sheathing boards.

3. Embed tie sections in masonry joints. Provide not less than 2 inches (50 mm) of air space between back of masonry veneer and face of sheathing.

4. Locate anchor sections to allow maximum vertical differential movement of ties up and down.

5. Space anchors as indicated, but not more than 18 inches (458 mm) o.c. vertically and 24 inches (610 mm) o.c. horizontally, with not less than 1 anchor for each 2 sq. ft. (0.2 sq. m) of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 8 inches (203 mm), around perimeter.

6. Space anchors as indicated, but not more than 16 inches (406 mm) o.c. vertically and 24 inches (610 mm) o.c. horizontally with not less than 1 anchor for each 2.67 sq. ft. (0.25 sq. m) of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 36 inches (914 mm), around perimeter.

3.10 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry using one of the following methods:

1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.

2. Install preformed control-joint gaskets designed to fit standard sash block.

3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.

4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

C. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Division 07 Section "Joint Sealants," but not less than 3/8 inch (10 mm).

1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.11 LINTELS

A. Install steel lintels where indicated.

B. Provide masonry lintels where shown and where openings of more than 12 inches (305 mm) for brick-size units and 24 inches (610 mm) for block-size units are shown without structural steel or other supporting lintels.

C. Provide minimum bearing of 8 inches (200 mm) at each jamb unless otherwise indicated.

3.12 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.

2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 8 inches (200 mm), and through inner wythe to within 1/2 inch (13 mm) of the interior face of wall in exposed masonry. Where interior face of wall is to receive furring or framing, carry flashing completely through inner wythe and turn flashing up approximately 2 inches (50 mm) on interior face.

3. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least 8 inches (200 mm); with upper edge tucked under building paper or building wrap, lapping at least 4 inches (100 mm).

4. At lintels and shelf angles, extend flashing a minimum of 6 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.

5. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches (38 mm) or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Division 07 Section "Joint Sealants" for application indicated.

6. Install metal drip edges with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Division 07 Section "Joint Sealants" for application indicated.

7. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal drip edge.

8. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal flashing termination.

9. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

E. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:

1. Use specified weep/vent products to form weep holes.

2. Use wicking material to form weep holes above flashing under brick sills. Turn wicking down at lip of sill to be as inconspicuous as possible.

3. Space weep holes 24 inches (600 mm) o.c. unless otherwise indicated.

4. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.

F. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

G. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/vent products to form vents.

1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.13 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.

2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

2. Limit height of vertical grout pours to not more than 12.67 ft. (3.86 m).

3.14 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Level 1 special inspections according to the "International Building Code."

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.

2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.

3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 5000 sq. ft. (464 sq. m) of wall area or portion thereof.

E. Clay Masonry Unit Test: For each type of unit provided, according to ASTM C 67 for compressive strength.

F. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

G. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

H. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.

I. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

J. Prism Test: For each type of construction provided, according to ASTM C 1314 at 7 days and at 28 days.

3.15 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent

construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.

2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.

3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.

4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.

5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.

3.16 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Excess Masonry Waste: Remove excess clean masonry waste and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION

DIVISION 5

METALS

05 12 00 STRUCTURAL STEEL FRAMING

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Structural steel.
2. Grout.

1.03 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC's "Code of Standard Practice for Steel Buildings and Bridges," that support design loads.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
5. Indicate size and location of all lifting, filling, vent and drain holes required for galvanizing. Lifting, filling, vent and drain holes shall be coordinated with the galvanizer.
6. Galvanized items which will receive paint must be designated as such.

C. Welding Certificates:

1. Provide the following welding certificates:
    a. Weld Procedure Specifications (WPSs) for all welds indicated in the Contract Documents.
        1). If a WPS is not prequalified in accordance with AWS D1.1, then submit a performance qualification record (PQR) for each WPS that is not prequalified.
    b. Personnel qualifications for each person performing welding on the Site.

D. Qualification Data: For testing agency, installer and fabricator.

E. Mill Test Reports: Signed by manufacturers certifying that the following products comply with requirements:

1. Structural steel including chemical and physical properties.
2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
3. Shear stud connectors.
4. Shop primers.
5. Nonshrink grout.

F. Source Quality-Control Test Reports.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer with a record of successfully performed projects of comparable size and complexity during the previous 5 years.

B. Fabricator Qualifications: A qualified fabricator with a record of successfully performed projects of comparable size and complexity during the previous 5 years.

C. Welding: Qualify procedures and personnel according to AWS D1.1, “Structural Welding Code--Steel.”

D. Comply with applicable provisions of the following specifications and documents:

1. AISC's “Specification for Structural Steel Buildings,” ANSI/AISC 360-05.
2. RCSC's “Specification for Structural Joints Using ASTM A325 or A490 Bolts.”

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.

1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
    a. If allowed, Tension-Control bolt assemblies shall be protected from moisture and corrosion. Tension-Control bolts may not be cleaned or relubricated.
2. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.07 COORDINATION

A. Furnish anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

B. Coordinate lifting, filling, venting and drain holes required for galvanized items with the galvanizer prior to shop drawing submittal. The fabricator shall consult with Architect/Engineer and hot-dip galvanizer regarding potential concerns during the galvanizing process that may require design modification before fabrication proceeds.

2.00 PRODUCTS

2.01 STRUCTURAL-STEEL MATERIALS

A. As indicated on the Drawings.

B. Welding Electrodes: Comply with AWS requirements.

1. Unless indicated otherwise, all electrodes shall be E70XX, low hydrogen.

2.02 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A325, Type 1, heavy hex steel structural bolts; ASTM A563 heavy hex carbon-steel nuts; and ASTM F436 hardened carbon-steel washers.

1. Material:

a. ASTM A325, unless noted otherwise.

b. ASTM A490, in locations shown or allowed on the Drawings. Do not use ASTM A490 in galvanized or zinc coated applications.

2. Finish:

a. Unless noted otherwise: Plain.

b. For bolts at galvanized members or as otherwise indicated: Hot-dip zinc coating, ASTM F2329 or Mechanically deposited zinc coating, ASTM B695, Class 55.

B. High-Strength Bolts, Nuts, and Washers: ASTM A490, Type 1, heavy hex steel structural bolts; ASTM A563 heavy hex carbon-steel nuts; and ASTM F436 hardened carbon-steel washers, plain.

C. Shear Connectors: ASTM A108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.

D. Anchor Rods (headed or unheaded): ASTM F1554, Grade 36, unless noted otherwise.

1. Configuration: Straight.

2. Nuts: ASTM A563 heavy hex carbon steel.

3. Plate Washers: ASTM A36 carbon steel.

4. Washers: ASTM F436 hardened carbon steel.

5. Finish: Hot-dip zinc coating, ASTM F2329 or Mechanically deposited zinc coating, ASTM B695, Class 55.

E. Threaded Rods: ASTM A36.

1. Nuts: ASTM A563 heavy hex carbon steel.

2. Washers: ASTM F436 hardened carbon steel.

3. Finish:

a. Unless noted otherwise: Plain.

b. For rods at galvanized members or as otherwise indicated: Hot-dip zinc coating, ASTM F2329 or Mechanically deposited zinc coating, ASTM B695, Class 55.

F. Clevises and Turnbuckles: ASTM A108, Grade 1035, cold-finished carbon steel.

G. Eye Bolts and Nuts: ASTM A108, Grade 1030, cold-finished carbon steel.

H. Sleeve Nuts: ASTM A108, Grade 1018, cold-finished carbon steel.

2.03 PRIMER

A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer.

B. Refer to Division 9 painting Sections.

C. Galvanizing Repair Paint: SSPC-Paint 20.

1. Zinc Level 1: Minimum zinc loading of 94 percent by weight of the dry film.

2.04 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.05 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and ANSI/AISC 360

1. Camber structural-steel members where indicated.

2. Identify high-strength structural steel according to ASTM A6/ A 6M and maintain markings until structural steel has been erected.

3. Mark and match-mark materials for field assembly.

4. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations, if required.

B. Drawings indicate the design, sections and weights of members. Substitutions shall not be permitted except upon written permission from the Engineer.

C. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.

D. Bolt Holes: Cut, drill or punch bolt holes perpendicular to metal surfaces.

1. Unless noted otherwise, all holes are AISC standard.

E. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

F. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 2, "Hand Tool Cleaning."

1. Slip critical faying surfaces shall be treated according to the RCSC Specification.

2. Slip critical faying surfaces for galvanized members shall be galvanized and roughened with hand wire brush according to the RCSC Specification for a Class C surface.

G. Galvanized Components:

1. Lifting, filling, vent and drain holes shall be constructed at the Fabricator’s shop prior to delivery to the galvanizer.
2. Fabricate structural steel in accordance with Class I, II, III guidelines as described in AGA's Recommended Details for Galvanized Structures.
3. Fabrication practices for products to be in accordance with the applicable portions of ASTM A143, A384, and A385. Avoid fabrication techniques that could cause steel distortion or embrittlement.
4. Provide holes and/or lifting lugs to allow for handling during galvanizing.

2.06 SHOP CONNECTIONS

A. Shop connections shall be composed of bolted or welded connections. Combinations of bolted and welded connections on a common shearing face are not allowed.

B. High-Strength Bolts: Shop install high-strength bolts according to RCSC's “Specification for Structural Joints Using ASTM A325 or A490 Bolts” for type of bolt and type of joint specified.
   1. Joint Type: Snug tightened bearing type with threads included in the shear plane, unless noted otherwise.
      a. The following bolted connections shall be pretensioned:
         1). Slip critical bolts.
         2). Bracing connections.
         3). Bolts loaded by axial wind loads in the connected member.
         4). Bolted connections at truss supports.
         5). Where noted on the Drawings.
   2. Pretensioning method: Acceptable methods of pretensioning are as follows:
      a. Turn-of-Nut Pretensioning.
         1). Match-marking shall be clearly provided.
      b. Twist-Off-Type Tension-Control Bolt Pretensioning.
      c. Direct-Tension-Indicator Pretensioning.

C. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
   1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's “Code of Standard Practice for Steel Buildings and Bridges” for mill material.

2.07 SHOP PRIMING

A. Shop prime steel surfaces except the following:
   1. Surfaces to be field welded.
   2. Surfaces to be high-strength bolted with slip-critical connections.

3. Surfaces to receive sprayed fire-resistive materials.

4. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 2, “Hand Tool Cleaning.”

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.08 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel indicated in the Drawings and Specifications according to ASTM A123/A123M.

1. Fill vent holes and grind smooth after galvanizing.

2. Galvanize lintels and shelf angles attached to structural-steel frame and located in exterior walls.

2.09 SOURCE QUALITY CONTROL

A. Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

C. Welded Connections:

1. Full penetration welds and other welds as specified: In addition to 100 percent visual inspection, 10 percent of connections will be tested and inspected according to AWS D1.1 and the following inspection procedures, at testing agency's option:

a. Liquid Penetrant Inspection: ASTM E165.

b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.

c. Ultrasonic Inspection: ASTM E164.

d. Radiographic Inspection: ASTM E94.

3.00 EXECUTION

3.01 EXAMINATION

A. Verify elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements.

B. Dimensions scaled from the Drawings shall not be used for fabrication, and the Contractor shall determine actual dimensions of the structure.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

3.03 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC's “Code of Standard Practice for Steel Buildings and Bridges” and “Specification for Structural Steel Buildings,” ANSI/AISC 360.

B. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.

1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.

2. Weld plate washers to top of base plate where required.

3. Tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate before packing with grout.

4. Promptly pack grout solidly between bearing surfaces and base or bearing plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC's “Code of Standard Practice for Steel Buildings and Bridges.”

D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.

2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection unless approved by Engineer. Finish thermally cut sections within smoothness limits in AWS D1.1.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.04 FIELD CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's “Specification for Structural Joints Using ASTM A325 or A490 Bolts” for type of bolt and type of joint specified.

1. Joint Type: Snug tightened, unless noted otherwise.

2. Pretensioning method: Acceptable methods of pretensioning are as follows:

a. Turn-of-Nut Pretensioning.

1). Match-marking shall be clearly provided.

b. Twist-Off-Type Tension-Control Bolt Pretensioning.

1). Bolts must be maintained in protected, sealed containers until used.

2). If bolts are installed but not pretensioned immediately, the pre-installation verification shall be performed on bolts with similar exposure only.

3). Bolts must be installed and pretensioned within 1 week of removal from protective packaging.

c. Direct-Tension-Indicator Pretensioning.

B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.

1. Comply with AISC's “Code of Standard Practice for Steel Buildings and Bridges” and “Specification for Structural Steel Buildings,” ANSI/AISC 360-05, for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

2. Unless indicated otherwise, beam flanges employing full penetration welds shall have 1-1/4-by-3/16-inch backup plate. Back gouge root pass and weld flush on backside where full penetration is specified.

3. For architecturally exposed steel, remove backing bars or runoff tabs, back gouge, and grind steel smooth.

4. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's “Code of Standard Practice for Steel Buildings and Bridges” for mill material.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.

B. Bolted Connections: Field-bolted connections will be tested and inspected according to RCSC's “Specification for Structural Joints Using ASTM A325 or A490 Bolts.”

C. Welded Connections: Field welds will be 100 percent visually inspected according to AWS D1.1.

1. Full penetration welds and other welds as specified: In addition to 100 percent visual inspection, 10 percent of connections will be tested and inspected according to AWS D1.1 and the following inspection procedures, at testing agency's option:
    a. Liquid Penetrant Inspection: ASTM E165.
    b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
    c. Ultrasonic Inspection: ASTM E164.
    d. Radiographic Inspection: ASTM E94.

D. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
    1. Corrective measures shall be taken when welding is unsatisfactory or indicates inferior workmanship. Chip and grind if the removal of part of the weld or a portion of the base metal is required. Where deposition of additional weld material is necessary, the sides of the area to be welded shall have no less than one to one (1:1) slope to allow room for depositing new material. Correct defective or unsound welds by the removal and replacement of the entire weld using the following procedures:
        a. Excessive Convexity: Reduce to size by removal of excess weld metal by grinding.
        b. Shrinkage Cracks, Cracks in Base Metal, Craters and Excessive Porosity: Remove defective portions of base and weld material down to sound metal, and deposit additional sound material.
        c. Undercutting, Undersize, and Excessive Concavity: Clean and deposit additional weld metal.
        d. Overlapping and Incomplete Fusion: Remove and replace the defective portion of the weld.
        e. Slag Inclusion: Remove those parts of the welds containing slag. Fill with sound weld metal.
        f. Removal of Adjacent Base Metal during Welding: Clean and form full size by depositing weld material.
    2. Remove cracked welds throughout their length.
    3. Where work performed subsequently to the making of the deficient weld has rendered the weld inaccessible, or has caused new conditions which make connection of the deficiency dangerous or ineffectual, restore the original conditions by removing welds or members, or both before making the necessary corrections. Another option is to compensate for the deficiency with additional work according to the revised design, approved by the Engineer.
    4. Cut apart and reweld improperly fitted and misaligned parts.
    5. Straighten members distorted by heat of welding using mechanical means or by carefully supervised application of a limited amount of localized heat. Heated areas shall not exceed 1200 degrees Fahrenheit as measured by Tempilsticks. Parts to be heated for straightening shall be free from external stress forces, except when mechanical means are used in conjunction with heat application.

6. If faulty welding or its removal for rewelding damages the base metal so that, in the Engineer's judgment, it is not in accordance with the intent of the Contract Documents, remove and replace the damaged material and compensate for the deficiency in a manner acceptable to the Engineer.

7. Maximum space between pieces or members for fillet welds shall be 1/16 inch. Only effective portion shall be considered in measuring fillet welds.

3.06 REPAIRS AND PROTECTION

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A780 and manufacturer's written instructions.

B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories, bearing plates, and abutting structural steel.

1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

END OF SECTION

05 21 00 STEEL JOIST FRAMING

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Open-web K-series steel joists.
2. KCS-type, open-web K-series steel joists.
3. LH-series long-span steel joists.
4. DLH-series deep long-span steel joists.
5. Joist girders.
6. Joist accessories.

B. Related Sections include the following:

1. Section 03 30 00 “Cast-In-Place Concrete” for installing bearing plates in concrete.
2. Section 04 20 00 “Unit Masonry” for installing bearing plates in unit masonry.
3. Section 05 50 00 “Metal Fabrications” for furnishing steel bearing plates.

1.03 DEFINITIONS

A. Special Joists: Joists requiring modification by the manufacturer to support nonuniform, unequal, or special loading conditions that invalidate SJI’s ”Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders.”

1.04 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide special joists and connections capable of withstanding design loads within limits and under conditions indicated on drawings.

1.05 SUBMITTALS

A. Product Data: For each type of joist, accessory, and product indicated.

B. Shop Drawings: Show layout, mark, number, type, location, and spacings of joists. Include joining and anchorage details, bracing, bridging, accessories; splice and connection locations and details; and attachments to other construction.

1. Comprehensive engineering analysis signed and sealed by the qualified professional engineer responsible for its preparation.

C. Welding Certificates: Copies of certificates for welding procedures and personnel.

D. Mill certificates signed by manufacturers of bolts certifying that their products comply with specified requirements.

E. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

F. Research/Evaluation Reports: Evidence of steel joists' compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing joists similar to those indicated for this Project and with a record of successful in-service performance.

1. Manufacturer must be certified by SJI to manufacture joists complying with SJI standard specifications and load tables.

2. Assumes responsibility for engineering special joists to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

3. Professional Engineer Qualifications: A professional engineer who is legally authorized to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of joists that are similar to those indicated for this Project in material, design, and extent.

B. SJI Specifications: Comply with SJI's "Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders" (hereafter, "Specifications"), applicable to types of joists indicated.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle joists as recommended in SJI's "Specifications."

B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

2.00 PRODUCTS

2.01 MATERIALS

A. Steel: Comply with SJI's "Specifications" for chord and web members.

B. Carbon-Steel Bolts and Threaded Fasteners: ASTM A307, Grade A, carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.

1. Finish: Plain, uncoated.

C. High-Strength Bolts and Nuts: ASTM A325/A325M, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers.

1. Finish: Plain, uncoated.

D. Welding Electrodes: Comply with AWS standards.

2.02 PRIMERS

A. Primer: SSPC-Paint 15, Type I, red oxide; FS TT-P-636, red oxide; or manufacturer's standard shop primer complying with performance requirements of either of these red-oxide primers.

2.03 OPEN-WEB K-SERIES STEEL JOISTS

A. Manufacture steel joists according to "Standard Specifications for Open Web Steel Joists, K-Series," in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord; of joist type indicated.

1. Joist Type: K-series steel joists and KCS-type K-series steel joists.

B. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.

C. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated, complying with SJI's "Specifications."

Note to Specifier: Delete paragraph above or below if not required. SJI distinguishes between Type S and Type R joist extensions to K-series joists. See Evaluations and SJI's "Specifications."

D. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI's "Specifications."

E. Camber joists according to SJI's "Specifications" recommended magnitudes without the option to neglect camber.

F. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches (1:48).

2.04 LONG-SPAN STEEL JOISTS

A. Manufacture steel joists according to "Standard Specifications for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series," in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements as indicated.

B. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.

C. Camber long-span steel joists according to SJI's "Specifications."

D. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches (1:48).

2.05 JOIST ACCESSORIES

A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span.

1. Furnish additional erection bridging if required.
2. Furnish additional bridging required to resist net wind uplift indicated on drawings.
3. Bridging indicated on drawings is schematic only and should be interpreted as an additional requirement to that bridging required above. Bridging shown on the drawings should not be interpreted as limiting the installation of additional bridging or negating the joist supplier's need to design the bridging for the above requirements.

B. Steel bearing plates with integral anchorages are specified in Section 05 50 00 "Metal Fabrications."

C. Supply ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch (13 mm) of finished wall surface, unless otherwise indicated.

D. Supply miscellaneous accessories, including splice plates and bolts required by joist manufacturer to complete joist installation.

2.06 CLEANING AND SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories to be primed by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.

B. Apply one shop coat of primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.

3.00 EXECUTION

3.01 EXAMINATION

A. Examine supporting substrates, embedded bearing plates, and abutting structural framing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written recommendations, and requirements in this Section.

1. Before installation, splice joists delivered to Project site in more than one piece.
2. Space, adjust, and align joists accurately in location before permanently fastening.
3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads have been applied.

C. Field weld joists to supporting steel bearing plates. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

D. Bolt joists to supporting steel framework using high-strength structural bolts, unless otherwise indicated. Comply with RCSC's "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A325 or A490 Bolts" for high-strength structural bolt installation and tightening requirements.

E. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.03 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.

B. Field welds will be visually inspected according to AWS D1.1.

C. Bolted connections will be visually inspected.

1. High-strength, field-bolted connections will be tested and verified according to procedures in RCSC's "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A325 or A490 Bolts."

D. Correct deficiencies in Work that inspections and test reports have indicated are not in compliance with specified requirements.

E. Additional testing will be performed to determine compliance of corrected Work with specified requirements.

3.04 REPAIRS AND PROTECTION

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A780 and manufacturer's written instructions.

B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories, bearing plates and abutting structural steel.

1. Clean and prepare surfaces by hand-tool cleaning, SSPC-SP 2, or power-tool cleaning, SSPC-SP 3.

2. Apply a compatible primer of the same type as the shop primer used on adjacent surfaces.

C. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, that ensure joists and accessories are without damage or deterioration at time of Substantial Completion.

END OF SECTION

05 31 00 STEEL DECKING

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

1. Roof deck.
2. Non-composite form deck.

B. Related Sections include the following:

1. Section 03 30 00 “Cast-In-Place Concrete” for concrete fill and reinforcing steel.
2. Section 05 12 00 “Structural Steel Framing” for shop-welded shear connectors.
3. Section 05 50 00 “Metal Fabrications” for framing deck openings with miscellaneous steel shapes.

1.03 SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, deck openings, special jointing, accessories, and attachments to other construction. Clearly indicate any required shoring.

C. Record Data: Certification by the deck manufacturer or detailer that the deck meets the minimum structural performance criteria as indicated in Quality Assurance.

D. Product Certificates: Signed by steel deck manufacturers certifying that products furnished comply with requirements.

E. Mill Test Reports: Signed by manufacturers certifying that the following products comply with requirements:

1. Shear stud connectors.

F. Welding Certificates: Copies of certificates for welding procedures and personnel.

G. Research/Evaluation Reports: Evidence of steel deck’s compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed steel deck similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E329 to conduct the testing indicated.

C. Welding: Qualify procedures and personnel according to AWS D1.1, “Structural Welding Code--Steel,” and AWS D1.3, “Structural Welding Code--Sheet Steel.”

D. AISI Specifications: Calculate structural characteristics of steel deck according to AISI’s “Specification for the Design of Cold-Formed Steel Structural Members.”

E. Structural Performance Criteria:

1. Provide roof deck of the gage which is the larger of the following:

a. As indicated on drawings.

b. As required to resist a minimum of 20 psf for the actual deck span conditions.

2. Provide floor deck of the gage which is the larger of the following:

a. As indicated on drawings.

b. As required to provide an SDI maximum clear span which meets or exceeds the anticipated deck spans based on shoring plan and actual deck span criteria.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

2.00 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Steel Deck:

a. BHP Steel Building Products USA Inc.

b. Consolidated Systems, Inc.

c. Epic Metals Corp.

d. Marlyn Steel Products, Inc.

e. Nucor Corp.; Vulcraft Div.

f. Roof Deck, Inc.

g. United Steel Deck, Inc.

h. Verco Manufacturing Co.

i. Wheeling Corrugating Co.; Div. of Wheeling-Pittsburgh Steel Corp.

2.02 ROOF DECK

A. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 29, and the following:

1. Prime-Painted Steel Sheet: ASTM A1008, Grade C or D minimum, shop primed with gray or white baked-on, lead- and chromate-free rust-inhibitive primer complying with performance requirements of FS TT-P-664.
2. Deck Profile: As indicated on drawings.
3. Profile Depth: As indicated on drawings.
4. Design Uncoated-Steel Thickness: As indicated on drawings.
5. Span Condition: Triple span or more. Increase deck gage as required at other span conditions encountered.
6. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.03 NONCOMPOSITE FORM DECK

A. Non-composite Steel Form Deck: Fabricate ribbed-steel sheet non-composite form deck panels to comply with "SDI Specifications and Commentary for Non-composite Steel Form Deck," in SDI Publication No. 29, the minimum section properties indicated, and the following:

1. Prime-Painted Steel Sheet: ASTM A1008, Grade C minimum, bottom surface shop primed with gray or white baked-on, lead- and chromate-free rust-inhibitive primer complying with performance requirements of FS TT-P-664.
2. Profile Depth: As indicated on drawings.
3. Design Uncoated-Steel Thickness: As indicated on drawings.
4. Span Condition: Triple span or more. Increase deck gage as required at other span conditions encountered.
5. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.04 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359 inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Steel Sheet Accessories: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.

G. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 29 for overhang and slab depth.

H. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.

I. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.

J. Repair Paint: Lead- and chromate-free rust-inhibitive primer complying with performance requirements of FS TT-P-664.

3.00 EXECUTION

3.01 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

3.02 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 29, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels, if required to meet deflection limitations.

C. Locate decking bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to decking.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of decking, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.03 ROOF DECK INSTALLATION

A. Fasten roof deck panels to steel supporting members.

1. Mechanically fastening with self-drilling No. 12 diameter or larger carbon-steel screws.

a. Zink plated to a minimum thickness of 0.005 inch for corrosion resistance.

2. Mechanically fastening with powder actuated or pneumatically driven fastening systems.

a. Minimum shank diameter of 0.145 inch.

b. Zink plated to a minimum thickness of 0.005 inch for corrosion resistance.

c. A single fastener must be suitable for the full range of base metal thickness encountered in field.

3. Attachment Spacing:

a. Deck shall be attached to support framing as indicated on the drawings. Coordinate with side lap attachment.

b. Attach all side laps at support steel.

c. Attachment spacing is applicable to support steel perpendicular or parallel to deck orientation.

B. Side-Lap and Perimeter Edge Fastening:

1. Mechanically fasten with self-drilling No. 10 diameter or larger carbon-steel screws.

a. Zink plated to a minimum thickness of 0.005 inch for corrosion resistance.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:

1. End Joints: Lapped 2 inches minimum or butted at Contractor's option.

D. Miscellaneous Roof Deck Accessories: Install ridge and valley plates, finish strips, cover plates, end closures, and reinforcing channels according to deck manufacturer's written instructions. Attach to substrate to provide a complete deck installation.

3.04 FLOOR DECK INSTALLATION

A. Fasten floor deck panels to steel supporting members:

1. Mechanically fastening with self-drilling No. 12 diameter or larger carbon-steel screws.

a. Zink plated to a minimum thickness of 0.005 inch for corrosion resistance.

2. Mechanically fastening with powder actuated or pneumatically driven fastening systems.

a. Minimum shank diameter of 0.145 inch.

b. Zink plated to a minimum thickness of 0.005 inch for corrosion resistance.

c. A single fastener must be suitable for the full range of base metal thickness encountered in field.

3. Attachment Spacing: Weld edge ribs of panels at each support. Space additional attachments an average of 12 inches apart, but not more than 18 inches apart.

B. Side-Lap and Perimeter Edge Fastening:

1. Mechanically fasten with self-drilling No. 10 diameter or larger carbon-steel screws.

2. Mechanically clinch or button punch.
3. Fasten with a minimum of 1-1/2-inch long welds.
4. Maximum Spacing:
    a. Fasten side laps and perimeter edges of panels between supports at the spacing and with the method consistent with the support attachment spacing criteria above.
    b. Maximum spacing shall not exceed the lesser of one-half of the span or 30 inches.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 2-1/2 inches, with end joints as follows:
    1. End Joints: Butted.

D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations, unless otherwise indicated.

E. Floor Deck Closures: Attach steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of decking. Attach cover plates at changes in direction of floor deck panels, unless otherwise indicated.

3.05 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing agency to perform field quality-control testing.

B. Field welds will be subject to inspection.

C. Testing agency will report test results promptly and in writing to Contractor and Engineer.

D. Remove and replace work that does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.06 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A780 and manufacturer's written instructions.

B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
    1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.

C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION

05 50 00 METAL FABRICATIONS

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Steel framing and supports for overhead doors.
2. Steel framing and supports for mechanical and electrical equipment.
3. Steel framing and supports for applications where framing and supports are not specified in other Sections.
4. Shelf angles.
5. Metal ladders.
6. Ladder safety cages.
7. Metal ships' ladders and pipe crossovers.
8. Metal floor plate and supports.
9. Structural-steel door frames.
10. Miscellaneous steel trim including steel angle corner guards and steel edgings.
11. Metal bollards.
12. Abrasive metal nosings, treads and thresholds.
13. Loose bearing and leveling plates for applications where they are not specified in other Sections.

B. Products furnished, but not installed, under this Section:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

C. Related Sections:

1. Section 03 30 00 "Cast-In-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
2. Section 04 20 00 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
3. Section 05 12 00 "Structural Steel Framing."

4. Section 05 51 00 “Metal Stairs.”
5. Section 05 52 13 “Pipe and Tube Railings.”
6. Section 05 53 00 “Metal Gratings.”

1.03 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design ladders, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance of Aluminum Ladders: Aluminum ladders shall withstand the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 F (67 C), ambient; 180 F (100 C), material surfaces.

1.04 ACTION SUBMITTALS

A. Product Data: For the following:

1. Nonslip aggregates and nonslip-aggregate surface finishes.
2. Prefabricated building columns.
3. Metal nosings and treads.
4. Paint products.
5. Grout.

B. Shop Drawings: Show fabrication and installation details for metal fabrications.

1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified professional engineer.

B. Mill Certificates: Signed by manufacturers of stainless-steel certifying that products furnished comply with requirements.

C. Welding certificates.

D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.06 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, “Structural Welding Code - Steel.”
2. AWS D1.2/D1.2M, “Structural Welding Code - Aluminum.”
3. AWS D1.6, “Structural Welding Code - Stainless Steel.”

1.07 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.08 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers’ written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages and steel weld plates and angles for casting into concrete. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

2.00 PRODUCTS

2.01 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.02 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Stainless-Steel Sheet, Strip, and Plate: ASTM A240/A240M or ASTM A666, Type 304.

C. Stainless-Steel Bars and Shapes: ASTM A276, Type 304.

D. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.

E. Rolled-Stainless-Steel Floor Plate: ASTM A793.

F. Abrasive-Surface Floor Plate: Steel plate with abrasive granules rolled into surface or with abrasive material metallically bonded to steel.

1. Products: Subject to compliance with requirements, provide one of the following:

a. IKG Industries, a division of Harsco Corporation; Mebac.

b. SlipNOT Metal Safety Flooring, a W. S. Molnar company; SlipNOT.

G. Steel Tubing: ASTM A500, cold-formed steel tubing.

H. Steel Pipe: ASTM A53/A53M, standard weight (Schedule 40) unless otherwise indicated.

I. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.

1. Size of Channels: As indicated.
2. Material: Galvanized steel, ASTM A653/A653M, structural steel, Grade 33 (Grade 230), with G90 (Z275) coating; 0.108-inch (2.8-mm) nominal thickness.

2.03 NONFERROUS METALS

A. Aluminum Plate and Sheet: ASTM B209 (ASTM B209M), Alloy 6061-T6.

B. Aluminum Extrusions: ASTM B221 (ASTM B221M), Alloy 6063-T6.

C. Aluminum-Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.

D. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.

E. Bronze Plate, Sheet, Strip, and Bars: ASTM B36/B36M, Alloy UNS No. C28000 (muntz metal, 60 percent copper).

F. Bronze Extrusions: ASTM B455, Alloy UNS No. C38500 (extruded architectural bronze).

G. Bronze Castings: ASTM B584, Alloy UNS No. C83600 (leaded red brass) or No. C84400 (leaded semi-red brass).

H. Nickel Silver Extrusions: ASTM B151/B151M, Alloy UNS No. C74500.

I. Nickel Silver Castings: ASTM B584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).

2.04 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless-steel fasteners for fastening aluminum.
2. Provide stainless-steel fasteners for fastening stainless steel.
3. Provide stainless-steel fasteners for fastening nickel silver.
4. Provide bronze fasteners for fastening bronze.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A (ASTM F568M, Property Class 4.6); with hex nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.

C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F593 (ASTM F738M); with hex nuts, ASTM F594 (ASTM F836M); and, where indicated, flat washers; Alloy Group 1 (A1).

D. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.

1. Hot-dip galvanized or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

E. Eyebolts: ASTM A489.

F. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).

G. Lag Screws: ASME B18.2.1 (ASME B18.2.3.8M).

H. Wood Screws: Flat head, ASME B18.6.1.

I. Plain Washers: Round, ASME B18.22.1 (ASME B18.22M).

J. Lock Washers: Helical, spring type, ASME B18.21.1 (ASME B18.21.2M).

K. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329.

L. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.

2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

2.05 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Shop Primers: Provide primers that comply with Section 09 96 00 “High-Performance Coatings.”

C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

D. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

E. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187.

G. Nonshrink, Metallic Grout: Factory-packaged, ferrous-aggregate grout complying with ASTM C1107, specifically recommended by manufacturer for heavy-duty loading applications.

H. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

I. Concrete: Comply with requirements in Section 03 30 00 “Cast-In-Place Concrete” for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa).

J. Anti-Seize Lubricant: Loctite LB 8023 Marine Grade Anti-Seize lubricant or approved equal.

2.06 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

2.07 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Fabricate units from slotted channel framing where indicated.

2. Furnish inserts for units installed after concrete is placed.

C. Galvanize miscellaneous framing and supports where indicated.

D. Prime miscellaneous framing and supports with primer specified in Section 09 96 00 “High-Performance Coatings” where indicated.

2.08 METAL LADDERS

A. General:

1. Comply with ANSI A14.3 unless otherwise indicated.

2. For elevator pit ladders, comply with ASME A17.1.

B. Steel Ladders:

1. Space siderails as indicated on drawings.

2. Siderails: Continuous, size as indicated on drawings steel flat bars, with eased edges.

3. Rungs: Size as indicated on drawings steel bars.

4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.

5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.

6. Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung.

a. Products: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:

1). IKG Industries, a division of Harsco Corporation; Mebac.

2). SlipNOT Metal Safety Flooring, a W. S. Molnar company; SlipNOT.

7. Provide platforms as indicated fabricated from welded or pressure-locked steel bar grating, supported by steel angles. Limit openings in gratings to no more than 1/2 inch (12 mm) in least dimension.

8. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted steel brackets.

9. Galvanize ladders, including brackets and fasteners.

C. Aluminum Ladders:

1. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ACL Industries, Inc.

b. Alco-Lite Industrial Products.

c. Halliday Products.

d. O’Keeffe’s Inc.

e. Precision Ladders, LLC.

f. Royalite Manufacturing, Inc.

g. Thompson Fabricating, LLC.

2. Space siderails 16 inches (406 mm) apart unless otherwise indicated.

3. Siderails: Continuous extruded-aluminum channels or tubes, not less than 2-1/2 inches (64 mm) deep, 3/4 inch (19 mm) wide, and 1/8 inch (3.2 mm) thick.

4. Rungs: Extruded-aluminum tubes, not less than 3/4 inch (19 mm) deep and not less than 1/8 inch (3.2 mm) thick, with ribbed tread surfaces.

5. Fit rungs in centerline of siderails; fasten by welding or with stainless-steel fasteners or brackets and aluminum rivets.

6. Provide platforms as indicated fabricated from pressure-locked aluminum bar grating or extruded-aluminum plank grating**,** supported by extruded-aluminum framing. Limit openings in gratings to no more than 1/2 inch (12 mm) in least dimension.

7. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted aluminum brackets.

8. Provide minimum 72-inch (1830-mm) high, hinged security door with padlock hasp at foot of ladder to prevent unauthorized ladder use.

2.09 LADDER SAFETY CAGES

A. General:

1. Fabricate ladder safety cages to comply with ANSI A14.3. Assemble by welding or with stainless-steel fasteners.

2. Provide primary hoops at tops and bottoms of cages and spaced not more than 20 feet (6 m) o.c. Provide secondary intermediate hoops spaced not more than 48 inches (1200 mm) o.c. between primary hoops.

3. Fasten assembled safety cage to ladder rails and adjacent construction by welding or with stainless-steel fasteners unless otherwise indicated.

B. Steel Ladder Safety Cages:

1. Primary Hoops: 1/4-by-4-inch (6.4-by-100-mm) flat bar hoops.

2. Secondary Intermediate Hoops: 1/4-by-2-inch (6.4-by-50 mm) flat bar hoops.

3. Vertical Bars: 3/16-by-1-1/2-inch (4.8-by-38-mm) flat bars secured to each hoop.

4. Galvanize ladder safety cages, including brackets and fasteners.

5. Prime ladder safety cages, including brackets and fasteners, with primer specified in Section 09 96 00 “High-Performance Coatings.”

C. Aluminum Ladder Safety Cages:

1. Primary Hoops: 1/4-by-4-inch (6.4-by-100-mm) flat bar hoops.

2. Secondary Intermediate Hoops: 1/4-by-2-inch (6.4-by-50-mm) flat bar hoops.

3. Vertical Bars: 1/4-by-2-inch (6.4-by-50-mm) flat bars secured to each hoop.

2.10 METAL SHIPS' LADDERS AND PIPE CROSSOVERS

A. Provide metal ships' ladders and pipe crossovers where indicated. Fabricate of open-type construction with channel or plate stringers and pipe and tube railings unless otherwise indicated. Provide brackets and fittings for installation.

1. Fabricate ships' ladders and pipe crossovers, including railings from steel.
2. Fabricate treads and platforms from welded or pressure-locked steel bar grating. Limit openings in gratings to no more than 1/2 inch (12 mm) in least dimension.
3. Fabricate treads and platforms from rolled-steel floor plate.
4. Comply with applicable railing requirements in Section 05 52 13 "Pipe and Tube Railings."

B. Galvanize steel ships' ladders and pipe crossovers, including treads, railings, brackets, and fasteners.

2.11 METAL FLOOR PLATE

A. Fabricate from abrasive-surface floor plate of thickness indicated below:

1. Thickness: As indicated.

B. Provide grating sections where indicated fabricated from welded or pressure-locked steel bar grating. Limit openings in gratings to no more than 1/2 inch (12 mm) in least dimension.

C. Provide steel angle supports as indicated.

D. Include steel angle stiffeners, and fixed and removable sections as indicated.

E. Provide flush steel bar drop handles for lifting removable sections, one at each end of each section.

2.12 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Galvanize miscellaneous steel trim.

2.13 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 40 steel pipe.

1. Cap bollards with 1/4-inch (6.4-mm) thick steel plate.

2. Where bollards are indicated to receive controls for door operators, provide necessary cutouts for controls and holes for wire.

3. Where bollards are indicated to receive light fixtures, provide necessary cutouts for fixtures and holes for wire.

B. Fabricate bollards with 3/8-inch (9.5-mm) thick steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4-inch (19-mm) anchor bolts.

1. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.

C. Fabricate sleeves for bollard anchorage from steel pipewith 1/4-inch (6.4-mm) thick steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches (200 mm) deep and 3/4 inch (19 mm) larger than OD of bollard.

D. Fabricate internal sleeves for removable bollards from Schedule 40 steel pipe or 1/4-inch (6.4-mm) wall-thickness steel tubing with an OD approximately 1/16 inch (1.5 mm) less than ID of bollards. Match drill sleeve and bollard for 3/4 inch (19 mm) steel machine bolt.

E. Prime bollards with primer specified in Section 09 96 00 “High-Performance Coatings.”

2.14 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize plates.

C. Prime plates with primer specified in Section 09 96 00 “High-Performance Coatings.”

2.15 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.16 FINISHES, GENERAL

A. Comply with NAAMM’s “Metal Finishes Manual for Architectural and Metal Products” for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.17 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with universal shop primer unless primers specified in Section 09 96 00 “High-Performance Coatings” are indicated.

C. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:

1. Exterior Items: SSPC-SP 6/NACE No. 3, “Commercial Blast Cleaning.”

2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, “Commercial Blast Cleaning.”

3. Items Indicated to Receive Primers Specified in Section 09 96 00 “High-Performance Coatings”: SSPC-SP 6/NACE No. 3, “Commercial Blast Cleaning.”

4. Other Items: SSPC-SP 3, “Power Tool Cleaning.”

D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, “Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel,” for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.18 STAINLESS-STEEL FINISHES

A. Remove tool and die marks and stretch lines or blend into finish.

B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

C. Bright, Directional Satin Finish: No. 4.

D. Dull Satin Finish: No. 6.

E. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.19 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. As-Fabricated Finish: AA-M10 (Mechanical Finish: as fabricated, unspecified).

3.00 EXECUTION

3.01 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
1. Cast Aluminum: Heavy coat of bituminous paint.
2. Extruded Aluminum: Two coats of clear lacquer.

G. Anti-Seize Lubricant: Where stainless steel nuts and bolts will be installed, apply anti-seize lubricant to threads as recommended by lubricant manufacturer to prevent seizure of nut and bolt during installation or upon removal at a future date.

3.02 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for operable partitions securely to and rigidly brace from building structure.

C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

D. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.
1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.03 INSTALLING METAL BOLLARDS

A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.

1. Do not fill removable bollards with concrete.

B. Anchor bollards to existing construction with bolts indicated on drawings. Provide four 3/4-inch (19-mm) bolts at each bollard unless otherwise indicated.

1. Embed anchor bolts at least 4 inches (100 mm) in concrete.

C. Anchor bollards in concrete with pipe sleeves preset and anchored into concrete. Fill annular space around bollard solidly with nonshrink, nonmetallic grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch (3 mm) toward bollard.

D. Fill bollards solidly with concrete, mounding top surface to shed water.

1. Do not fill removable bollards with concrete.

3.04 INSTALLING NOSINGS, TREADS, AND THRESHOLDS

A. Center nosings on tread widths unless otherwise indicated.

B. For nosings embedded in concrete steps or curbs, align nosings flush with riser faces and level with tread surfaces.

C. Seal thresholds exposed to exterior with elastomeric sealant complying with Section 07 92 00 "Joint Sealants" to provide a watertight installation.

3.05 INSTALLING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

1. Use nonshrink, nonmetallic grout locations unless otherwise indicated.

2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.06 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.

B. Bolted Connections: Field-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A325 or A490 Bolts."

C. Welded Connections: Field welds will be 100 percent visually inspected according to AWS D1.1.

1. Full penetration welds and other welds as specified: In addition to 100 percent visual inspection, 10 percent of connections will be tested and inspected according to AWS D1.1 and the following inspection procedures, at testing agency's option:

a. Liquid Penetrant Inspection: ASTM E165.

b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.

c. Ultrasonic Inspection: ASTM E164.

d. Radiographic Inspection: ASTM E94.

D. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

1. Corrective measures shall be taken when welding is unsatisfactory or indicates inferior workmanship. Chip and grind if the removal of part of the weld or a portion of the base metal is required. Where deposition of additional weld material is necessary, the sides of the area to be welded shall have no less than one to one (1:1) slope to allow room for depositing new material. Correct defective or unsound welds by the removal and replacement of the entire weld using the following procedures:

a. Excessive Convexity: Reduce to size by removal of excess weld metal by grinding.

b. Shrinkage Cracks, Cracks in Base Metal, Craters and Excessive Porosity: Remove defective portions of base and weld material down to sound metal, and deposit additional sound material.

c. Undercutting, Undersize, and Excessive Concavity: Clean and deposit additional weld metal.

d. Overlapping and Incomplete Fusion: Remove and replace the defective portion of the weld.

e. Slag Inclusion: Remove those parts of the welds containing slag. Fill with sound weld metal.

f. Removal of Adjacent Base Metal during Welding: Clean and form full size by depositing weld material.

2. Remove cracked welds throughout their length.

3. Where work performed subsequently to the making of the deficient weld has rendered the weld inaccessible, or has caused new conditions which make connection of the deficiency dangerous or ineffectual, restore the original conditions by removing welds or members, or both before making the necessary corrections. Another option is to compensate for the deficiency with additional work according to the revised design, approved by the Engineer.

4. Cut apart and reweld improperly fitted and misaligned parts.

5. Straighten members distorted by heat of welding using mechanical means or by carefully supervised application of a limited amount of localized heat. Heated areas shall not exceed 1200 degrees Fahrenheit as measured by Tempilsticks. Parts to be heated for straightening shall be free from external stress forces, except when mechanical means are used in conjunction with heat application.

6. If faulty welding or its removal for rewelding damages the base metal so that, in the Engineer's judgment, it is not in accordance with the intent of the Contract Documents, remove and replace the damaged material and compensate for the deficiency in a manner acceptable to the Engineer.

7. Maximum space between pieces or members for fillet welds shall be 1/16 inch. Only effective portion shall be considered in measuring fillet welds.

3.07 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

   1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780.

END OF SECTION

05 51 00 METAL STAIRS

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Preassembled steel stairs with concrete-filled treads.
2. Industrial-type stairs with steel grating treads.
3. Steel tube railings attached to metal stairs.
4. Steel tube handrails attached to walls adjacent to metal stairs.
5. Railing gates at the level of exit discharge.

B. Related Sections:

1. Section 03 30 00 “Cast-In-Place Concrete” for concrete fill for stair treads and platforms.
2. Section 05 50 00 “Metal Fabrications” for metal treads and nosings installed at locations other than in metal stairs.
3. Section 05 52 13 “Pipe and Tube Railings” for pipe and tube railings not attached to metal stairs or to walls adjacent to metal stairs.
4. Section 09 22 16 “Non-Structural Metal Framing” for metal backing for anchoring railings.

1.03 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design metal stairs, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to L/240 or 1/4 inch (6.4 mm), whichever is less.

C. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Handrails and Top Rails of Guards:
    a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
    b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
    c. Uniform and concentrated loads need not be assumed to act concurrently.
2. Infill of Guards:
    a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
    b. Infill load and other loads need not be assumed to act concurrently.

D. Seismic Performance: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. Component Importance Factor is 1.5.

1.04 ACTION SUBMITTALS

A. Product Data: For metal stairs and the following:
1. Prefilled metal-pan stair treads.
2. Precast concrete treads.
3. Epoxy-resin-filled stair treads.
4. Nonslip aggregates and nonslip-aggregate finishes.
5. Abrasive nosings.
6. Metal floor plate treads.
7. Paint products.
8. Grout.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Verification: For the following products, in manufacturer's standard sizes:
1. Precast concrete treads.
2. Epoxy-resin-filled stair treads.
3. Stair treads with nonslip-aggregate surface finish.
4. Metal floor plate treads.
5. Grating treads.
6. Abrasive nosings.

D. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified professional engineer.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.

1. Industrial-Type Stairs: Industrial class.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.07 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Coordinate locations of hanger rods and struts with other work so that they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.

2.00 PRODUCTS

2.01 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.02 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Steel Tubing: ASTM A500 (cold formed) or ASTM A513.

C. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.

D. Abrasive-Surface Floor Plate: Steel plate with abrasive granules rolled into surface or with abrasive material metallically bonded to steel.

1. Products: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:

a. IKG Industries, a division of Harsco Corporation; Mebac.

b. SlipNOT Metal Safety Flooring, a W. S. Molnar company; SlipNOT.

E. Steel Bars for Grating Treads: ASTM A36/A36M or steel strip, ASTM A1011/A1011M or ASTM A1018/A1018M.

F. Wire Rod for Grating Crossbars: ASTM A510 (ASTM A510M).

G. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

H. Uncoated, Cold-Rolled Steel Sheet: ASTM A1008/A1008M, either commercial steel, Type B, or structural steel, Grade 25 (Grade 170), unless another grade is required by design loads; exposed.

I. Uncoated, Hot-Rolled Steel Sheet: ASTM A1011/A1011M, either commercial steel, Type B, or structural steel, Grade 30 (Grade 205), unless another grade is required by design loads.

J. Galvanized-Steel Sheet: ASTM A653/A653M, G90 (Z275) coating, either commercial steel, Type B, or structural steel, Grade 33 (Grade 230), unless another grade is required by design loads.

K. Expanded-Metal, Carbon Steel: ASTM F1267, Type I (expanded), Class 1 (uncoated).

1. Style Designation: 1-1/2 number 10.

L. Perforated Metal: Cold-rolled steel sheet, ASTM A1008/A1008M, or hot-rolled steel sheet, ASTM A1011/A1011M, commercial steel Type B, 0.060 inch (1.52 mm) thick, with 1/4-inch (6.4-mm) holes 3/8 inch (9.5 mm) o.c. in staggered rows.

M. Perforated Metal: Galvanized-steel sheet, ASTM A653/A653M, G90 (Z275) coating, commercial steel Type B, 0.064 inch (1.63 mm) thick, with 1/4-inch (6.4-mm) holes 3/8 inch (9.5 mm) o.c. in staggered rows.

N. Woven-Wire Mesh: Intermediate-crimp, diamond pattern, 2-inch (50-mm) woven-wire mesh, made from 0.135-inch (3.5-mm) nominal diameter wire complying with ASTM A510 (ASTM A510M).

2.03 NONFERROUS METALS

A. Aluminum Extrusions: ASTM B221 (ASTM B221M), Alloy 6063-T6.

B. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.

2.04 FASTENERS

A. General: Provide zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.

2.05 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187.

E. Nonshrink, Nonmetallic Grout: Factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

F. Concrete Materials and Properties: Comply with requirements in Section 03 30 00 “Cast-In-Place Concrete” for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa) unless otherwise indicated.

G. Nonslip-Aggregate Concrete Finish: Factory-packaged abrasive aggregate made from fused, aluminum-oxide grits or crushed emery; rustproof and nonglazing; unaffected by freezing, moisture, or cleaning materials.

H. Welded Wire Fabric: ASTM A185/A185M, 6 by 6 inches (152 by 152 mm), W1.4 by W1.4, unless otherwise indicated.

2.06 PRECAST CONCRETE TREADS

A. Concrete Materials and Properties: Comply with requirements in Section 03 30 00 “Cast-In-Place Concrete” for normal-weight, ready-mixed concrete with a minimum 28-day compressive strength of 5000 psi (35 MPa) and a total air content of not less than 4 percent or more than 6 percent.

B. Reinforcing Wire Fabric: Galvanized, welded wire fabric, 2 by 2 inches (50 by 50 mm) by 0.062-inch (1.6-mm) diameter wire; comply with ASTM A185/A185M and ASTM A82/A82M, except for minimum wire size.

2.07 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.

2. Use connections that maintain structural value of joined pieces.

3. Fabricate treads and platforms of exterior stairs so finished walking surfaces slope to drain.

B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work with accurate angles and surfaces and straight edges.

F. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. Weld exposed corners and seams continuously unless otherwise indicated.

5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 3 welds: partially dressed weld with spatter removed.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.

H. Fabricate joints that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

2.08 STEEL-FRAMED STAIRS

A. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Alfab, Inc.

2. American Stair, Inc.

3. Sharon Companies Ltd. (The).

B. Stair Framing:

1. Fabricate stringers of steel plates or channels.

a. Provide closures for exposed ends of channel stringers.

2. Construct platforms of steel plate or channel headers and miscellaneous framing members as needed to comply with performance requirements.

3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.

4. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

C. Metal-Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements but not less than 0.067 inch (1.7 mm)**]**.

1. Steel Sheet: Uncoated hot-rolled steel sheet unless otherwise indicated.
2. Steel Sheet: Galvanized-steel sheet , where indicated.
3. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
4. Shape metal pans to include nosing integral with riser.
5. Attach abrasive nosings to risers.
6. At Contractor's option, provide stair assemblies with metal-pan subtreads filled with reinforced concrete during fabrication.
7. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.
    a. Smooth Soffit Construction: Construct subplatforms with flat metal under surfaces to produce smooth soffits.

D. Abrasive-Coating-Finished, Formed-Metal Stairs: Form risers, treads, and platforms to configurations shown from steel sheet of thickness needed to comply with performance requirements but not less than 0.097 inch (2.5 mm).

1. Steel Sheet: Uncoated hot-rolled steel sheet unless otherwise indicated.
2. Directly weld risers and treads to stringers; locate welds on underside of stairs.
3. Provide platforms of configuration indicated or, if not indicated, the same as treads. Weld platforms to platform framing.
4. Finish tread and platform surfaces with manufacturer's standard epoxy-bonded abrasive finish.

E. Metal Floor Plate Stairs: Form treads and platforms to configurations shown from rolled-steel abrasive-surface floor plate of thickness needed to comply with performance requirements, but not less than 1/4 inch (6.4 mm).

1. Form treads with integral nosing and back edge stiffener. Form risers of same material as treads.
2. Weld steel supporting brackets to stringers and weld treads to brackets.
3. Fabricate platforms with integral nosings matching treads and weld to platform framing.

F. Metal Bar-Grating Stairs: Form treads and platforms to configurations shown from metal bar grating; fabricate to comply with NAAMM MBG 531, "Metal Bar Grating Manual."

1. Fabricate treads and platforms from welded or pressure-locked steel grating with 1-1/4-by-3/16-inch (32-by-5-mm) bearing bars at 15/16 inch (24 mm) o.c. and crossbars at 4 inches (100 mm) o.c.

2. Surface: Serrated.

3. Finish: Galvanized.

4. Fabricate grating treads with rolled-steel floor plate nosing and with steel angle or steel plate carrier at each end for stringer connections. Secure treads to stringers with bolts.

5. Fabricate grating platforms with nosing matching that on grating treads. Provide toeplates at open-sided edges of grating platforms. Weld grating to platform framing.

2.09 STAIR RAILINGS

A. Comply with applicable requirements in Section 05 52 13 “Pipe and Tube Railings.”

B. Steel Tube Railings: Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads.

1. Rails and Posts: 1-5/8-inch (41-mm) diameter top and bottom rails and 1-1/2-inch (38-mm) square posts.

2. Picket Infill: 1/2-inch (13-mm) square pickets spaced less than 4 inches (100 mm) clear.

C. Welded Connections: Fabricate railings with welded connections. Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Finish welds to comply with NOMMA’s “Voluntary Joint Finish Standards” for Type 3 welds: partially dressed weld with spatter removed.

D. Form changes in direction of railings as follows:

1. By inserting prefabricated elbow fittings.

E. Close exposed ends of railing members with prefabricated end fittings.

F. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.

G. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.

1. Connect posts to stair framing by direct welding unless otherwise indicated.

2. For galvanized railings, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous-metal components.

3. For nongalvanized railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.

2.10 FINISHES

A. Comply with NAAMM’s “Metal Finishes Manual for Architectural and Metal Products” for recommendations for applying and designating finishes.

B. Finish metal stairs after assembly.

C. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

1. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

D. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed products:

1. Exterior Stairs: SSPC-SP 6/NACE No. 3, “Commercial Blast Cleaning.”

2. Interior Stairs: SSPC-SP 3, “Power Tool Cleaning.”

E. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, “Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel,” for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

3.00 EXECUTION

3.01 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

F. Field Welding: Comply with requirements for welding in “Fabrication, General” Article.

G. Place and finish concrete fill for treads and platforms to comply with Section 03 30 00 “Cast-In-Place Concrete.”

1. Install abrasive nosings with anchors fully embedded in concrete. Center nosings on tread width.

H. Install precast concrete treads with adhesive supplied by manufacturer.

3.02 INSTALLING METAL STAIRS WITH GROUTED BASEPLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of baseplates.

B. Set steel stair baseplates on wedges, shims, or leveling nuts. After stairs have been positioned and aligned, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

1. Use nonmetallic, nonshrink grout unless otherwise indicated.

2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.03 INSTALLING RAILINGS

A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:

1. Anchor posts to steel by welding directly to steel supporting members.

2. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with post-installed anchors and bolts.

B. Attach handrails to wall with wall brackets. Use type of bracket with predrilled hole for exposed bolt anchorage. Provide bracket with 1-1/2-inch (38-mm) clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads. Secure wall brackets to building construction as required to comply with performance requirements.

3.04 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780.

END OF SECTION

05 52 13 PIPE AND TUBE RAILINGS

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Aluminum pipe and tube railings.

1.03 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project Site in time for installation.

C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.04 ACTION SUBMITTALS

A. Product Data: For the following:

1. Manufacturer's product lines of mechanically connected railings.
2. Railing brackets.
3. Grout, anchoring cement, and paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
2. Fittings and brackets.
3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.
    a. Show method of connecting members at intersections.

D. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E894 and ASTM E935.

D. Evaluation Reports: For post-installed anchors, from ICC-ES.

1.06 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, “Structural Welding Code - Steel.”

2. AWS D1.2/D1.2M, “Structural Welding Code - Aluminum.”

3. AWS D1.6/D1.6M, “Structural Welding Code - Stainless Steel.”

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.08 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

2.00 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aluminum Pipe and Tube Railings:

a. ATR Technologies, Inc.

b. Blum, Julius & Co., Inc.

c. Braun, J. G., Company; a division of the Wagner Companies.

d. CraneVeyor Corp.

e. Hollaender Manufacturing Company.

f. Kee Industrial Products, Inc.

g. Moultrie Manufacturing Company.

h. Pisor Industries, Inc.

i. Sterling Dula Architectural Products, Inc.; Div. of Kane Manufacturing.

j. Superior Aluminum Products, Inc.

k. Thompson Fabricating, LLC.

l. Tri Tech, Inc.

m. Tubular Specialties Manufacturing, Inc.

n. Tuttle Railing Systems; Div. of Tuttle Aluminum & Bronze, Inc.

o. Wagner, R & B, Inc.; a division of the Wagner Companies.

B. Source Limitations: Obtain each type of railing from single source from single manufacturer.

2.02 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design railings, including attachment to building construction.

B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.

b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.

c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).

b. Infill load and other loads need not be assumed to act concurrently.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C, material surfaces).

2.03 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

1. Provide type of bracket with predrilled hole for exposed bolt anchorage and that provides 1-1/2-inch (38-mm) clearance from inside face of handrail to finished wall surface.

2.04 ALUMINUM

A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.

B. Extruded Structural Pipe: ASTM B429/B429M, Alloy 6063-T6.

1. Provide Standard Weight (Schedule 40) pipe unless otherwise indicated.

C. Plate and Sheet: ASTM B209 (ASTM B209M), Alloy 6061-T6.

2.05 FASTENERS

A. General: Provide the following:

1. Aluminum Railings: Type 304 stainless-steel fasteners.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.

2. Provide Phillips flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.

2.06 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

D. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.07 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with either welded or nonwelded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove flux immediately.

4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.

J. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

K. Form Changes in Direction as Follows:

1. By bending or by inserting prefabricated elbow fittings.

L. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

M. Close exposed ends of railing members with prefabricated end fittings.

N. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.

O. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

P. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

Q. For railing posts set in concrete, provide stainless-steel sleeves not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure.

R. For removable railing posts, fabricate slip-fit sockets from stainless-steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.

1. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.

S. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.08 ALUMINUM FINISHES

A. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

B. Mill Finish: AA-M12, nonspecular as fabricated.

3.00 EXECUTION

3.01 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.

2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).

3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (6 mm in 3.5 m).

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.02 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.

B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in “Fabrication” Article whether welding is performed in the shop or in the field.

C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches (150 mm) of post.

3.03 ANCHORING POSTS

A. Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer’s written instructions.

B. Form or core-drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer’s written instructions.

C. Cover anchorage joint with flange of same metal as post, attached to post with set screws.

D. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. For aluminum pipe railings, attach posts using fittings designed and engineered for this purpose.

E. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.04 ATTACHING RAILINGS

A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends or connected to railing ends using nonwelded connections.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends or connected to railing ends using nonwelded connections.

C. Attach railings to wall with wall brackets , except where end flanges are used. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

D. Secure wall brackets and railing end flanges to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.

2. For hollow masonry anchorage, use toggle bolts.

3.05 ADJUSTING AND CLEANING

A. Clean by washing thoroughly with clean water and soap and rinsing with clean water.

B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A780/A780M.

3.06 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION

05 53 00 METAL GRATINGS

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Metal bar gratings.
2. Expanded-metal gratings.
3. Formed-metal plank gratings.
4. Extruded-aluminum plank gratings.
5. Glass-fiber-reinforced plastic gratings.
6. Metal frames and supports for gratings.

B. Related Sections:

1. Section 05 12 00 “Structural Steel Framing” for structural-steel framing system components.
2. Section 05 51 00 “Metal Stairs” for grating treads and landings of steel-framed stairs.
3. Section 05 52 13 “Pipe and Tube Railings” for metal pipe and tube handrails and railings.

1.03 ACTION SUBMITTALS

A. Product Data: For the following:

1. Formed-metal plank gratings.
2. Extruded-aluminum plank gratings.
3. Glass-fiber-reinforced plastic gratings.
4. Clips and anchorage devices for gratings.
5. Paint products.

B. Shop Drawings: Include plans, sections, details, and attachments to other work.

1.04 INFORMATIONAL SUBMITTALS

A. Mill Certificates: Signed by manufacturers of stainless-steel sheet certifying that products furnished comply with requirements.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.05 QUALITY ASSURANCE

A. Metal Bar Grating Standards: Comply with NAAMM MBG 531, “Metal Bar Grating Manual” and NAAMM MBG 532, “Heavy-Duty Metal Bar Grating Manual.”

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, “Structural Welding Code - Steel.”

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, “Structural Welding Code - Steel.”

2. AWS D1.2/D1.2M, “Structural Welding Code - Aluminum.”

3. AWS D1.3, “Structural Welding Code - Sheet Steel.”

4. AWS D1.6, “Structural Welding Code - Stainless Steel.”

1.06 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

1.07 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers’ written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for gratings, grating frames, and supports. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

2.00 PRODUCTS

2.01 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Steel Bars for Bar Gratings: ASTM A36/A36M or steel strip, ASTM A1011/A1011M or ASTM A1018/A1018M.

C. Wire Rod for Bar Grating Crossbars: ASTM A510 (ASTM A510M).

D. Uncoated Steel Sheet: ASTM A1011/A1011M, structural steel, Grade 30 (Grade 205).

E. Galvanized-Steel Sheet: ASTM A653/A653M, structural quality, Grade 33 (Grade 230), with G90 (Z275) coating.

F. Expanded-Metal Carbon Steel: ASTM F1267, Class 1.

G. Expanded-Metal Galvanized Steel: ASTM F1267, Class 2, Grade A.

H. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A666, Type 304.

I. Stainless-Steel Bars and Shapes: ASTM A276, Type 304.

J. Expanded-Metal Stainless Steel: ASTM F1267, Class 3, made from stainless-steel sheet, ASTM A666, Type 304.

2.02 ALUMINUM

A. Aluminum, General: Provide alloy and temper recommended by aluminum producer for type of use indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.

B. Extruded Bars and Shapes: ASTM B221 (ASTM B221M), alloys as follows:

1. 6061-T6 or 6063-T6, for bearing bars of gratings and shapes.

2. 6061-T1, for grating crossbars.

C. Aluminum Sheet: ASTM B209 (ASTM B209M), Alloy 5052-H32.

2.03 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless-steel fasteners for fastening aluminum.

2. Provide stainless steel fasteners for fastening stainless steel.

2.04 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy that is welded.

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187.

2.05 FABRICATION

A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.

D. Fit exposed connections accurately together to form hairline joints.

E. Welding: Comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

F. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.

1. Fabricate toeplates to fit grating units and weld to units in shop unless otherwise indicated.

2. Fabricate toeplates for attaching in the field.

3. Toeplate Height: 4 inches (100 mm) unless otherwise indicated.

2.06 METAL BAR GRATINGS

A. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Alabama Metal Industries Corporation; a Gibraltar Industries company.

2. All American Grating.

3. BarnettBates Corporation.

4. Borden Metal Products (Canada) Limited.

5. Fisher & Ludlow; Division of Harris Steel Limited.

6. Grating Pacific, Inc.

7. Grupo Metelmex, S.A. de C.V.

8. IKG Industries; a division of Harsco Corporation.

9. Marwas Steel Co.; Laurel Steel Products Division.

10. Ohio Gratings, Inc.

11. Seidelhuber Metal Products; Division of Brodhead Steel Products.

B. Removable Grating Sections: Fabricate with banding bars attached by welding to entire perimeter of each section. Include anchors and fasteners of type indicated or, if not indicated, as recommended by manufacturer for attaching to supports.

1. Provide no fewer than four weld lugs for each heavy-duty grating section, with each lug shop welded to two bearing bars.

2. Furnish threaded bolts with nuts and washers for securing grating to supports.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1). Kee Industrial Products, Inc.; Grating Clip.

2). Lindapter North America, Inc.; Grate-Fast.

C. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.

1. Edge-band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.

D. Do not notch bearing bars at supports to maintain elevation.

2.07 EXPANDED-METAL GRATINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Alabama Metal Industries Corporation; a Gibraltar Industries company.

2. All American Grating.

3. Central Expanded Metal, Inc.

4. Fisher & Ludlow; Division of Harris Steel Limited.

5. Grating Pacific, Inc.

B. Provide expanded-metal gratings in material, finish, style, size, thickness, weight, and type indicated or, if not indicated, as recommended by manufacturer for indicated applications and as needed to support indicated loads.

C. Fabricate cutouts in grating sections for penetrations of sizes and at locations indicated. Cut openings neatly and accurately to size. Edge-band openings with bars having a thickness not less than overall grating thickness at contact points.

D. Where gratings are pierced by pipes, ducts, and structural members, cut openings neatly and accurately to size and weld a strap collar not less than 1/8 inch (3 mm) thick to the cut ends. Divide panels into sections only to extent required for installation where grating platforms and runways are to be placed around previously installed pipe, ducts, and structural members.

2.08 FORMED-METAL PLANK GRATINGS

A. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Alabama Metal Industries Corporation; a Gibraltar Industries company.

2. Fisher & Ludlow; Division of Harris Steel Limited.

3. Grating Pacific, Inc.

4. GS Metals Corp.

5. IKG Industries; a division of Harsco Corporation.
6. Morton Manufacturing Company.
7. Unistrut.

B. C-shaped channels rolled from heavy sheet metal of thickness indicated, and punched in serrated diamond shape to produce raised slip-resistant surface and drainage holes.

1. Products: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:
    a. Alabama Metal Industries Corporation, a Gibraltar Industries company; Diamond Grip.
    b. Fisher & Ludlow, Division of Harris Steel Limited; Grip Span.
    c. GS Metals Corp.; Grip Strut.
    d. IKG Industries, a division of Harsco Corporation; Deck Span.
    e. Morton Manufacturing Company; Grip-Tac.
2. Channel Width: As required to comply with structural performance requirements.
3. Channel Depth: As required to comply with structural performance requirements.

C. Fabricate cutouts in grating sections for penetrations of sizes and at locations indicated. Cut openings neatly and accurately to size. Edge-band openings with metal sheet or bars having a thickness not less than grating material.

D. Where gratings are pierced by pipes, ducts, and structural members, cut openings neatly and accurately to size and weld a strap collar not less than 1/8 inch (3 mm) thick to the cut ends. Divide panels into sections only to extent required for installation where grating platforms and runways are to be placed around previously installed pipe, ducts, and structural members.

2.09 EXTRUDED-ALUMINUM PLANK GRATINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Alabama Metal Industries Corporation; a Gibraltar Industries company.
2. IKG Industries; a division of Harsco Corporation.
3. Ohio Gratings, Inc.
4. Seidelhuber Metal Products; Division of Brodhead Steel Products.

B. Provide extruded-aluminum plank gratings in type, size, and finish indicated or, if not indicated, as recommended by manufacturer for indicated applications and as needed to support indicated loads.

1. Type: Extruded-aluminum planks approximately 6 inches (152 mm) wide with multiple flanges approximately 1.2 inches (30 mm) o.c., acting as bearing bars connected by a web that serves as a walking surface. Top surface has raised ribs to increase slip resistance.

2. Depth: As required to comply with structural performance requirements.

3. Finish: Mill finish, as fabricated.

C. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.

2.10 GLASS-FIBER-REINFORCED PLASTIC GRATINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Grating, LLC.

2. Creative Pultrusions, Inc.

3. Enduro Systems Inc.; Composite Products Division.

4. Fibergrate Composite Structures Inc.

5. Fisher & Ludlow; Division of Harris Steel Limited.

6. Grating Pacific, Inc.

7. Seasafe, Inc.; a Gibraltar Industries company.

8. Strongwell Corporation.

B. Molded Glass-Fiber-Reinforced Gratings: Bar gratings made by placing glass-fiber strands that have been saturated with thermosetting plastic resin in molds in alternating directions to form interlocking bars without voids and with a high resin content.

1. Resin: Vinylester.

a. Flame-Spread Index: 25 or less when tested according to ASTM E84.

2. Color: Manufacturer’s standard.

3. Traffic Surface: As indicated.

C. Pultruded Glass-Fiber-Reinforced Gratings: Bar gratings assembled from components made by simultaneously pulling glass fibers and extruding thermosetting plastic resin through a heated die under pressure to produce a product without voids and with a high glass-fiber content.

1. Resin Type: Vinylester.

a. Flame-Spread Index: 25 or less when tested according to ASTM E84.

2. Color: Manufacturer’s standard.

3. Traffic Surface: As indicated.

D. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.

2.11 GRATING FRAMES AND SUPPORTS

A. Frames and Supports for Metal Gratings: Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.

1. Unless otherwise indicated, fabricate from same basic metal as gratings.

2. Equip units indicated to be cast into concrete or built into masonry with integrally welded anchors. Unless otherwise indicated, space anchors 24 inches (600 mm) o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches (32 mm) wide by 1/4 inch (6 mm) thick by 8 inches (200 mm) long.

B. Frames and Supports for Glass-Fiber-Reinforced Plastic Gratings: Fabricate from glass-fiber-reinforced plastic shapes of sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.

1. Unless otherwise indicated, use shapes made from same resin as gratings.

2. Equip units indicated to be cast into concrete or built into masonry with integral anchors.

C. Galvanize steel frames and supports in the following locations:

1. Exterior.

2. Interior, where indicated.

2.12 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

2.13 STEEL FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish gratings, frames, and supports after assembly.

C. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

D. Shop prime gratings, frames and supports not indicated to be galvanized unless otherwise indicated.

1. Shop prime with universal shop primer unless zinc-rich primer is indicated.

E. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:

1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, “Commercial Blast Cleaning.”

3. Items Indicated to Receive Primers Specified in Section 09 96 00 “High-Performance Coatings”: SSPC-SP 6/NACE No. 3, “Commercial Blast Cleaning.”

4. Other Items: SSPC-SP 7/NACE No. 4, “Brush-off Blast Cleaning.”

F. Shop Priming: Apply shop primer to comply with SSPC-PA 1, “Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel,” for shop painting.

3.00 EXECUTION

3.01 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.

D. Fit exposed connections accurately together to form hairline joints.

1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

E. Attach toeplates to gratings by welding at locations indicated.

F. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

G. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.02 INSTALLING METAL BAR GRATINGS

A. General: Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.

B. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.

C. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.

3.03 INSTALLING EXPANDED-METAL GRATINGS

A. General: Comply with manufacturer's written instructions for installing gratings.

B. Place units with straight edge of bond up and with long direction of diamond-shaped openings parallel to direction of span.

C. Attach removable units to supporting members by bolting at 6-inch (150-mm) intervals.

D. Attach nonremovable units to supporting members by welding unless otherwise indicated. Space welds at 6-inch (150-mm) intervals.

E. Attach aluminum units to steel supporting members by bolting at 6-inch (150-mm) intervals.

F. Butt edges parallel to long direction of diamond-shaped openings and weld at every second bond point. Place individual grating sections so diamonds of one piece are aligned with those of adjacent sections.

3.04 INSTALLING METAL PLANK GRATINGS

A. General: Comply with manufacturer's written instructions for installing gratings. Use manufacturer's standard anchor clips and hold-down devices for bolted connections.

B. Attach removable units to supporting members by bolting at every point of contact.

C. Attach non-removable units to supporting members by welding unless otherwise indicated. Comply with manufacturer's written instructions for size and spacing of welds.

D. Attach aluminum units to steel supporting members by bolting at side channels at every point of contact and by bolting intermediate planks at each end on alternate sides. Bolt adjacent planks together at mid-span.

3.05 INSTALLING GLASS-FIBER-REINFORCED PLASTIC GRATINGS

A. Comply with manufacturer's written instructions for installing gratings. Use manufacturer's standard stainless-steel anchor clips and hold-down devices for bolted connections.

3.06 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780.

END OF SECTION

DIVISION 6

WOOD, PLASTIC, & COMPOSITES

06 10 00 ROUGH CARPENTRY

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Wood blocking and nailers.

2. Wood furring.

3. Plywood backing panels.

1.03 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal (38 mm actual) size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) size or greater but less than 5 inches nominal (114 mm actual) size in least dimension.

C. Exposed Framing: Framing not concealed by other construction.

D. OSB: Oriented strand board.

E. Timber: Lumber of 5 inches nominal (114 mm actual) size or greater in least dimension.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.

2. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5664.

3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

2.00 PRODUCTS

2.01 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.

2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.

3. Dress lumber, S4S, unless otherwise indicated.

2.02 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Treatment shall not promote corrosion of metal fasteners.

2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.

3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201 at 92 percent relative humidity. Use where exterior type is not indicated.

4. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D5664 and design value adjustment factors shall be calculated according to ASTM D6841.

C. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.

D. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not bleed through, contain colorants, or otherwise adversely affect finishes.

E. Application: Treat all rough carpentry unless otherwise indicated.

2.03 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.

2. Nailers.

B. Concealed Boards: 15 percent maximum moisture content of Construction or No. 2 grade lumber of any species.

C. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

E. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.04 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch (19-mm) nominal thickness.

2.05 FASTENERS

A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC58, ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B633, Class Fe/Zn 5.

3.00 EXECUTION

3.01 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking,and similar supports to comply with requirements for attaching other construction.

C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.

D. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

E. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.

F. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

G. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.

2. Use copper naphthenate for items not continuously protected from liquid water.

H. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).

2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.

3. ICC-ES evaluation report for fastener.

I. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.02 INSTALLATION OF WOOD BLOCKING AND NAILERS

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches (38 mm) wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.03 INSTALLATION OF WOOD FURRING

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

B. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal- (19-by-38-mm actual-) size furring vertically at 16 inches (406 mm) o.c.

3.04 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION

06 63 00 FIBERGLASS STAIRS, HAND RAILS, AND GRATING

1.00 GENERAL

1.01 DESCRIPTION

A. Scope: CONTRACTOR shall provide all labor, materials, tools, services, equipment and incidentals required to furnish, install, test and place in satisfactory operation, fiber reinforced plastic handrails, stairs, and grating systems as specified herein and shown on the drawings.

B. FRP stairs, handrails, and grating shall be a pre-fabricated system constructed to install without significant field cutting or fabrication. CONTRACTOR shall coordinate field measurements prior to submittal and include fully dimensioned fabrication drawings with the submittal.

1.02 MEASUREMENT AND PAYMENT

A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid Item.

1.03 QUALITY ASSURANCE

A. Substitution of any component or modification of system shall be made only when approved by the Owner or Engineer.

B. Fabricator Qualifications: All equipment required under this specification shall be supplied by a single supplier who shall assume responsibility for the adequacy, and performance of all the equipment.

C. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

1.04 DESIGN CRITERIA

A. The design of FRP products including connections shall be in accordance with governing building codes and standards as applicable.

B. Design live loads of FRP gratings, floor panels, platforms and walkways shall not be less than 100 PSF uniformly distributed unless specifically stated otherwise in drawings and/or supplementary conditions. Grating and floor panel deflection at the center of a simple span not to exceed 0.25".

C. Handrails are designed to resist a load of 50 plf applied in any direction at top and to transfer this load through the supports to the structure and to resist a single concentrated load of 200 lbs applied in any direction.

1.05 SUBMITTALS

A. Cross section drawings of handrails, kick-plates, gratings and treads, molded gratings and treads and appurtenances shall be submitted to the Engineer for approval in accordance with the requirements of Section 01 33 00 – Submittal Procedures.

B. Manufacturer's catalog data showing:

C. Dimensions, spacing, and construction of handrails and grating

D. Materials of construction

E. Unassembled and non-fabricated samples of each type of proposed product shall be submitted for approval prior to placement of purchase orders per the request of the Engineer.

F. Fabrication shall not start until receipt of Engineer's approval marked "Approved as Submitted" accompanied by full signature of Engineer.

1.06 SHIPPING AND STORAGE INSTRUCTIONS:

A. All materials and equipment necessary for the fabrication and installation of stairs, handrails, grating, frames, and treads and appurtenances shall be stored before, during, and after shipment in a manner to prevent cracking, twisting, bending, breaking, chipping or damage of any kind to the materials or equipment, including damage due to over exposure to the sun. Any material which, in the opinion of the Owner or Engineer, has become damaged as to be unfit for use, shall be promptly removed from the site of work, and the Contractor shall receive no compensation for the damaged material or its removal.

B. The manufacturer shall utilize best practice packaging systems of recyclable material for all crates and skids while taking measures to ensure material and systems arrive at their destination undamaged.

2.00 PRODUCTS

2.01 GENERAL

A. Materials used in the manufacture of the FRP products shall be raw materials in conformance with this specification.

B. If required, after fabrication, all cut ends, holes and abrasions of FRP shapes shall be sealed with a sealer material or compatible resin coating.

C. All FRP products non-exposed or exposed to weather shall contain an ultraviolet inhibitor incorporated into the resin matrix as well as a synthetic surfacing veil on outer most layer not less than 10 mil thick.

D. All exposed surfaces shall be smooth and true to form and meet the tolerances of the manufacturer's data.

2.02 MANUFACTURERS

A. Fibergrate Composite Products, Dallas, TX

B. Bedford Reinforced Plastics, Inc., Bedford, PA

C. Strongwell, Bristol, VA

D. Or equal

2.03 STAIRS AND HANDRAIL

A. The rails and posts shall be 1.9 inch inner diameter round tube. The kickplate shall be 4-inch x ½ inch x 0.125 inch thick fiberglass shape.

B. The protruded parts shall be made with a fire retardant resin that meets ASTM E-84 test for a flame spread of 25 or less.

C. The Fiberglass Material Properties shall meet or exceed the values listed in Table 1:

Table 1: Fiberglass Material Properties

Properties	Test Method	Units	Values
Tensile Stress, LW	ASTM D638	psi	30,000
Tensile Modulus, LW	ASTM D638	10^6 psi	2.5
Compressive Stress, LW	ASTM D695	psi	30,000
Compressive Modulus, LW	ASTM D695	10^6 psi	2.5
Flexural Stress, LW	ASTM D790	psi	30,000
Flexural Modulus, LW	ASTM D790	10^6 psi	1.6
Short Beam Shear, LW	ASTM D2344	psi	4,500
Density	ASTM D792	lbs/in3	0.06 – 0.07

D. The components used to join fabricated sections together shall be shipped loose, to be epoxied and riveted together in the field by the contractor, per the manufacturer's recommendations.

2.04 GRATING

A. Design

1. The grating shall be one piece construction with the tops and bottoms of the bearing bars and cross bars in the same plane.

2. The mesh pattern and thickness shall be:

   a. 1" Thick, 1-1/2" Square Mesh

3. The standard resin systems:

   a. The resin used in the manufacture of the grating shall be light gray.

   b. Resin shall be isophthalic polyester manufactured from raw materials.

   c. Grating shall be fire retardant with a flame spread rating of 25 or less when tested in accordance with ASTM E-84.

4. Hold down clamps shall be type 316L stainless steel and provided by grating manufacturer. Use 2 at each support with a minimum of 4 per panel.

3.00 EXECUTION

3.01 PREPARATION

A. Coordinate and furnish appropriate hardware as specified by the engineer, architect or manufacturer, supply drawings, diagrams and/or instructions and directions for installation of Fiberglass Systems.

3.02 INSTALLATION

A. Fastening to in-place construction: Provide fasteners where necessary for securing miscellaneous FRP fabrications to in-place as determined by the Engineer.

B. Cutting, fitting and placement: Field fabrication of component system is not allowed. Any miscellaneous repairs or modifications for fit and function shall be kept to a minimum and only performed when absolutely necessary. Perform cutting, drilling and fitting required for installation of miscellaneous FRP fabrications. Set FRP fabrication accurately in location, alignment and elevation; with edges and surfaces level, plumb, true and free of rack; measured from established lines and levels.

C. Provide temporary bracing or anchors in form work for items that are to be built into concrete masonry or similar construction.

3.03 ALL FRP INSTALLATION

A. If required, all field cut and drilled edges, holes and abrasions shall be sealed with a catalyzed resin compatible with the original resin as recommended by the manufacturer.

B. Install items specified as indicated and in accordance with manufacturer's instructions.

C. Following installation CONTRACTOR shall inspect installed components for scratches and / or damage and make necessary repairs, including, but not limited to repairs to surface veils.

END OF SECTION

DIVISION 7

THERMAL & MOISTURE PROTECTION

07 21 00 THERMAL INSULATION

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Polyisocyanurate foam-plastic board.

2. Glass-fiber blanket.

B. Related Requirements:

1. Section 075216 "Styrene-Butadiene-Styrene (SBS) Modified Bituminous Membrane Roofing" for insulation specified as part of roofing construction.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.04 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

B. Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

2.00 PRODUCTS

2.01 POLYISOCYANURATE FOAM-PLASTIC BOARD

A. Polyisocyanurate Board, Foil Faced <Insert drawing designation>: ASTM C1289, foil faced, Type I, Class 1 or 2.

1. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. Atlas EPS; a Division of Atlas Roofing Corporation.

    b. Atlas Roofing Corporation.

    c. Carlisle Coatings & Waterproofing Inc.

    d. Dow Chemical Company (The).

    e. Firestone Building Products.

    f. Hunter Panels.

2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.02 GLASS-FIBER BLANKET

A. Glass-Fiber Blanket, Unfaced: ASTM C665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E84; passing ASTM E136 for combustion characteristics.

1. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

    a. CertainTeed Corporation.

    b. Johns Manville; a Berkshire Hathaway company.

    c. Knauf Insulation.

2.03 INSULATION **FASTENERS**

A. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. AGM Industries, Inc.

2.04 ACCESSORIES

A. Insulation for Miscellaneous Voids:

1. Glass-Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E84.

2. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.

B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

3.00 EXECUTION

3.01 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.02 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.03 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

1. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

2. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.

3. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

4. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.

5. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

6. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.

    a. Exterior Walls: Set units with facing placed toward exterior of construction.

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).

3.04 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

07 22 16 ROOF BOARD INSULATION

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Base layer insulation and secondary/cover board insulation.

B. Related Sections include the following:

1. Division 07 Section “Standing Seam Metal Roof Panels.”

2. Division 07 Section “Sheet Metal Flashing and Trim.”

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM):

B. Standards:

1. FM Global Approval Guide.

2. Underwriters Laboratories: Building Materials Guide.

3. National Roofing Contractors Association (NRCA): The NRCA Roofing and Waterproofing Manual.

C. ASCE 7-10: “Minimum Design Loads for Buildings and Other Structures”.

D. Polyisocyanurate Insulation Manufacturer’s Association: Technical Bulletin 109 – “Storage and Handling Recommendations for Polyisocyanurate”.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer’s product data sheets, providing descriptive data, dimensions, LTTR values, and other pertinent criteria for each material proposed for use in construction of roof assembly.

B. Samples: Provide physical examples of materials/components proposed for use to compromise the specified roof system.

1.05 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Classified by Underwriters Laboratories Inc as Class A rated material.

2. Follow local, state and federal regulations, safety standards and codes. When conflict exists, the more restrictive document shall govern.

B. Installation:

1. Install in accordance with manufacturer's current published application procedures, general requirements of NRCA, and as supplemented by these documents.

2. Consider roof system manufacturer's technical specifications part of this Specification and use as reference for specific application procedures.

3. Install roof system in accordance with prime roof material manufacturer's technical departments uplift calculations and attachment requirements. Negative pressures shall be based on ASCE 7-10.

1.06 DELIVERY, STORAGE AND HANDLING

A. Store materials in accordance with manufacturer's recommendations.

B. Outdoor Storage:

1. Tarp and shield insulation from moisture and exposure to sun.

2. Elevate insulation above substrate 4-inches minimum.

3. Secure insulation to resist winds.

4. Do not use insulation which has been determined "wet" or which has been been wet and has dried.

5. Distribute insulation stored on roof deck to prevent concentrated loads that would impose excessive stress or strain on deck and structural members or impede drainage.

1.07 SEQUENCING AND SCHEDULING

A. Plan roof layout with respect to roof deck slope to prevent rainwater drainage into completed roofing.

B. Do not install more insulation than can be made watertight in same day.

1.08 PROJECT CONDITIONS

A. Environmental recommendations:

1. Apply roofing and insulation in dry weather.

2. Do not proceed with roof construction during inclement weather or when precipitation is predicted with 30 percent or higher probability.

3. Do not apply insulation over wet or moist deck or in foggy conditions.

4. Wind speeds in excess of 30 mph shall constitute “Inclement Weather”.

B. Maintain on-site equipment and material necessary to apply emergency temporary weather protection to incomplete work in event of sudden or unexpected precipitation.

2.00 PRODUCTS

2.01 ROOF INSULATION

A. Base Layer Insulation: Rigid, closed cell polyisocyanurate rigid board insulation utilizing non-chlorine/non-ozone depleting blowing agent, bonded to non-asphaltic coated fiberglass facers, ASTM C 1289, Type II, Class 1, Grade 2 (20 psi), 4.5-inch total thickness (R-25); maximum board size 48” x 96” for mechanically attached applications: “ACFoam-III” by Atlas Roofing Corporation or pre-approved equal.

1. Base insulation layer shall consist of one 2-inch and one 2.5-inch boards, all joints staggered.

2. Other acceptable manufacturers include:

a. Atlas EPS; a Division of Atlas Roofing Corporation.

b. Carlisle Coatings & Waterproofing Inc.

c. Dow Chemical Company (The).

d. Firestone Building Products.

e. Hunter Panels.

B. Secondary Insulation Layer/Cover Board: Moisture resistant, 1/2-inch thick gypsum roof board, ASTM C 1278; provide 48” by 48” nominal size: “DensDeck” by Georgia Pacific or pre-approved equal.

2.02 RELATED MATERIALS

A. Compressible Fill Insulation: Foil or paper-faced compressible fiberglass batten roll insulation of proper size and thickness to insert at openings at penetrations, perimeters, and curbs: Manufactured by Owens Corning or pre-approved equal.

B. Steel Deck Insulation Fasteners: CR-10 flourocarbon coated, self-tapping screws of sufficient length to penetrate the steel deck a minimum of 1-inch, with 3-inch steel plates with recessed screw head for use with roof board insulation: "#12 Standard Roof Fastener" manufactured by OMG or ES Products.

3.00 EXECUTION

3.01 EXAMINATION

A. Roof system manufacturer's representative shall inspect roof deck and associated substrates and provide written acceptance of conditions.

B. Manufacturer's approved roofing contractor shall inspect and approve deck and substrates.

C. Roofing contractor shall examine roof deck and related substrates and verify that there are no conditions that would prevent roof system manufacturer's approved application of roof system. These conditions include, but are not limited to, the following:

1. Inadequate support or anchorage of decking or substrates to structure.
2. Accumulations of moisture.
3. Tears, holes, or punctures.
4. Ridges, uneven conditions, or gaps.
5. Rust or other forms of deterioration.
6. Presence of foreign materials.

D. Start of work constitutes acceptance of substrate and site conditions.

3.02 PROTECTION

A. Provide special protection from traffic on yet to be removed roofing and newly installed roof materials.

3.03 APPLICATION

A. General:

1. Install insulation to achieve a minimum R-25 continuous across the roof deck in general accordance with manufacturer's guidelines.

2. Stagger end joints of insulation boards ½ of overall length of board.

3. Butt joints tightly allowing no more than ¼-inch wide gaps between units. Fill joints between adjacent boards with like insulation or foam adhesive.

4. Do not use warped, bent or otherwise damaged insulation boards.

5. Field cut and fit insulation at penetrations, curbs, and walls.

6. Stagger all joints (side and end) between layers of insulation.

B. Mechanically Attached Insulation Layers:

1. Mechanically attach polyisocyanurate insulation layer to deck.

2. Install insulation with longitudinal joints continuous and end joints staggered.

3. Mechanically attach insulation to roof deck in strict accordance with roof membrane manufacturer's project specific ASCE 7-10 calculations.

4. Fully engage and seat fasteners. Do not over tighten or strip threads. Bent, deformed, or unseated fasteners or plates are unacceptable.

5. Fasteners must penetrate deck 1-inch, minimum, through the deck. Do not overdrive fasteners. Remove and replace overdriven, stripped, or non-engaged fasteners.

6. Properly seat mechanical fasteners and keep heads flush with plates. Cupped plates or unseated screw heads are not acceptable.

7. Do not rupture or deform surface of the insulation by mechanical fastening.

C. Insulation Filler: Install compressible fiberglass insulation at openings in deck at penetrations, perimeters, expansion joints, and/or curbs.

3.04 CLEANING

A. Remove debris and material wrappers from roof to dumpster daily. Leave insulation clean, dry, and ready to receive new roofing.

3.05 ADJUSTING

A. Remove damaged insulation and install acceptable new units before installation of roof membrane system.

END OF SECTION

07 41 13 STANDING SEAM METAL ROOF PANELS

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Work includes all labor, materials, equipment and services necessary for fabrication and installation of mechanically seamed standing seam metal roof panels.

B. Related Sections include the following:

1. Division 07 Section “Roof Board Insulation.”

2. Division 07 Section “Sheet Metal Flashing and Trim.”

1.03 REFERENCES

A. American Architectural Manufacturer's Association (AAMA):

1. AAMA 621 - Voluntary Specifications for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) & Zinc-Aluminum Coated Steel Substrates.

2. AAMA 809.2 - Voluntary Specification Non-Drying Sealants.

B. American Society of Civil Engineers (ASCE):

1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

C. ASTM International (ASTM):

1. ASTM A 653 - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

2. ASTM A 755 - Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.

3. ASTM A 792/A 792M - Standard Specification for Steel Sheet, 55 % Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

4. ASTM A 980 - Standard Specification for Steel, Sheet, Carbon, Ultra High Strength Cold Rolled.

5. ASTM C 645 - Specification for Nonstructural Steel Framing Members.

6. ASTM D 226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.

7. ASTM D 1003 - Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics.

8. ASTM D 2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.

9. ASTM D 4214 - Test Methods for Evaluating Degree of Chalking of Exterior Paint Films.

10. ASTM E 1514 - Standard Specification for Structural Standing Seam Steel Roof Panel Systems.

11. ASTM E 1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.

12. ASTM E 1646 - Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference.

13. ASTM E 1680 - Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems.

14. ASTM E 1980 - Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.

D. International Accreditation Service (IAS):

1. IAS AC 472 - Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems, Part B.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation Meeting: Prior to erection of framing, conduct pre-installation meeting at site attended by Owner, Architect, manufacturer's technical representative, inspection agency and related trade contractors.

1. Coordinate building framing in relation to metal panel system.

2. Coordinate openings and penetrations of metal panel system.

3. Coordinate work of Division 07 Sections with installation of metal panels.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Installer must be currently certified for the installation of the specified roof system.

B. Source Limitations: Obtain all components of roof system from a single manufacturer. Secondary products that are required shall be recommended and approved in writing by the roofing system Manufacturer.

1. Upon request of the Architect or Owner, submit Manufacturer's written approval of secondary components in list form, signed by an authorized agent of the Manufacturer.

2. Manufacturer shall have direct authority and control over all fabrication of steel components as well as the raw materials used in their fabrication.

C. Source Quality Control: Manufacturer shall have in place a documented, standardized quality control program such as ISO-9001 approval.

D. Engage the Manufacturer's Field Representative to conduct required periodic inspections of work in progress as described herein and shall furnish written documentation of all such inspections.

E. Manufacturer shall provide the project Owner with a written statement that they will provide site inspections three days per week that confirms that the project is being constructed as specified, by an experienced, full time employee of the company.

F. Panel system must meet ASTM standards for air and water infiltration (ASTM E 1680/ASTM E 1648).

1.06 SUBMITTALS

A. Comply with pertinent provisions of Division 01 Section “Submittal Procedures, unless otherwise indicated.”

B. Product Data: Include manufacturer's detailed material and system description, panel and field seam installation instructions, engineering performance and finish specifications. Indicate hat channel/furring member and fastener spacing if applicable.

C. Shop Drawings: Show layouts of metal panels. Include details of each condition of installation, panel profiles, and attachment to building. Provide details at a minimum scale 1-1/2 inch per foot of edge conditions, joints, fastener and sealant placement, flashings, openings, penetrations, roof accessories, lightning arresting equipment, and special details. Make distinctions between factory and field assembled work.

1. Indicate points of supporting structure that must coordinate with metal panel system installation.

2. Include data indicating compliance with performance requirements.

3. Include structural data indicating compliance with requirements of authorities having jurisdiction.

D. Samples for Initial Selection: For each exposed product specified including sealants. Provide representative color charts of manufacturer's full range of colors.

E. Samples for Verification: Provide twelve (12) inch long section of each metal panel profile. Provide color chip verifying color selection.

F. Specimen Warranty: Provide an unexecuted copy of the warranty specified for this Project, identifying the terms and conditions required of the Manufacturer and the Owner.

G. Certifications:

1. Letter of certification from the manufacturer that the installer is in compliance and meets specified requirements.

2. Letter of certification from the manufacturer that strictest applicable standards are being implemented to ensure quality.

H. Design and Test Reports: Provide the following certified test reports from an independent testing laboratory:

1. Independent laboratory testing report for system design load and seam integrity.

2. Professional engineer's documentation that roofing system incorporates sufficient allowance for stress and movement.

3. A letter from an officer of the manufacturing company certifying that the materials furnished for this project are the same as represented in tests and supporting data.

4. Manufacturer's verifications that the panels are factory roll formed.

5. ASTM E1592: Test results must clearly demonstrate compliance with the following requirements:

a. The ultimate test failure load shall be reduced by the safety factor specified to determine the allowable working load for the panel system.

b. The proposed system has been tested to insure that the allowable working load of the panel system meets or exceeds the specified negative wind uplift pressures for all roof zones.

c. The test results are applicable for the thickness, width, and profile specified. Results are not applicable for systems that are thinner or wider than the system which was tested. If the tested material was not the specialty material specified herein (for instance, the tested material was galvalume steel), then the test results shall be reduce by the ratio of the yield strength (Fy) of the specified material to the tested material.

1.07 CLOSEOUT SUBMITTALS

A. General: Comply with Requirements of Division 01 Section Closeout Submittals.

B. Special Project Warranty: Provide specified warranty for the Project, executed by the authorized agent of the Manufacturer.

C. Roofing Maintenance Instructions: Provide a manual of manufacturer's recommendations for maintenance of installed roofing systems.

1.08 DELIVERY, STORAGE AND HANDLING

A. Manufacturer's Responsibilities:

1. All roof panels shall be shipped from the manufacturer with strippable film or similar packaging material separating the individual panels to minimize flexing, stressing, scratching or otherwise damaging the material during transit to the job.

2. Fully cover panels with tarpaulins or similar protective cover during transit to prevent dirt and debris from coming in contact with the finished goods.

B. Installer's Responsibilities:

1. Stack pre-finished materials to prevent twisting, bending, abrasion and denting and elevate one end to facilitate moisture run-off.

2. Unload roof panels using a boom or crane, supporting the panels in at least two locations during lifting, and never lift more than three panels at a time.

3. Protect moisture-sensitive and water-based materials from the weather.

4. Inspect materials upon delivery. Reject and remove physically damaged or marred material from project site.

5. Panels with strippable plastic film must not be stored in the open, exposed to the sun.

6. Prevent contact with materials during storage which may cause discoloration or staining.

7. In handling prefinished panels, lift up panels and do not slide panels when un-stacking.

1.09 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace metal roof panel assemblies that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including rupturing, cracking, or puncturing.

b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: Five years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal roof panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.

b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.

c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

C. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

1.10 MANUFACTURER'S FIELD REPRESENTATION

A. Manufacturer's Field Representative: An authorized, full-time employee of the roof system manufacturer shall be assigned to the project to conduct field observations during the installation phase.

B. Regularly scheduled site observations shall be required by the manufacturer's field representative during the roofing installation period; exceptions being made for inclement weather, holidays, etc.

C. Observation reports shall include the following:

1. Written report/documentation of the installation progress at the time of the site visit to be delivered to the architect and owner within 48 hours of the site visit.

2. This report shall include documentation of any issues/question and resolution.

3. This report shall include record of directives given to the roofing contractor.

4. Digital photographic documentation of the roofing progress; including documentation of specific issues and areas of concern.

5. Each report shall contain project name, architect's project number, and date/time/duration of site visit.

D. In addition to the progress observations, the manufacturer's representative must:

1. Attend the roofing trade start-up meeting.

2. Inspect and approve the roof substrate/deck prior to the start of roofing work.

E. All observation reports shall be kept current and shall be delivered electronically to the architect and contractor within five (5) calendar days after the observation. Progress payments for roofing work may be withheld if observation report submissions are not current.

F. After completion of all roofing work, and prior to acceptance of the roofing installation, the manufacturer's representative shall conduct an observation to document all roofing work to be corrected as a condition of acceptance.

1. Each item requiring corrective work shall be identified (including specific location) and required corrective action shall be noted.

2. The final observation report must be produced in writing with photographic back-up. Marking corrective items on the roof alone shall not be acceptable.

1.11 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

2.00 PRODUCTS

2.01 MANUFACTURERS

A. Standing Seam Metal Roof Panels:

1. Basis of Design Manufacturer: The Garland Company, Inc., R-Mer Span 16"

2. Other Acceptable Manufacturers:

a. AEP-Span.

b. Architectural Building Components.

c. Architectural Metal Systems.

d. Architectural Roofing and Siding, Inc.

e. Berridge Manufacturing Company

f. Butler Manufacturing; a BlueScope Steel company.

g. CENTRIA Architectural Systems.

h. Dimensional Metals, Inc.

i. Englert, Inc.

j. Fabral.

k. IMETCO.

l. Integris Metals.

m. MBCI, Inc.

n. McElroy Metal, Inc.

o. Merchant & Evans.

p. Metal-Fab Manufacturing, LLC.

q. Metal Sales Manufacturing Corporation.

r. Metecno-Morin; Division of Metecno Inc.

s. Modern Metal Systems, Inc.

t. Petersen Aluminum Corporation.

u. Ultra Seam Incorporated.

v. VICWEST; Div. of Jenisys Engineered Products.

B. Membrane Underlayment:

1. Basis of Design Manufacturer: The Garland Company, Inc., R-Mer Seal

2. Required primers, liquid adhesives, mastic, and liquid membranes are to be supplied by the same manufacturer as membrane underlayment and as per manufacturer's recommendation.

3. Other Acceptable Manufacturers:

a. Carlisle Coatings & Waterproofing Inc., Div. of Carlisle Companies Inc.

b. Grace Construction Products; a unit of Grace, W. R. & Co.

c. Henry Company

d. Metal-Fab Manufacturing, LLC

e. Owens Corning

C. Basis of Design Materials, manufacturer's product designations, and/or manufacturer's names specified herein shall be regarded as the minimum standard of quality required for work of this Section. Comply with all manufacturer and contractor/fabricator quality and performance criteria specified in Part 1.

D. Substitutions: Products proposed as equal to the products specified in this Section shall be submitted in accordance with Bidding Requirements and Division 01 provisions.

1. Proposals shall be accompanied by a copy of the manufacturer's standard specification section. That specification section shall be signed and sealed by a professional engineer licensed in the state in which the installation is to take place. Substitution requests containing specifications without licensed engineer certification shall be rejected for non-conformance.

2. Include a list of three (3) projects of similar type and extent, located within a twenty-five (25)-mile radius from the location of the project. In addition, the three projects must be at least five (5) years old and be available for inspection by the Architect, Owner or Owner's Representative.

3. Provide all submittal information for the proposed substitution as specified in Article 1.06 of this specification section.

4. Equivalency of performance criteria, warranty terms as described in Article 1.09 of this specification section, submittal procedures, and contractual terms will constitute the basis of acceptance.

2.02 PERFORMANCE REQUIREMENTS

A. General Performance: Metal roof panels shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.

B. Delegated Design: Design metal roof panel assembly, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Air Infiltration: Air leakage through assembly of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) of roof area when tested according to ASTM E 1680 at the following test-pressure difference:

1. Test-Pressure Difference: Positive and negative 1.57 lbf/sq. ft. (75 Pa).

2. Positive Preload Test-Pressure Difference: Greater than or equal to 15.0 lbf/sq. ft. (720 Pa) and the greater of 75 percent of building live load or 50 percent of building design positive wind-pressure difference.

3. Negative Preload Test-Pressure Difference: 50 percent of design wind-uplift-pressure difference.

D. Water Penetration: No water penetration when tested according to ASTM E 1646 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft. (137 Pa).

2. Test-Pressure Difference: 20 percent of positive design wind pressure, but not less than 6.24 lbf/sq. ft. (300 Pa) and not more than 12.0 lbf/sq. ft. (575 Pa).

3. Positive Preload Test-Pressure Difference: Greater than or equal to 15.0 lbf/sq. ft. (720 Pa) and the greater of 75 percent of building live load or 50 percent of building design positive wind-pressure difference.

4. Negative Preload Test-Pressure Difference: 50 percent of design wind-uplift-pressure difference.

E. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E 2140.

F. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

1. Uplift Rating: As Indicated on Drawings

G. Structural Performance: Provide metal roof panel assemblies capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 1592:

1. Wind Loads: Determine loads based on the following minimum design wind pressures:

a. As Indicated on Drawings.

2. Deflection Limits: Metal roof panel assemblies shall withstand wind and snow loads with vertical deflections no greater than 1/180 of the span.

H. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

I. Energy Performance: Provide roof panels with solar reflectance index not less than 29 when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency.

2.03 METAL ROOF PANELS

A. Mechanically-seamed, Concealed Fastener, Metal Roof Panels: Structural metal roof panel consisting of formed metal sheet with vertical ribs at panel edges, installed by attaching panels to supports using concealed clips and fasteners in a weathertight installation.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

2. Basis of Design: The Garland Company, Inc., R-Mer Span 16

3. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 coating designation; structural quality. Pre-painted by the coil-coating process to comply with ASTM A 755/A 755M.

4. Nominal Coated Thickness: 22 gauge (0.029 inches).

a. Panel Profile: Provided with minimum 1-1/2 inches wide elevated mesa's every 2 inches on center continuous throughout panel. Stiffening ribs shall also be located in flat of panel next to the standing seam legs. Panel profile shall be symmetric in shape.

b. Standing Seam: 2-3/8 inch tall mechanically seamed with factory installed hot melt sealant in-seam cap.

c. Exterior Finish: Fluoropolymer two-coat system.

d. Color: Selected by Architect/Owner from Manufacturer’s Standard Color Chart.

5. Panel Width: 16 inches.

6. Panel Seam Height: 2-3/8 inch.

7. Joint Type: Mechanically seamed.

2.04 METAL ROOF PANEL ACCESSORIES

A. General: Provide complete metal roof panel assembly incorporating trim, copings, and miscellaneous flashings, in manufacturer's standard profiles unless shown otherwise on drawings. Provide required fasteners, closure strips, thermal spacers, splice plates, support plates, and sealants as indicated in manufacturer's written instructions.

B. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

C. Panel Anchor Clips: Provide panel clip of type specified, at spacing indicated on approved shop drawings.

1. Concealed Standard Anchor Clips: Clips must be extruded aluminum ONE (1) piece clip with projecting legs for additional panel alignment and provision for unlimited thermal movement in each direction along the longitudinal dimension.

a. Two-piece clips are unacceptable.

b. Sealant applied in panel cap must be isolated from clip to insure that no sealant damage occurs from the movement of the panel during expansion and contraction.

c. Clip must maintain a clearance of a minimum of 1/2 inch between panel and substrate for proper ventilation to help prevent condensation on underside of panel and eliminate the contact of panel fastener head to panel.

D. Panel Fasteners:

1. Concealed fasteners: Corrosion resistant steel fasteners (zinc plated, stainless steel or equal) designed to meet structural loading requirements.

2. Exposed fasteners: Series 410 stainless steel fasteners or 1/8 inch diameter stainless steel waterproof rivets. All exposed fasteners shall be factory painted to match the color of the standing seam panels.

E. Joint Sealers: Manufacturer's standard or recommended liquid and preformed sealers and tapes, and as follows:

1. Factory-Applied Seam Sealant: Manufacturer's standard hot-melt type.

2. Tape Sealers: Manufacturer's standard non-curing butyl tape, AAMA 809.2.

F. Steel Sheet Miscellaneous Framing Components: ASTM C 645, with ASTM A 653/A 653M, G60 (Z180) hot-dip galvanized zinc coating.

G. Gutters: Formed from the same material as roof panels complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96" long sections. of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual". Furnish gutter supports spaces a maximum of 36" o.c., fabricated from the same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Color to match roof as approved by Architect.

H. Downspouts: Formed from same material as roof panels. Fabricate in 10' long sections, complete with formed elbows and offsets, of size an metal thickness according to SMACNA's "Architectural Sheet Metal Manual". Color as approved by Architect.

I. Roof Accessories: Approved by metal roof panel manufacturer. Refer to Roof Accessories for requirements for equipment supports, roof hatches, heat and smoke vents, ventilators, and preformed flashing sleeves.

1. Closures: Factory precut closed cell foam meeting ASTM D 1056 or ASTM D 3575, enclosed in metal channel matching panels when used at hip, ridge, rake, and jamb.

2. Bearing Plates:

a. Galvanized steel bearing plates 3 inches by 5 inches by 16 gauge, minimum.

b. Pre-punch with a hole pattern matching that of the panel anchor clips. Slotted holes are acceptable.

J. Roof Curbs: Fabricated from same material as roof panels, 0.048-inch nominal thickness; with bottom of skirt profiled to match roof panel profiles and with welded top box and full length cricket. Fabricate curb sub-framing of 0.060-inch- nominal thickness, angle-, C-, or Z shaped steel sheet. Fabricate curb and sub-framing to withstand indicated loads of size and height indicated. Finish roof curbs to match metal roof panels.

1. Insulate roof curb with 1-inch- thick, rigid insulation.

2.05 FABRICATION

A. General: Provide factory fabricated and finished metal panels and accessories meeting performance requirements, indicated profiles, and structural requirements.

B. Fabricate metal panel joints configured to accept factory-applied sealant providing weathertight seal and preventing metal-to-metal contact and minimizing noise resulting from movement.

C. Form panels in continuous lengths for full length of detailed runs, except where otherwise indicated on approved shop drawings.

D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's written instructions, approved shop drawings, and project drawings. Form from materials matching metal panel substrate and finish.

2.06 FINISHES

A. Finishes, General: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

B. Fluoropolymer Two-Coat System: 0.2 – 0.3 mil primer with 0.7 - 0.8 mil 70 percent PVDF fluoropolymer color coat, AAMA 621, meeting solar reflectance index requirements.

C. Interior Finish: 0.5 mil total dry film thickness consisting of primer coat and wash coat of manufacturer's standard light-colored acrylic or polyester backer finish.

3.00 EXECUTION

3.01 EXAMINATION

A. Examine metal panel system substrate and supports with Installer present. Inspect for erection tolerances and other conditions that would adversely affect installation of metal panel installation.

1. Inspect metal panel support substrate to determine if support components are installed as indicated on approved shop drawings. Confirm presence of acceptable supports at recommended spacing to match installation requirements of metal panels.

2. Panel Support Tolerances: Confirm that panel supports are within tolerances acceptable to metal panel system manufacturer but not greater than the following:

a. 1/4 inch (6 mm) in 20 foot (6.1 m) in any direction.

b. 3/8 inch (9 mm) over any single roof plane.

B. Correct out-of-tolerance work and other deficient conditions prior to proceeding with insulated metal roof panel system installation.

3.02 PREPARATION

A. Miscellaneous Supports: Install sub-framing, girts, furring, and other miscellaneous panel support members according to ASTM C 754 and manufacturer's written instructions.

B. Flashings: Install flashings to cover exposed underlayment per Section 07 62 00 "Sheet Metal Flashing and Trim".

3.03 METAL PANEL INSTALLATION

A. Mechanically-Seamed, Standing Seam Metal Roof Panels: Install weathertight metal panel system in accordance with manufacturer's written instructions, approved shop drawings, and project drawings. Install metal roof panels in orientation, sizes, and locations indicated, free of waves, warps, buckles, fastening stresses, and distortions. Anchor panels and other components securely in place. Provide for thermal and structural movement.

B. Attach panels to supports using clips, screws, fasteners, and sealants recommended by manufacturer and indicated on approved shop drawings.

1. Fasten metal panels to supports with concealed clips at each location indicated on approved shop drawings, with spacing and fasteners recommended by manufacturer.

2. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.

3. Provide weatherproof jacks for pipe and conduit penetrating metal panels of types recommended by manufacturer.

4. Dissimilar Materials: Where elements of metal panel system will come into contact with dissimilar materials, treat faces and edges in contact with dissimilar materials using EC-1202 tape or zinc chromate paint.

3.04 ACCESSORY INSTALLATION

A. General: Install metal panel trim, flashing, and accessories using recommended fasteners and joint sealers, with positive anchorage to building, and with weather tight mounting. Provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel assembly, including trim, copings, flashings, sealants, closure strips, and similar items.

2. Comply with details of assemblies utilized to establish compliance with performance requirements and manufacturer's written installation instructions.

3. Provide concealed fasteners except where noted on approved shop drawings.

4. Set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently weather resistant.

B. Joint Sealers: Install joint sealers where indicated and where required for weathertight performance of metal panel assemblies, in accordance with manufacturer's written instructions.

1. Prepare joints and apply sealants per requirements of Division 07 Section "Joint Protection".

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Engage an independent testing and inspecting agency acceptable to Owner to perform field tests and inspections and to prepare test reports.

3.06 CLEANING AND PROTECTION

A. Remove temporary protective films immediately in accordance with metal roof panel manufacturer's instructions. Clean finished surfaces as recommended by metal roof panel manufacturer.

B. Replace damaged panels and accessories that cannot be repaired to the satisfaction of the Architect.

END OF SECTION

07 42 66 METAL SOFFIT PANELS

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Work includes all labor, materials, equipment and services necessary for fabrication and installation of pre-formed metal soffit panels.

B. Related Sections include the following:

1. Division 07 Section “Roof Board Insulation.”

2. Division 07 Section “Standing Seam Metal Roof Panels.”

3. Division 07 Section “Sheet Metal Flashing and Trim.”

1.03 REFERENCES

A. ASTM International (ASTM):

1. B209 Specification for Aluminum and Aluminum – Alloy Sheet and Plate.

B. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):

1. 1993 Architectural Sheet Metal Manual, 5th edition.

1.04 SUBMITTALS

A. Product Data: Include manufacturer’s detailed material and system description, concealed anchor clips, sealant and closure installation instructions, and finish specifications. Indicate fastener types and spacing; and required fastener pullout values.

B. Samples: Provide full-size samples of the following materials and system components. Samples shall be of identical material type, thickness, panel width, and material grade/alloy as the system specified for this project.

1. Submit sample of panel section, at least 4” long x full panel width showing panel profile and also a sample of color selected.

2. Submit sample of panel fasteners.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Engage an Installer who has completed the Manufacturer's Approved Contractor course and is currently certified for the installation of the specified system.

B. If required, fabricator/installer shall submit work experience and evidence of adequate financial Responsibility. The Owner's representative reserves the right to inspect fabrication facilities in determining qualifications.

C. Source Limitations: Obtain all components from a single manufacturer. Secondary products that are required shall be recommended and approved in writing by the Manufacturer.

1. Upon request of the Architect or Owner, submit Manufacturer's written approval of secondary components in list form, signed by an authorized agent of the Manufacturer.

2. Manufacturer shall have direct authority and control over all fabrication of steel components as well as the raw materials used in their fabrication.

D. Source Quality Control: Manufacturer shall have in place a documented, standardized quality control program such as ISO-9001 approval.

E. Engage the Manufacturer's Field Representative to conduct required periodic inspections of work in progress as described herein and shall furnish written documentation of all such inspections.

F. Manufacturer shall provide the Owner project with a written statement that they will provide site inspections three days per week to confirm that the project is being constructed as specified, by an experienced, full time employee of the company.

1.06 DELIVERY, STORAGE AND HANDLING

A. Manufacturer's Responsibilities:

1. All panels shall be shipped from the manufacturer with polystyrene or similar cushioned packaging material separating the individual panels to minimize flexing, stressing, scratching or otherwise damaging the material during transit to the job.

2. Fully cover panels with tarpaulins or similar protective cover during transit to prevent dirt and debris from coming in contact with the finished goods.

B. Installer's Responsibilities:

1. Stack pre-finished materials to prevent twisting, bending, abrasion and denting and elevate one end to facilitate moisture run-off.

2. Unload panels using a boom or crane, supporting the panels in at least two locations during lifting, and never lift more than three panels at a time.

3. Protect moisture-sensitive and water-based materials from the weather.

4. Inspect materials upon delivery. Reject and remove physically damaged or marred material from project site.

5. Panels with strippable plastic film must not be stored in the open, exposed to the sun.

6. Prevent contact with materials during storage which may cause discoloration or staining.

7. In handling prefinished panels, lift up panels and do not slide panels when un-stacking.

1.07 PROJECT CONDITIONS

A. Determine that work of other trades will not hamper or conflict with necessary fabrication and storage and protection requirements for wall panel system.

1. Protection:

a. Protect completed work from subsequent construction operations. Comply with Manufacturer's recommendations.

b. Do not encumber the site with stored materials or equipment.

1.08 MANUFACTURER'S INSPECTIONS

A. When the project is in progress, the system manufacturer will provide the following:

1. Keep the Architect or Owner informed as to the progress and quality of the work as observed.

2. Provide job site inspections.

3. Report to the Architect in writing any failure or refusal of the Contract to correct unacceptable practices called to the Contractor's attention.

4. Confirm after completion that manufacturer has observed no applications procedures in conflict with the specifications other than those that may have been previously reported and corrected.

1.09 WARRANTY

A. Manufacturer shall execute a single warranty covering of the following criteria. Multiple-source warranties are not acceptable.

1. Twenty (20) year coverage on finish including checking, crazing, peeling, chalking, fading and/or adhesion.

2. Warranty shall commence on date of substantial completion or final payment, whichever is agreed by contract.

B. Installer shall provide manufacturer with two (2) year warranty from date of substantial completion of building, covering panel installation.

2.00 PRODUCTS

2.01 MANUFACTURERS

A. Soffit Panel System:

1. Basis of Design Manufacturer: The Garland Company, Inc., R-Mer Soffit

a. 3800 East 91st Street, Cleveland, OH, 44105

b. Manufacturer's Representative:

1). Blake Dieste; bdieste@garlandind.com; (M) 832-488-4783

2. Other Acceptable Manufacturers include:

a. AEP Span; A BlueScope Steel Company.

b. Architectural Building Components.

c. ATAS International, Inc.

d. Berridge Manufacturing Company.

e. CENTRIA Architectural Systems.

f. Dimensional Metals, Inc.

g. Drexel Metals.

h. Englert, Inc.

i. Fabral.

j. Firestone Building Products.

k. Innovative Metals Company, Inc.

l. MBCI.

m. McElroy Metal, Inc.

n. Merchant and Evans.

o. Metal Sales Manufacturing Corporation.

p. PAC-CLAD; Petersen Aluminum Corporation.

B. Basis of Design Materials, manufacturer's product designations, and/or manufacturer's names specified herein shall be regarded as the minimum standard of quality required for work of this Section. Comply with all manufacturer and contractor/fabricator quality and performance criteria specified in Part 1.

C. Substitutions: Products proposed as equal to the products specified in this Section shall be submitted in accordance with Bidding Requirements and Division 01 provisions.

1. Proposals shall be accompanied by a copy of the manufacturer's standard specification section. That specification section shall be signed and sealed by a professional engineer licensed in the state in which the installation is to take place. Substitution requests containing specifications without licensed engineer certification shall be rejected for non-conformance.

2. Include a list of three (3) projects of similar type and extent, located within a twenty-five (25)-mile radius from the location of the project. In addition, the three projects must be at least five (5) years old and be available for inspection by the Architect, Owner or Owner's Representative.

2.02 SOFFIT PANEL SYSTEM

A. Materials:

1. Panel material: .032” thickness aluminum, 3105-H14 alloy, smooth as per ASTM B209-96.

2. Flashing and flat stock material. Fabricate from .032” thick aluminum in profiles indicated on drawings of same material and finish as soffit system, unless indicated otherwise.

B. Finish on surfaces:

1. Exposed surfaces for coated panels:

a. Two coat coil applied, baked-on full-strength (70% resin) fluorocarbon coating system (polyvinylidene fluoride, PVF2), applied by manufacturer’s approved applicator.

b. Coating system shall provide nominal one point zero (1.0) mil dry film thickness, consisting of primer and color coat.

c. Color shall be GARLAND Regal White.

2. Unexposed surfaces for coated panels shall be baked-on polyester coating with .20 - .30 dry film thickness (TDF).

3. Exposed and unexposed surfaces for uncoated panels shall be as shipped from the mill.

C. Characteristics:

1. Fabrication: Panels shall be factory roll-formed from the specified metal. Field rolled panels will not be allowed.

2. Configuration: Interlocking flush/flat seams incorporating concealed screw type fastener. Concealed clip systems are not acceptable.

3. Panel width: twelve (12) inch nominal.

4. Panel lengths: Full length without joints to the extent as is practical. For lengths which exceed twenty-five (25) feet, shorter panels may be butted end-to-end (no overlap). End joints shall be staggered.

5. Panels shall have one (1) V-groove mechanically formed reveal at the center of the pan.

6. All panels shall be solid (non-vented).

D. Accessories:

1. Fasteners:

a. Concealed fasteners: Corrosion resistant steel screws, #10 x 1” long, pancake head, Phillips drive. Use self-drilling, self-tapping for metal substrate or A-point for plywood substrate.

b. Exposed fasteners: Series 410 stainless steel screws or one eighth (1/8) inch diameter stainless steel waterproof rivets. All exposed fasteners shall be factory painted to match the color of the soffit panels.

2. Provide all miscellaneous accessories for complete installation.

2.03 ACCESSORY PRODUCTS

A. A. Sealant:

1. Acceptable product:

a. Concealed Application: PTI-707 or Bostik Chem-Caulk butyl sealant or equal.

b. Exposed Application: General Electric Co., SILGLAZE II 2800 or equal.

2. Colors: As selected by architect from sealant manufacturer's standard selection.

3. See other acceptable sealants / manufacturers

B. Soffit Substrate:

1. Install 15/32" (minimum) thickness exterior grade plywood sheathing along soffit area.

2.04 FABRICATION

A. General: Provide factory fabricated and finished metal panels and accessories meeting performance requirements, indicated profiles, and structural requirements.

B. Shop fabricate metal panels and flashing components to the maximum extent possible, forming metal work with clear sharp, straight, and uniform bends and rises. Hem exposed edges of flashings.

C. Form flashing components from single width sheet in minimum ten (10) feet zero (0) inch sections. Provide shop fabricated, mitered corners, joined using closed end pop rivets and joint sealant.

D. Fabricate panels and related sheet metal work in accordance with approved shop drawings and applicable standards.

3.00 EXECUTION

3.01 EXECUTION, GENERAL

A. Comply with requirements of Division 01 Section "Common Execution Requirements."

3.02 PREPARATION

A. Inspection: Examine the alignment and placement of the building structure and substrate. Correct any objectionable warp, waves or buckles in the substrate before proceeding with installation of the pre-formed metal panels.

3.03 INSTALLATION

A. All details will be shown on manufacturer's shop drawings to successful bidder; install soffit and flashings in accordance with approved shop drawings and manufacturer's product data, within specified erection tolerances.

B. Prepare soffit for the installation of panels, including:

1. Install all sheathing, framing, and/or furring members as indicated in this specification and bid documents. Install all sheathing, framing, and/or air infiltration barriers as indicated in this specification and bid documents.

2. Install all temporary water proofing materials as required in this specification and bid documents.

C. Directly over the completed soffit substrate, install metal soffit panels. All panels will be fastened into the structural substrate with screw type fasteners at twenty-four (24) inches o.c. maximum spacing along each panel seam.

D. Seal laps and joints in accordance with roofing system manufacturer's product data.

E. Coordinate flashing and sheet metal work to provide weathertight conditions at soffit terminations. Fabricate and install in accordance with standard of SMACNA Manual.

F. Installed system shall be true to line and place and free of dents, and physical defects. In light gauge panels with wide flat surfaces, some oil canning may be present. Oil canning does not affect the finish or structural integrity of the panel and is therefore not cause for rejection.

G. Form joints in linear sheet metal to allow for one quarter (1/4) inch minimum expansion at twenty (20) feet zero (0) inch on-center maximum and eight (8) feet zero (0) inch from corners.

H. At joints in linear sheet metal items, set sheet metal items in two (2) one quarter (1/4) inch beads of butyl sealant. Extend sealant over all metal surfaces. Mate components for positive seal. Allow no sealant to migrate onto exposed surfaces.

I. Remove damaged work and replace with new, undamaged components.

J. Touch up exposed fasteners using paint furnished by soffit panel manufacturer and matching exposed panel surface finish.

K. Clean exposed surfaces of soffit and accessories after completion of installation. Leave in clean condition at date of substantial completion. Touch up minor abrasions and scratches in finish.

3.04 CLEANING

A. Clean installed work in accordance with the manufacturer's instructions.

B. Replace damaged work than cannot be restored by normal cleaning methods.

3.05 CONSTRUCTION WASTE MANAGEMENT

A. Remove and properly dispose of waste products generated during construction. Comply with requirements of authorities having jurisdiction.

3.06 FINAL INSPECTION

A. At completion of installation and associated work, meet with Contractor, Architect, installer, installer or associated work, Owner, system manufacturer's representative, and other representative directly concerned with performance of system.

B. Inspect work and flashing of penetrations, walls, curbs and other equipment. List all items requiring correction or completion and furnish copy of list to each party in attendance.

C. Repair or replace deteriorated or defective work found at time above inspection as required to a produce an installation which is free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

D. Notify the Architect upon completion of corrections.

E. Following the final inspection, provide written notice of acceptance of the installation from the system manufacturer.

F. Immediately correct panel system leakage during construction. If the Contractor does not respond within twenty four (24) hours, the Owner will exercise to correct the Work under the terms of the Conditions of the Contract.

END OF SECTION

07 52 16 STYRENE-BUTADIENE-STYRENE (SBS) MODIFIED BITUMINOUS MEMBRANE ROOFING

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Styrene-butadiene-styrene (SBS)-modified bituminous membrane roofing.
2. Hybrid roofing system that combines built-up ply sheets with styrene-butadiene-styrene (SBS)-modified bituminous cap sheet.
3. Substrate board.
4. Vapor retarder.
5. Roof insulation.
6. Cover board.
7. Walkways.

B. Section includes the installation of sound-absorbing insulation strips in ribs of roof deck. Sound-absorbing insulation strips are furnished under Section 053100 "Steel Decking."

C. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking, and for wood-based, structural-use roof deck panels.
2. Section 072216 "Roof Board Insulation" for insulation beneath the roof deck.
3. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
4. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.03 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D1079 and glossary of NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to Work of this Section.

1.04 PREINSTALLATION MEETINGS

A. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review deck substrate requirements for conditions and finishes, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing.

B. Shop Drawings: Include plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane terminations.
3. Flashing details at penetrations.
4. Tapered insulation, including slopes.
5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
6. Crickets, saddles, and tapered edge strips, including slopes.
7. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
8. Tie-in with adjoining air barrier.

C. Samples for Verification: For the following products:

1. Cap Sheet: Samples of manufacturer's standard colors for selection by Architect.
2. Flashing Sheet: Samples of manufacturer's standard colors for selection by Architect.

3. Aggregate surfacing material in gradation and color required.
4. Walkway Pads or Rolls: Samples of manufacturer's standard colors for selection by Architect.

D. Wind Uplift Resistance Submittal: For roofing system indicating compliance with wind uplift performance requirements.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

a. Submit evidence of complying with performance requirements.

2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

C. Product Test Reports: For roof membrane and insulation, tests performed by a qualified testing agency, indicating compliance with specified requirements.

D. Evaluation Reports: For components of membrane roofing system, from ICC-ES.

E. Field Test Reports:

1. Concrete internal relative humidity test reports.
2. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

F. Field quality-control reports.

G. Sample Warranties: For manufacturer's special warranties.

1.07 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

1.08 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is UL listed for roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer.

1. Protect stored liquid material from direct sunlight.
2. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources.

1. Store in a dry location.
2. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.10 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes roof membrane, base flashings, roof insulation, fasteners, cover boards, vapor retarder, substrate board, and other components of roofing system.
2. Warranty Period: 20 years from date of Substantial Completion.

B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of roofing system such as roof membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, and walkway products, for the following warranty period:

1. Warranty Period: Two years from date of Substantial Completion.

2.00 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing system and flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roof system and flashings shall remain watertight.

1. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
2. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746/D3746M, ASTM D4272/D4272M, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.

B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.

C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897:

1. Zone 1 (Roof Area Field): <**Insert lbf/sq. ft. (kPa/sq. m)**>.
2. Zone 2 (Roof Area Perimeter): <**Insert lbf/sq. ft. (kPa/sq. m)**>.

    a. Location: From roof edge to <**Insert dimension**> inside roof edge.

3. Zone 3 (Roof Area Corners): <**Insert lbf/sq. ft. (kPa/sq. m)**>.

    a. Location: <**Insert dimension**> in each direction from each building corner.

D. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and shall be listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.

1. Fire/Windstorm Classification: [**Class 1A-60**] [**Class 1A-75**] [**Class 1A-90**] [**Class 1A-105**] [**Class 1A-120**] <**Insert class**>.
2. Hail-Resistance Rating: [**MH**] [**SH**].

E. Energy Performance: Roofing system shall have an initial solar reflectance of not less than [**0.70**] <**Insert value**> and an emissivity of not less than [**0.75**] <**Insert value**> when tested according to CRRC-1.

F. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency.

1. Identify products with appropriate markings of applicable testing agency.

G. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated.

1. Identify products with appropriate markings of applicable testing agency.

2.02 MANUFACTURERS

A. Source Limitations: Obtain components for roofing system from roof membrane manufacturer.

2.03 BASE SHEET MATERIALS

A. SBS-Modified Bitumen Polyester Mat Base Sheet: ASTM D6164/D6164M, Type I, Grade S, SBS-modified asphalt sheet, reinforced with polyester fabric, smooth surfaced, suitable for cold adhesive or hot asphalt application method.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Bitec, Inc.
b. Firestone Building Products.
c. GAF.
d. Henry Company.
e. IKO Industries Inc.
f. Johns Manville; a Berkshire Hathaway company.
g. Polyglass USA, Inc.
h. Soprema, Inc.

2.04 INTERPLY SHEETS

A. Glass-Fiber Interply Sheet: ASTM D2178/D2178M, [**Type IV**] [**Type VI**], asphalt-impregnated, glass-fiber felt.

2.05 STYRENE-BUTADIENE-STYRENE (SBS) MODIFIED BITUMINOUS CAP SHEET

A. Granule-Surfaced Roofing Cap Sheet: ASTM D6164/D6164M, Type I, Grade G, SBS-modified asphalt sheet, reinforced with polyester fabric, suitable for cold adhesive or hot asphalt application method.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Bitec, Inc.
b. CertainTeed Corporation.
c. Ecology Commercial and Industrial Roofing Systems.
d. Firestone Building Products.
e. GAF.
f. Henry Company.
g. IKO Industries Inc.
h. Johns Manville; a Berkshire Hathaway company.
i. Polyglass USA, Inc.
j. Soprema, Inc.
k. Tamko Building Products, Inc.

2. Granule Color: White.

2.06 BASE FLASHING SHEET MATERIALS

A. Backer Sheet: ASTM D6164/D6164M, Type I or II, Grade S, SBS-modified asphalt sheet, reinforced with polyester fabric, smooth surfaced, suitable for application method specified.

B. Granule-Surfaced Flashing Sheet: ASTM D6164/D6164M, Type I or II, Grade G, SBS-modified asphalt sheet, reinforced with polyester fabric, granule surfaced, suitable for application method specified, and as follows:

1. Granule Color: White.

C. Glass-Fiber Fabric: Woven glass-fiber cloth, treated with asphalt, complying with ASTM D1668/D1668M, Type I.

D. Liquid Flashing System: Roof membrane manufacturer's standard one- or two-part moisture curing resin with low solvent content, consisting of a primer, flashing cement, and scrim.

2.07 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.

1. Adhesives and Sealants: Comply with VOC limits of authorities having jurisdiction.

B. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

C. Roof Vents: As recommended by roof membrane manufacturer.

1. Size: Not less than4-inch (100-mm) diameter.

D. Sheathing Paper: Red-rosin type, minimum 3 lb/100 sq. ft. (0.16 kg/sq. m).

E. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

F. Cold-Applied Asphalt Adhesive: ASTM D3019, Type III, roof membrane manufacturer's standard asphalt-based, one- or two-part, asbestos-free, cold-applied adhesive, specially formulated for compatibility and use with roofing membrane and base flashings.

G. Cold-Applied Polymer-Modified Asphalt Adhesive: Roof membrane manufacturer's standard solvent-and asbestos-free, cold-applied adhesive, specially formulated for compatibility and use with interply sheets and aggregate surfacing adhesive.

H. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required by roofing system manufacturer for application.

I. Mastic Sealant: Polyisobutylene, plain or modified bitumen; nonhardening, nonmigrating, nonskinning, and nondrying.

J. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate; tested by manufacturer for required pullout strength, and acceptable to roofing

K. Roofing Granules: Ceramic-coated roofing granules, No. 11 screen size with 100 percent passing No. 8 (2.36-mm) sieve and 98 percent of mass retained on No. 40 (0.425-mm) sieve; color to match roof membrane.

L. Miscellaneous Accessories: Provide those recommended by roofing system manufacturer.

2.08 SUBSTRATE BOARDS

A. Substrate Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum substrate or ASTM C1278/C1278M, fiber-reinforced gypsum board.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed Corporation.
b. Georgia-Pacific Gypsum LLC.

c. National Gypsum Company.

2. Thickness: 1/2 inch (13 mm).

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

2.09 ROOF INSULATION

A. General: Preformed roof insulation boards, manufactured by roof membrane manufacturer,.

B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Atlas EPS; a Division of Atlas Roofing Corporation.
b. Atlas Roofing Corporation.
c. Carlisle SynTec Incorporated.
d. CertainTeed Corporation.
e. Dyplast Products.
f. Firestone Building Products.
g. GAF.
h. Hunter Panels.
i. Insulfoam; Carlisle Construction Materials Company.
j. Johns Manville; a Berkshire Hathaway company.

2. Compressive Strength: 20 psi (138 kPa).
3. Size: 48 by 48 inches (1219 by 1219 mm).
4. Thickness:

a. Base Layer: 1-1/2 inches (38 mm).

C. Tapered Insulation: Provide factory-tapered insulation boards.

1. Material: Match roof insulation.
2. Minimum Thickness: 1/4 inch (6 mm).
3. Slope:

a. Roof Field: 1/4 inch per foot (1:48) unless otherwise indicated on Drawings.
b. Saddles and Crickets: 1/2 inch per foot (1:24) unless otherwise indicated on Drawings.

2.10 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

C. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:

1. Modified asphaltic, asbestos-free, cold-applied adhesive.
2. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
3. Full-spread spray-applied, low-rise, two-component urethane adhesive.

D. Insulation Cant Strips: ASTM C728, perlite insulation board.

E. Insulation Cant Strips: ASTM C208, Type II, Grade 1, cellulosic-fiber insulation board.

F. Wood Nailer Strips: Comply with requirements in Section 061000 "Rough Carpentry."

G. Tapered Edge Strips: ASTM C728, perlite insulation board.

H. Tapered Edge Strips: ASTM C208, Type II, Grade 1, cellulosic-fiber insulation board.

I. Cover Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum board or ASTM C1278/C1278M, fiber-reinforced gypsum board.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Georgia-Pacific Gypsum LLC.
b. National Gypsum Company.

2. Thickness: 1/2 inch (13 mm).
3. Surface Finish: Factory primed.

2.11 ASPHALT MATERIALS

A. Asphalt Primer: ASTM D41/D41M.

B. Roofing Asphalt: ASTM D312/D312M, Type III or IV as recommended by roofing system manufacturer for application.

2.12 WALKWAYS

A. Walkway Pads: Reinforced asphaltic composition pads with slip-resisting mineral-granule surface, manufactured as a traffic pad for foot traffic and acceptable to roofing system manufacturer, 3/8 inch (10 mm) thick, minimum.

1. Pad Size: Approximately 36 by 60 inches (914 mm by 1524 mm).
2. Color: Contrasting with cap sheet.

3.00 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
2. Verify that wood cants, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."
4. Verify that deck is securely fastened with no projecting fasteners and with no adjacent units in excess of 1/16 inch (1.6 mm) out of plane relative to adjoining deck.
5. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
6. Verify that concrete substrate is visibly dry and free of moisture, and that minimum concrete internal relative humidity is not more than 75 percent, or as recommended by roofing system manufacturer, when tested according to ASTM F2170.

    a. Test Frequency: One test probe per each 1000 sq. ft. (93 s2. m), or portion thereof,of roof deck, with not less than three test probes.
    b. Submit test reports within 24 hours of performing tests.

7. Verify that concrete-curing compounds that impair adhesion of roofing components to roof deck have been removed.
8. Verify that joints in precast concrete roof decks have been grouted flush with top of concrete.
9. Verify that minimum curing period recommended by roofing system manufacturer for lightweight insulating concrete roof decks has passed.
10. Verify that any damaged sections of cementitious wood-fiber decks have been repaired or replaced.
11. Verify that adjacent cementitious wood-fiber panels are vertically aligned to within 1/8 inch (3 mm) at top surface.)

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions.

1. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction.

1. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Prime surface of concrete deck with asphalt primer at a rate of 3/4 gal./100 sq. ft. (0.3 L/sq. m), and allow primer to dry.

D. Perform fastener-pullout tests according to roof system manufacturer's recommendations.

1. Submit test result within 24 hours of performing tests.

a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

E. Install sound absorbing insulation strips in ribs of acoustical roof decks according to acoustical roof deck manufacturer's written instructions.

3.03 INSTALLATION OF ROOFING, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

B. Complete terminations and base flashings, and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast.

1. Remove and discard temporary seals before beginning work on adjoining roofing.

C. Install roof membrane and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition.

D. Asphalt Heating:

1. Heat asphalt to its equiviscous temperature, measured at the mop cart or mechanical spreader immediately before application.

a. For cap sheets, heat asphalt according to cap sheet manufacturer's recommendations.

2. Circulate asphalt during heating.
3. Do not raise asphalt temperature above equiviscous temperature range more than one hour before time of application.

a. For cap sheets, comply with cap sheet manufacturer's recommendations.

4. Do not exceed asphalt manufacturer's recommended temperature limits during asphalt heating.
5. Do not heat asphalt within 25 deg F (14 deg C) of flash point.
6. Discard asphalt maintained at a temperature exceeding finished blowing temperature for more than four hours.
7. Apply hot roofing asphalt within plus or minus 25 deg F (14 deg C) of equiviscous temperature.

a. For cap sheets, comply with cap sheet manufacturer's recommendations.

E. Asphalt Heating: Heat and apply SEBS-modified roofing asphalt according to roofing system manufacturer's written instructions.

F. Substrate-Joint Penetrations: Prevent roofing asphalt and adhesives from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

3.04 INSTALLATION OF SUBSTRATE BOARD

A. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inches (600 mm) in adjacent rows.

1. At steel roof decks, install substrate board at right angle to flutes of deck.

a. Locate end joints over crests of steel roof deck.

2. Tightly butt substrate boards together.
3. Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.
4. Fasten substrate board to top flanges of steel deck according to recommendations in FM Approvals' RoofNav and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.
5. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions.

6. Loosely lay substrate board over roof deck.

3.05 INSTALLATION OF INSULATION

A. Coordinate installing roofing system components, so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Nailer Strips: Mechanically fasten 4-inch nominal- (89-mm actual-) width, wood nailer strips of same thickness as insulation perpendicular to sloped roof deck at the following spacing:

1. 16 feet (4.88 m) apart for roof slopes greater than 1 inch per 12 inches (1:12) but less than 3 inches per 12 inches (3:12).
2. 48 inches (1219 mm) apart for roof slopes greater than 3 inches per 12 inches (3:12).

D. Insulation Cant Strips: Install and secure preformed 45-degree insulation cant strips at junctures of roofing system with vertical surfaces or angle changes greater than 45 deg F (14 deg C).

E. Installation Over Metal Decking:

1. Install base layer of insulation with joints staggered not less than 24 inches (600 mm) in adjacent rows and with long joints continuous at right angle to flutes of decking.

a. Locate end joints over crests of decking.
b. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
e. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).

1) Trim insulation, so that water flow is unrestricted.

f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
h. Mechanically attach base layer of insulation and substrate board using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.

1) Fasten insulation according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

2. Install upper layers of insulation and tapered insulation, with joints of each layer offset not less than 12 inches (300 mm) from previous layer of insulation.

a. Staggered end joints within each layer not less than 24 inches (600 mm) in adjacent rows.
b. Install with long joints continuous and with end joints staggered not less than 12 inches (300 mm) in adjacent rows.
c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
e. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).
f. Trim insulation, so that water flow is unrestricted.
g. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
h. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
i. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

F. Installation Over Concrete Decks:

1. Install base layer of insulation with joints staggered not less than 24 inches (600 mm) in adjacent rows.

a. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer. Trim insulation

neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.

b. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.

c. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).

    1) Trim insulation, so that water flow is unrestricted.

d. Fill gaps exceeding 1/4 inch (6 mm) with insulation.

e. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.

f. Adhere base layer of insulation to concrete roof deck according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

    1) Prime surface of concrete deck with asphalt primer at rate of 3/4 gal./100 sq. ft. (0.3 L/sq. m), and allow primer to dry.
    2) Set insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
    3) Set insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
    4) Set insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

2. Install upper layers of insulation and tapered insulation, with joints of each layer offset not less than 12 inches (300 mm) from previous layer of insulation.

    a. Staggered end joints within each layer not less than 24 inches (600 mm) in adjacent rows.

    b. Install with long joints continuous and with end joints staggered not less than 12 inches (300 mm) in adjacent rows.

    c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.

    d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.

    e. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).

        1) Trim insulation, so that water flow is unrestricted.

    f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.

g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
h. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

G. Installation Over Lightweight Insulating Concrete Decks:

1. Mechanically fasten vented base sheet to lightweight insulating concrete roof deck, with vented side down, using mechanical fasteners specifically designed and sized for fastening to lightweight insulating concrete decks.

a. Fasten vented base sheet according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
b. Fasten vented base sheet to resist uplift pressure at corners, perimeter, and field of roof.

2. Install base layer of insulation with joints staggered not less than 24 inches (600 mm) in adjacent rows.

a. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
d. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).

1) Trim insulation, so that water flow is unrestricted.

e. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
f. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.

g. Adhere base layer of insulation to vented base sheet according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Set insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
2) Set insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
3) Set insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3. Install upper layers of insulation and tapered insulation, with joints of each layer offset not less than 12 inches (300 mm) from previous layer of insulation.

a. Staggered end joints within each layer not less than 24 inches (600 mm) in adjacent rows.
b. Install with long joints continuous and with end joints staggered not less than 12 inches (300 mm) in adjacent rows.
c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
d. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
e. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).

1) Trim insulation, so that water flow is unrestricted.

f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
h. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
2) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
3) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.06 INSTALLATION OF COVER BOARDS

A. Install cover boards over insulation with long joints in continuous straight lines, with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction.

1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
2. At internal roof drains, conform to slope of drain sump.

    a. Trim cover board, so that water flow is unrestricted.

3. Cut and fit cover board tight to nailers, projections, and penetrations.
4. Adhere cover board to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

    a. Set cover board in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
    b. Set cover board in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
    c. Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

B. Install sheathing paper over cover board and immediately beneath roof membrane.

3.07 INSTALLATION OF ROOFING MEMBRANE, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions and applicable recommendations in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."

B. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

C. Where roof slope exceeds 1/2 inch per 12 inches (1:24), install roofing membrane sheets parallel with slope.

1. Backnail roofing sheets to substrate according to roofing system manufacturer's written instructions.

D. Coordinate installation of roofing system so insulation and other components of the roofing system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.

1. Provide tie-offs at end of each day's work to cover exposed roofing sheets and insulation with a course of coated felt set in roofing cement or hot roofing asphalt, with joints and edges sealed.
2. Complete terminations and base flashings, and provide temporary seals to prevent water from entering completed sections of roofing system.
3. Remove and discard temporary seals before beginning work on adjoining roofing.

3.08 INSTALLATION OF BASE SHEET

A. Before installing, unroll base sheet, cut into workable lengths, and allow to lie flat for a time period recommended by manufacturer for the ambient temperature.

B. Loosely lay one course of sheathing paper, lapping edges and ends a minimum of 2 inches (51 mm) and 6 inches (150 mm), respectively.

C. Installation of SBS-Modified Bitumen Polyester-Mat Base Sheet:

1. Install base sheet according to roofing manufacturer's written instructions, starting at low point of roofing system.
2. Extend roofing sheets over and terminate above cants.
3. Install base sheet in a shingle fashion.
4. Adhere to substrate in a uniform coating of cold-applied adhesive.
5. Torch apply to substrate.

    a. Perform torch application according to NFPA 241, including two-hour fire watch after torches have been extinguished.

6. Mechanically attach base sheet to roof deck using mechanical fasteners specifically designed and sized for fastening base sheet to decks.

    a. Fasten base sheet to resist specified uplift pressure at corners, perimeter, and field of roof.

7. Install base sheet without wrinkles, rears, and free from air pockets.
8. Laps: Accurately align roofing sheets, without stretching, and maintain uniform side and end laps.

    a. Lap side laps as recommended by roof membrane manufacturer but not less than 3 inches (76 mm).
    b. Lap end laps as recommended by roof membrane manufacturer but not less than 12 inches (300 mm).
    c. Stagger end laps not less than 18 inches (450 mm).
    d. Completely bond and seal laps, leaving no voids.
    e. Roll laps with a 20-pound (9-kg) roller.

9. Repair tears and voids in laps and lapped seams not completely sealed.
10. Apply pressure to the body of the base sheet according to manufacturer's instructions, to remove air pockets and to result in complete adhesion of base sheet to substrate.

3.09 INSTALLATION OF INTERPLY SHEETS

A. Install three ply sheets, starting at low point of roofing.

1. Align ply sheets without stretching.
2. Shingle side laps of ply sheets uniformly to achieve required number of plies throughout thickness of roofing membrane.

    a. Shingle in direction to shed water.

3. Extend ply sheets over and terminate above cants.

3.10 INSTALLATION OF SBS-MODIFIED BITUMINOUS CAP SHEET

A. Before installing, unroll cap sheet, cut into workable lengths, and allow to lie flat for a time period recommended by manufacturer for the ambient temperature at which cap sheet will be installed.

B. Install modified bituminous roofing cap sheet according to roofing manufacturer's written instructions, starting at low point of roofing system.

1. Extend cap sheet over and terminate above cants.
2. Install cap sheet in a shingle fashion.
3. Install cap sheet as follows:

    a. Adhere to substrate in a solid mopping of hot roofing asphalt applied at asphalt temperature recommended by cap sheet manufacturer.
    b. Adhere to substrate in cold-applied adhesive.
    c. Torch apply to substrate.

        1) Perform torch application according to NFPA 241, including two-hour fire watch after torches have been extinguished.

4. Install cap sheet without wrinkles or tears, and free from air pockets.
5. Install cap sheet, so side and end laps shed water.

C. Laps: Accurately align roofing sheets, without stretching, and maintain uniform side and end laps.

1. Lap side laps as recommended by roof membrane manufacturer but not less than 3 inches (76 mm).

2. Lap end laps as recommended by roof membrane manufacturer but not less than 12 inches (300 mm).
3. Stagger end laps not less than 18 inches (450 mm).
4. Completely bond and seal laps, leaving no voids.
5. Roll laps with a 20-pound (9-kg) roller.
6. Repair tears and voids in laps and lapped seams not completely sealed.

D. Apply pressure to the body of the cap sheet according to manufacturer's instructions, to remove air pockets and to result in complete adhesion of base sheet to substrate.

E. Apply roofing granules of same color as roof membrane to cover exuded bead at laps while bead is hot, to provide a continuous color appearance.

3.11 INSTALLATION OF FLASHING AND STRIPPING

A. Install base flashing over cant strips and other sloped and vertical surfaces, at roof edges, and at penetrations through roof, and secure to substrates according to roofing system manufacturer's written instructions and as follows

1. Prime substrates with asphalt primer if required by roofing system manufacturer.
2. Backer Sheet Application:

a. Mechanically fasten backer sheet to walls or parapets.
b. Adhere backer sheet over roofing membrane at cants in a solid mopping of hot roofing asphalt.
c. Seal all laps.

3. Flashing Sheet Application: Adhere flashing sheet to substrate in a solid mopping of hot roofing asphalt applied at asphalt temperature recommended by flashing sheet manufacturer. Apply hot roofing asphalt to back of flashing sheet if recommended by roofing system manufacturer.

B. Extend base flashing up walls or parapets a minimum of 8 inches (200 mm) above roofing membrane and 4 inches (100 mm) onto field of roofing membrane.

C. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.

1. Seal top termination of base flashing with a strip of glass-fiber fabric set in asphalt roofing cement.

D. Install liquid flashing system according to manufacturer's recommendations.

1. Extend liquid flashing not less than 3 inches (76 mm) in all directions from edges of item being flashed.

2. Embed granules, matching color of roof membrane, into wet compound.

E. Install roofing cap-sheet stripping where metal flanges and edgings are set on roofing according to roofing system manufacturer's written instructions.

F. Roof Drains: Set 30-by-30-inch- (760-by-760-mm-) 4-pound (1.8 kg) lead flashing in bed of asphaltic adhesive on completed roofing membrane.

1. Cover lead flashing with roofing cap-sheet stripping, and extend a minimum of [**4 inches (100 mm)**] [**6 inches (150 mm)**] beyond edge of metal flashing onto field of roofing membrane.
2. Clamp roofing membrane, metal flashing, and stripping into roof-drain clamping ring.
3. Install stripping according to roofing system manufacturer's written instructions.

3.12 INSTALLATION OF WALKWAYS

A. Walkway Pads: Install walkway pads using units of size indicated or, if not indicated, of manufacturer's standard size, according to walkway pad manufacturer's written instructions.

1. Install walkways at the following locations:

a. Perimeter of each rooftop unit.
b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
d. Top and bottom of each roof access ladder.
e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
f. Locations indicated on Drawings.
g. As required by roof membrane manufacturer's warranty requirements.

2. Provide 3-inch (76-mm) clearance between adjoining pads.
3. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.13 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to inspect substrate conditions, surface preparation, roof membrane application, flashings, protection, and drainage components, and to furnish reports to Architect.

B. Perform the following tests:

1. Flood Testing: Flood test each roofing area for leaks, according to recommendations in ASTM D5957, after completing roofing and flashing but before overlying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.

    a. Perform tests before overlying construction is placed.
    b. Flood to an average depth of 2-1/2 inches (65 mm) with a minimum depth of 1 inch (25 mm) and not exceeding a depth of 4 inches (100 mm). Maintain 2 inches (51 mm) of clearance from top of base flashing.
    c. Flood each area for 24 hours.
    d. After flood testing, repair leaks, repeat flood tests, and make further repairs until roofing and flashing installations are watertight.

        1) Cost of retesting is the responsibility of the Contractor.

    e. Testing agency shall prepare survey report indicating locations of initial leaks, if any, and final survey report.

C. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.

1. Notify Architect and Owner 48 hours in advance of date and time of inspection.

D. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

E. Roofing system will be considered defective if it does not pass tests and inspections.

1. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.14 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period.

1. When remaining construction does not affect or endanger roofing, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.15 ROOFING INSTALLER'S WARRANTY

A. WHEREAS _____ of _____, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:

1. Owner: <**Insert name of Owner**>.
2. Address: <**Insert address**>.
3. Building Name/Type: <**Insert information**>.
4. Address: <**Insert address**>.
5. Area of Work: <**Insert information**>.
6. Acceptance Date: _____.
7. Warranty Period: <**Insert time**>.
8. Expiration Date: _____.

B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period Roofing Installer will, at Roofing Installer's own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:

a. lightning;
b. peak gust wind speed exceeding <**Insert mph (m/s)**>;
c. fire;
d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
f. vapor condensation on bottom of roofing; and
g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this _____ day of _____, _____.

1. Authorized Signature: _____.
2. Name: _____.
3. Title: _____.

END OF SECTION

07 62 00 SHEET METAL FLASHING AND TRIM

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Receivers.
2. Counter flashings.
3. Curb cap flashings.
4. Exhaust vents.
5. Drip edge.
6. Gutters and downspouts.
7. Miscellaneous sheet metal accessories.

B. Related Sections include the following:

1. Division 07 Section “Standing Seam Metal Roof Panels.”

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM):

B. National Roofing Contractor’s Association (NRCA): NRCA Roofing and Waterproofing Manual, latest edition.

C. Sheet Metal and Air Conditioning Contractor’s National Association, Inc. (SMACNA): Architectural Sheet Metal Manual, latest edition.

D. ANSI/SPRI ES-1 Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems.

1.04 WARRANTY

A. Contractor's Warranty: Provide Owner a written warranty which shall warrant sheet metal work to be free of leaks and defects in materials and workmanship for two years after date of final acceptance by owner.

B. For pre-finished metal, provide manufacturer's twenty-year guarantee covering deterioration or failure of the flouropolymer finish.

1.05 PERFORMANCE REQUIREMENTS

C. Fabricate and install sheet metal edge flashings to comply with ANSI/SPRI ES-1 requirements.

2.00 PRODUCTS

2.01 ACCEPTABLE MANUFACTURER'S

A. Accessory sheet metal components of the roofing system shall be supplied by the prime roof manufacturer. Alternate manufacturer's shall not be permitted unless pre-approved in writing by the prime roof manufacturer.

2.02 SHEET METAL MATERIAL

A. Pre-finished Metal: "Kynar 500" or "Hylar 5000" flouropolymer pre-finished G90 galvanized/galvalume sheet metal, minimum 24 gauge. "Kynar 500" or "Hylar 5000" finish shall consist of a two-coat Polyvinyladine fluoride, minimum 70 percent by weight in coatings, dry film thickness 1 mil, factory applied by metal manufacturer or supplier. Color to be selected by Owner and Architect from manufacturer's standard color chart.

B. Zinc-coated (Galvanized) Sheet Metal: Commercial Quality with 0.20 percent copper, in accordance with ASTM A 526 except ASTM A 527 for lock forming; coating designation G() hot-dip galvanized, and mill phosphatized for painting in accordance with ASTM A 525 (paint-grip type), 22 gauge minimum.

C. Stainless Steel Sheet Metal: ASTM A240, Type 304, ASTM A480, No. 2B/2D Mill Finish, gauge as scheduled.

2.03 FASTENERS

A. Fasteners shall be same metal as flashing and sheet metal being joined.

B. Exposed fasteners shall be self-sealing or gasketed for watertight installation.

C. Heads of fasteners, including but not limited to, rivets, screws, and bolts, that are exposed or visible shall have same manufactured finishes as item being secured; color to match when applicable.

D. Mechanical Fasteners:

1. Washers: Steel washers with bonded rubber sealing gasket.

2. Screws: Self-tapping sheet metal type compatible with material fastened.

3. Rivets: Stainless steel material for the stem with closed end, head of color to match sheet metal items being adjoined.

2.04 RELATED MATERIALS

A. Solder:

1. ASTM B 32, alloy grade 58, 50 percent tin, 50 percent lead.

2. For Use with Stainless Steel: 60-40 tin/lead solder, ASTM B 32.

B. Flux:

1. Phosphoric acid type, manufacturer's standard.

2. For Use with Steel or Copper: Rosin flux.

3. For Use with Stainless Steel: Acid-chloride type flux, except use rosin flux over tinned surfaces.

C. Underlayment: As specified in Division 7 Section “Standing Seam Metal Roof Panels”.

D. Adhesives: Type recommended by flashing sheet manufacturer for waterproof and weather resistant seaming and adhesive application of flashing sheet.

E. Metal Accessories: Sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of work, matching or compatible with material being installed, noncorrosive, size and gauge required for performance.

2.05 FABRICATION – GENERAL

A. Fabricate work in accordance with SMACNA Architectural Sheet Metal Manual and other recognized industry practices and approved shop drawings.

B. Comply with material manufacturer's instructions and recommendations for forming material.

C. Shop fabricate work to greatest extent possible. Fabricate inside and outside corners for metal edge flashings and copings from single piece with equal length legs, minimum 3 feet. Notch, lap, and seam inside and outside corners of counter flashings.

D. Fabricate for waterproof and weather resistant performance with expansion provisions for running work sufficient to permanently prevent leakage, damage, or deterioration of work. Form work to fit substrates.

E. Make angle bends and folds for interlocking metal with full regard for expansion and contraction to avoid buckling.

F. Form materials with straight lines, sharp angles, smooth curves, and true levels. Avoid tool marks, buckling, and oil canning.

G. Fold back edges of exposed ends of sheet metal edge to form hem, 6-inch minimum.

H. Lap joints 1-inch (25mm) minimum. Rivet and solder joints on parts that are to be permanently and rigidly assembled for copper, stainless, aluminum, and galvanized sheet metal. Install rivets, spaced 1-inch (25mm) on-center and apply solder to secure and seal exposed edge of sheet metal in a uniform continuous bead with smooth top finish. Clean residue upon completion of soldering process. Fabricate sheet metal assemblies so that adjoining sections are nested to achieve continuous metal-to-metal contact.

I. Seams:

1. Fabricate non-moving seams in sheet metal with flat-lock seams.

2. Pre-finished Galvanized Sheet metal: Seal pre-finished metal seams with rivets, spaced 1-inch (25mm) on-center, and silicone sealant, color to match metal finish.

3. Metal Other than Aluminum: Tin edges to be seamed, form seams, and solder.

J. Expansion Provisions: Where lapped or bayonet type expansion provisions in work cannot be used or would not be sufficiently waterproof or weatherproof, form expansion joints of intermeshing hooked flanges, not less than 1-inch deep, filled with sealant concealed within joints.

2.06 FABRICATED ITEMS

A. Receivers & Counter flashings: Minimum 24-gauge prefinished or stainless steel sheet metal formed in maximum 10 foot (3m) lengths; fabricate “S”-shaped receiver to engage counter flashing a minimum of 1-inch; fabricate counter flashing with broken fascia of length to extend over top edge of base flashing a minimum of 4-inches with ó-inch hemmed drip edge.

B. Cleats/Clips:

1. Concealed Cleats/Clips: Continuous strips, 22 gauge sheet metal, same metal type and fascia profile as adjacent metal item, with a 3/4-inch drip edge formed at a 30 degree angle with vertical wall.

2. Exposed Cleats/Clips: 24 gauge prefinished or stainless steel sheet metal.

C. Drip Edge: 24 gauge pre-finished sheet metal with 6-inch wide cover plates of same material/profile. Form 3/4-inch drips with 5/8-inch returns at 30-degree angle with vertical wall at bottom end of both interior and exterior fascias.

D. Gutters and Downspouts: 24 gauge pre-finished sheet metal with straps of the same material/profile.

E. Curb Cap Flashing: 24 gauge stainless steel sheet metal with 4-inch vertical fascias.

3.00 EXECUTION

3.01 EXAMINATION

A. Verify that substrates are smooth and clean to extent needed for sheet metal work.

B. Verify that reglets, nails, cants, and blocking to receive sheet metal are installed and free of debris.

C. Do not start sheet metal work until conditions are satisfactory.

3.02 INSTALLATION

A. Install sheet metal with lines, arises, and angles sharp and true, and plane surfaces free from objectionable wave, warp, or buckle. Exposed edges of sheet metal shall be folded back to form 1/4-inch hem on concealed side from view. Finished work shall be free from water retention and leakage under all weather conditions. Install prefabricated corners or transitions at changes in direction, elevation or plane, and at intersections. Locate field joints not less than 12-inches, not more than 3 feet from actual corner. Laps for all metals, except for prefinished metal, shall be 1-inch wide, fastened with rivets spaced 1-inch on-center and soldered.

B. Anchor units of work securely in place to prevent damage or distortion from wind or buckling. Provide for thermal expansion of metal units; conceal fasteners where possible; and set units true to line and level as indicated. Install work with laps, joints, and seams permanently watertight and weatherproof.

C. Install fabricated sheet metal items in accordance with manufacturer's installation instructions and recommendations and with SMACNA Architectural Sheet Metal Manual.

D. Separations: Provide for separation of metal from non-compatible metal or corrosive substrates by coating affected surfaces with zinc chromate or other permanent liquid-applied or sheet product separation at locations of contact.

E. Continuous Cleat: At exposed edges of metal edge flashings, fascias, copings, and where required, attach continuous cleat at 6-inches on-center with appropriate fasteners metal or steel substrate. At a distance of 10 feet from each direction of corner, install fasteners spaced 3-inches on-center. Install cleat so fascia extends a minimum of 1-inch below top of exterior wall finish.

F. Counter flashings:

1. Install counter flashings under equipment housing flanges and receivers along rise or parapet walls to extend a minimum of 4-inches below top edge of base flashing.

2. Secure counter flashing at 6-inches on-center with self-tapping screws.

3. Saw-cut reglet mounted assemblies: Saw cut new joint, 1/2-inch X 1-inch deep, in masonry/concrete where required and to install new receiver. Clean and prepare joint surfaces to receive sealant and insert receiver into joint. Secure new receiver in place with lead wedges spaced 12-inches on-center wedged into joint. Install backer rod into saw-cut reglet and apply a continuous bead of sealant along reglet and top edge of receiver and tool sealant to provide outward sloping finished surface. Secure counter flashing to receiver utilizing self-tapping grommetted screws spaced 6-inches on-center.

4. Surface-mounted assemblies: Secure 2-piece surface-mounted receiver and counter flashing assemblies along substrates. Install sealant tape between receiver and substrate. Secure receiver to substrate with termination bar and appropriate fasteners spaced 12-inches o.c. Install a continuous bead of sealant along caulk trough/top edge of receiver and tool sealant to provide outward sloping finished surface. Secure counter flashing to receiver utilizing grommetted self-tapping screws spaced 6-inches on-center.

5. Install receivers extending behind wall finish and secure vertical flange of receiver 6-inches on-center to back-up wall or metal wall panels. Extend underlayment and/or dampproofing material over vertical flange of receiver, where applicable.

6. Lap adjacent sections of receivers and counter flashings a minimum of 4-inches. Apply a continuous bead of sealant in lap.

7. Secure counter flashing to equipment flanges utilizing self-tapping screws spaced 6-inches on-center.

8. Install wind clips to termination bar spaced 24-inches on-center and engage drip edge of counter flashing a minimum of 1/2-inch.

9. Fabricate the counter flashing to form an integral closure at terminations.

3.03 CLEANING

A. Remove flux and residual acid immediately by neutralizing with baking soda and washing with clean water. Leave work clean and free of stains, scrap, and debris.

B. Clean exposed metal surfaces, removing substances which might cause corrosion of metal or deterioration/damage of finishes. Paint (color to match) areas of prefinished metal where finish is damaged. Replace sheet metal items when damaged finish can not be repaired to an acceptable condition.

C. Prime soldered area of phosphatized metal after cleaning to prevent rusting.

END OF SECTION

07 92 00 JOINT SEALANTS

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Silicone joint sealants.

B. Related Requirements:

1. Section 321373 "Concrete Paving Joint Sealants" for sealing joints in paved roads, parking lots, walkways, and curbing.

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

IF NEEDED, INSERT LIST OF CONFERENCE PARTICIPANTS NOT MENTIONED IN SECTION 013100 "PROJECT MANAGEMENT AND COORDINATION."

1.04 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Product Test Reports: For each kind of joint sealant, for tests performed by a qualified testing agency.

C. Preconstruction Laboratory Test Schedule: Include the following information for each joint sealant and substrate material to be tested:

1. Joint-sealant location and designation.
2. Manufacturer and product name.
3. Type of substrate material.
4. Proposed test.
5. Number of samples required.

D. Preconstruction Laboratory Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.

2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.

E. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

F. Field-Adhesion-Test Reports: For each sealant application tested.

G. Sample Warranties: For special warranties.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: Qualified according to ASTM C1021 to conduct the testing indicated.

C. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.07 PRECONSTRUCTION TESTING

A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Adhesion Testing: Use ASTM C794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

2. Compatibility Testing: Use ASTM C1087 to determine sealant compatibility when in contact with glazing and gasket materials.

3. Stain Testing: Use ASTM C1248 to determine stain potential of sealant when in contact with concrete substrates.

4. Submit manufacturer's recommended number of pieces of each type of material, including joint substrates, joint-sealant backings, and miscellaneous materials.

5. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.

6. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.

7. Testing will not be required if joint-sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, staining of, and compatibility with joint substrates and other materials matching those submitted.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:

1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.

2. Conduct field tests for each kind of sealant and joint substrate.

3. Notify Architect seven days in advance of dates and times when test joints will be erected.

4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.

    a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.

        1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.

6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.08 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).

2. When joint substrates are wet.

3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.

4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.09 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.

2. Disintegration of joint substrates from causes exceeding design specifications.

3. Mechanical damage caused by individuals, tools, or other outside agents.

4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

2.00 PRODUCTS

2.01 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: [As indicated by manufacturer's designations] [Match Architect's samples] [As selected by Architect from manufacturer's full range].

2.02 SILICONE JOINT SEALANTS

A. Silicone, S, NS, 100/50, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Dow Corning Corporation; 790.

b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.

c. May National Associates, Inc.; Bondaflex Sil 290.

d. Pecora Corporation; 301 NS.

e. Sika Corporation, Construction Products Division; SikaSil-C990.

f. Tremco Incorporated; Spectrem 1

2.03 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Adfast.

b. Alcot Plastics Ltd.

c. BASF Corporation.

B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.04 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

3.00 EXECUTION

3.01 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

    a. Concrete.

    b. Masonry.

    c. Unglazed surfaces of ceramic tile.

3. Remove laitance and form-release agents from concrete.

4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

a. Metal.

b. Glass.

c. Porcelain enamel.

d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.

2. Do not stretch, twist, puncture, or tear sealant backings.

3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.

2. Completely fill recesses in each joint configuration.

3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.

2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

3. Provide concave joint profile per Figure 8A in ASTM C1193 unless otherwise indicated.

3.04 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:

a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.

b. Perform one test for each 1000 feet (300 m) of joint length thereafter or one test per each floor per elevation.

2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.

a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

3. Inspect tested joints and report on the following:

a. Whether sealants filled joint cavities and are free of voids.

b. Whether sealant dimensions and configurations comply with specified requirements.

c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.

4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.

5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.05 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.06 PROTECTION

Joint Sealants

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.07 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

a. Construction joints in cast-in-place concrete.

b. Joints between plant-precast architectural concrete units.

c. Joints between metal panels.

d. Joints between different materials listed above.

e. Perimeter joints between materials listed above and frames of doors windows and louvers.

f. Control and expansion joints in ceilings and other overhead surfaces.

g. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

B. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

a. Control and expansion joints on exposed interior surfaces of exterior walls.

b. Tile control and expansion joints.

c. Vertical joints on exposed surfaces of unit masonry and concrete walls and partitions.

d. Other joints as indicated on Drawings.

2. Joint Sealant: Acrylic based.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

C. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

a. Joints between plumbing fixtures and adjoining walls, floors, and counters.

b. Tile control and expansion joints where indicated.

c. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION

DIVISION 8

OPENINGS

08 11 13 HOLLOW METAL DOORS AND FRAMES

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes:

1. Interior standard steel doors and frames.
2. Exterior standard steel doors and frames.

B. Related Requirements:
1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

1.03 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or ANSI/SDI A250.8.

1.04 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.05 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.06 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, temperature-rise ratings, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door type.

2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
7. Details of anchorages, joints, field splices, and connections.
8. Details of accessories.
9. Details of moldings, removable stops, and glazing.

C. Samples for Verification:

1. Finishes: For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches (75 by 127 mm).
2. Fabrication: Prepare Samples approximately 12 by 12 inches (305 by 305 mm) to demonstrate compliance with requirements for quality of materials and construction:

    a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
    b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.

D. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.07 INFORMATIONAL SUBMITTALS

A. Qualification Data: For door inspector.

1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, Section 5.2.3.1.
2. Egress Door Inspector: Submit documentation of compliance with NFPA 101, Section 7.2.1.15.4.
3. Submit copy of DHI Fire and Egress Door Assembly Inspector (FDAI) certificate.

B. Product Test Reports: For each type of fire-rated hollow-metal door and frame assembly, fire-rated borrowed-lite assembly and windborne-debris impact resistance door for tests performed by a qualified testing agency indicating compliance with performance requirements.

C. Oversize Construction Certification: For assemblies required to be fire-rated and exceeding limitations of labeled assemblies.

D. Field quality control reports.

1.08 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

2.00 PRODUCTS

2.01 MANUFACTURERS

1. Airtec Corporation.
2. Apex Industries, Inc.
3. Baron Metal Industries Inc.; an Assa Abloy Group company.
4. Ceco Door; ASSA ABLOY.
5. Concept Frames, Inc.
6. Curries Company; ASSA ABLOY.
7. Custom Metal Products.
8. Daybar Industries, Ltd.
9. DCI Hollow Metal.
10. DE LA FONTAINE.
11. Deansteel Manufacturing Company, Inc.
12. Deronde Products.
13. DKS Steel Door & Frame Systems, Inc.
14. Fleming Door Products Ltd.; Assa Abloy Group Company.
15. Gensteel Doors, Inc.
16. HMF Express, LLC.
17. Hollow Metal Inc.

18. Hollow Metal Xpress.
19. JR Metal Frames Manufacturing, Inc.
20. Karpen Steel Custom Doors & Frames.
21. L.I.F. Industries, Inc.
22. LaForce, Inc.
23. Megamet Industries, Inc.
24. Mesker Door Inc.
25. Metropolitan Door Industries Corp.
26. Michbi Doors Inc.

2.02 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
3. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.

B. Fire-Rated, Borrowed-Lite Assemblies: Assemblies complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

C. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 3 for enhanced protection.

1. Large-Missile Test: For glazed openings located within 30 feet (9.1 m) of grade.

2.03 INTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B.

1. Doors:

    a. Type: As indicated in the Door and Frame Schedule.
    b. Thickness: 1-3/4 inches (44.5 mm).
    c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch (1.0 mm).
    d. Edge Construction: Model 1, Full Flush.
    e. Edge Bevel: Bevel lock and hinge edges 1/8 inch in 2 inches (3.2 mm in 51 mm).
    f. Core: Vertical steel stiffener.
    g. Fire-Rated Core: Manufacturer's standard vertical steel stiffener core for fire-rated and temperature-rise-rated doors.

2. Frames:

    a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
    b. Sidelite Frames: Fabricated from same thickness material as adjacent door frame.
    c. Construction: Full profile welded.

3. Exposed Finish: Prime.

2.04 EXTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B.

1. Doors:

    a. Type: As indicated in the Door and Frame Schedule.
    b. Thickness: 1-3/4 inches (44.5 mm).
    c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch (1.0 mm), with minimum A60 (ZF180) coating.
    d. Edge Construction: Model 1, Full Flush.
    e. Edge Bevel: Bevel lock and hinge edges 1/8 inch in 2 inches (3.2 mm in 51 mm).
    f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
    g. Bottom Edges: Close bottom edges of doors with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
    h. Core: Vertical steel stiffener.
    i. Fire-Rated Core: Manufacturer's standard vertical steel stiffener with insulation core for fire-rated doors.

2. Frames:

   a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A60 (ZF180) coating.
   b. Construction: Full profile welded.

3. Exposed Finish: Prime.

2.05 BORROWED LITES

A. Fabricate of metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm).

B. Construction: Full profile welded.

C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.

D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2.06 FRAME ANCHORS

A. Jamb Anchors:
   1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.

   2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches (610 mm) of frame height above 7 feet (2.1 m).
   3. Postinstalled Expansion Anchor: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at top of underlayment.

D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

   1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized according to ASTM A153/A153M, Class B.

2.07 MATERIALS

A. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.

B. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.

C. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

D. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

E. Glazing: Comply with requirements in Section 088000 "Glazing."

2.08 FABRICATION

A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

1. Sidelite Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to ANSI/SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

D. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted hairline joints.

1. Provide stops and moldings flush with face of door, and with square stops unless otherwise indicated.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

2.09 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.10 LOUVERS

A. Provide louvers for interior doors, where indicated, which comply with SDI 111, with blades or baffles formed of 0.020-inch- (0.5-mm-) thick, cold-rolled steel sheet set into 0.032-inch- (0.8-mm-) thick steel frame.

1. Sightproof Louver: Stationary louvers constructed with inverted-V or inverted-Y blades.

B. Form corners of moldings with hairline joints. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.

3.00 EXECUTION

3.01 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.02 INSTALLATION

A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.

B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.

    a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
    b. Install frames with removable stops located on secure side of opening.

2. Fire-Rated Openings: Install frames according to NFPA 80.
3. Floor Anchors: Secure with postinstalled expansion anchors.

    a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

4. Solidly pack mineral-fiber insulation inside frames.
5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:

    a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.

1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8.
2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.03 REPAIR

A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

C. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION

08 33 23 OVERHEAD COILING DOORS

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Insulated service doors.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for miscellaneous steel supports, door-opening framing, corner guards, and bollards.

1.03 ACTION SUBMITTALS

A. Product Data: For each type and size of overhead coiling door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.

2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

3. Include description of automatic-closing device and testing and resetting instructions.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, and mounting details.

2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.

3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.

4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.

5. Show locations of controls, locking devices, detectors or replaceable fusible links, and other accessories.

6. Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.

1. Include similar Samples of accessories involving color selection.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing and inspecting agency.

B. Sample Warranty: For special warranty.

1.05 CLOSEOUT SUBMITTALS

A. Special warranty.

B. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

C. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

1.07 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

2.00 PRODUCTS

2.01 MANUFACTURERS

A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.

1. Obtain operators and controls from overhead coiling-door manufacturer.

2.02 PERFORMANCE REQUIREMENTS

B. Structural Performance, Exterior Doors: Capable of withstanding the following design wind loads:

1. Design Wind Load: As indicated on Drawings.

2. Testing: According to ASTM E330/E330M or DASMA 108 for garage doors and complying with acceptance criteria of DASMA 108.

3. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.

4. Operability under Wind Load: Design overhead coiling doors to remain operable under uniform pressure (velocity pressure) of 20-lbf/sq. ft. (960-Pa) wind load, acting inward and outward.

C. Windborne-Debris Impact Resistance: Provide impact-protective overhead coiling doors that pass ASTM E1886 missile-impact and cyclic-pressure tests according to ASTM E1996 for Wind Zone 3.

1. Large-Missile Test: For overhead coiling doors located within 30 feet (9.1 m) of grade.

2.03 DOOR ASSEMBLY H

A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Basis of Design Product: Overhead Coiling Stormtite Insulated Service Doors: Overhead Door Corporation Model 625.

b. ACME Rolling Doors.

c. Advanced Door Technologies.

d. Clopay Building Products.

e. Cookson Company.

f. Cornell.

g. McKeon Rolling Steel Door Company, Inc.

h. Southwestern Rolling Steel Door Co.

B. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

1. Include tamperproof cycle counter.

C. Air Infiltration: Maximum rate of 1.0 cfm/sq. ft. (5.1 L/s per sq. m) at 15 and 25 mph (24.1 and 40.2 km/h) when tested according to ASTM E283.

D. Curtain R-Value: 7.70 deg F x h x sq. ft./Btu (1.35 K x sq. m/W).

E. Door Curtain Material: Galvanized steel.

F. Door Curtain Slats: Flat profile slats of 2-5/8-inch (67-mm) center-to-center height.

1. Insulated-Slat Interior Facing: Metal.

2. Gasket Seal. Manufacturer's standard continuous gaskets between slats.

G. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch (38 by 38 by 3 mm) thick; fabricated from hot-dip galvanized steel and finished to match door.

H. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.

I. Hood: Match curtain material and finish.

1. Shape: Round.

2. Mounting: Face of wall.

J. Locking Devices: Equip door with slide bolt for padlock and chain lock keeper.

1. Locking Device Assembly: Single-jamb side locking bars, operable from inside and outside with cylinders.

K. Electric Door Operator:

1. Usage Classification: Heavy duty, 25 or more cycles per hour and more than 90 cycles per day.

2. Operator Location: Wall.

3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet (2.44 m) or lower.

4. Motor Exposure: Exterior, wet, and humid.

5. Motor Electrical Characteristics:

a. Horsepower: [**1/2**] [**1**] [**2**] [**3**] <**Insert value**> hp.

b. Voltage: [**115-V ac**] [**208-V ac**] [**230-V ac**], single phase, 60 Hz.

c. Voltage: [**208-V ac**] [**230-V ac**] [**460-V ac**], three phase, 60 Hz.

6. Emergency Manual Operation: Chain type.

7. Obstruction-Detection Device: Automatic photoelectric sensor.

8. Control Station(s): Interior mounted.

L. Curtain Accessories: Equip door with weatherseals.

M. Door Finish:

1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.

2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.04 MATERIALS, GENERAL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.05 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural-steel sheet; complying with ASTM A653/A653M, with G90 (Z275) zinc coating; nominal sheet thickness (coated) of 0.028 inch (0.71 mm); and as required.

2. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E84 or UL 723. Enclose insulation completely within slat faces.

3. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum steel thickness of 0.010 inch (0.25 mm).

B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.

2.06 HOODS

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Galvanized Steel: Nominal 0.028-inch- (0.71-mm-) thick, hot-dip galvanized-steel sheet with G90 (Z275) zinc coating, complying with ASTM A653/A653M.

2.07 LOCKING DEVICES

A. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

1. Lock Cylinders: As specified in Section 087100 "Door Hardware" and keyed to building keying system.

2. Keys: Three for each cylinder.

B. Chain Lock Keeper: Suitable for padlock.

C. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.08 CURTAIN ACCESSORIES

A. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.

1. At door head, use 1/8-inch- (3-mm-) thick, replaceable, continuous-sheet baffle secured to inside of hood or field-installed on the header.

2. At door jambs, use replaceable, adjustable, continuous, nylon brushes.

2.09 COUNTERBALANCE MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless or welded carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. (2.5 mm/m) of span under full load.

C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.

D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.10 ELECTRIC DOOR OPERATORS

A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake,

clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

1. Comply with NFPA 70.

2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.

B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

C. Door Operator Location(s): Operator location indicated for each door.

1. Wall Mounted: Operator is mounted to the inside front wall on the left or right side of door and connected to door drive shaft with drive chain and sprockets. Side room is required for this type of mounting. Wall-mounted operator can also be mounted above or below shaft; if above shaft, headroom is required.

D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated for each door assembly.

1. Electrical Characteristics: Minimum as indicated for each door assembly. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. (203 mm/s) and not more than 12 in./sec. (305 mm/s), without exceeding nameplate ratings or service factor.

2. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.

3. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.

E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

F. Obstruction-Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel.

1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.

a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring

feature is activated, door closes only with sustained or constant pressure on close button.

G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."

1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.

H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf (111 N).

I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

2.11 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.12 STEEL AND GALVANIZED-STEEL FINISHES

A. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

3.00 EXECUTION

3.01 EXAMINATION

A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Examine locations of electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.

C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with the accessibility standard.

D. Power-Operated Doors: Install according to UL 325.

3.03 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

2. After electrical circuitry has been energized, operate doors to confirm proper motor rotation and door performance.

3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.04 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

1. Adjust exterior doors and components to be weather resistant.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust seals to provide tight fit around entire perimeter.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION

08 42 13 ALUMINUM-FRAMED ENTRANCES

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Manual-swing entrance doors.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For aluminum-framed entrances. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.

2. Include full-size isometric details of each type of vertical-to-horizontal intersection of aluminum-framed entrances, showing the following:

a. Joinery, including concealed welds.

b. Anchorage.

c. Expansion provisions.

d. Glazing.

e. Flashing and drainage.

3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

4. Include point-to-point wiring diagrams showing the following:

   a. Power requirements for each electrically operated door hardware.

   b. Location and types of switches, signal device, conduit sizes, and number and size of wires.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

E. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch (300-mm) lengths of full-size components and showing details of the following:

1. Joinery, including concealed welds.

2. Anchorage.

3. Expansion provisions.

4. Glazing.

5. Flashing and drainage.

F. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Energy Performance Certificates: For aluminum-framed entrances, accessories, and components, from manufacturer.

1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance.

C. Product Test Reports: For aluminum-framed entrances.

D. Field quality-control reports.

E. Sample Warranties: For special warranties.

1.05 CLOSEOUT SUBMITTALS

A. Maintenance Data: For aluminum-framed entrances to include in maintenance manuals.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Testing Agency Qualifications: Qualified according to ASTM E699 for testing indicated.

1.07 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D2244.

b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.

c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: Five years from date of Substantial Completion.

2.00 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Basis of Design Product: Kawneer 350T Thermal and Impact Resistant Entrance Door System.

2. EFCO Corporation.

3. Oldcastle BuildingEnvelope™.

4. Pittco Architectural Metals, Inc.

5. Trulite Glass & Aluminum Solutions, LLC.

6. Tubelite Inc.

7. U.S. Aluminum; a brand of C.R. Laurence.

B. Source Limitations: Obtain all components of aluminum-framed entrance, including framing and accessories, from single manufacturer.

2.02 PERFORMANCE REQUIREMENTS

A. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

B. Structural Loads:

1. Wind Loads: As indicated on Drawings.

C. Structural: Test according to ASTM E330/E330M as follows:

1. When tested at positive and negative wind-load design pressures, entrance doors do not evidence deflection exceeding specified limits.

2. When tested at 150 percent of positive and negative wind-load design pressures, entrance doors, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.

3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

D. Air Infiltration: Test according to ASTM E283 for infiltration as follows:

1. Entrance Doors:

a. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. (2.54 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).

E. Water Penetration under Static Pressure: Test according to ASTM E331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas of entrance doors when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).

F. Energy Performance: Certify and label energy performance according to NFRC as follows:

1. Thermal Transmittance (U-factor): Fixed glazing and framing areas as a system shall have U-factor of not more than 0.52 Btu/sq. ft. x h x deg F as determined according to NFRC 100.

2. Solar Heat Gain Coefficient (SHGC): Fixed glazing and framing areas as a system shall have a SHGC of no greater than [**0.26**] [**0.35**] [**0.40**] [**0.45**] <**Insert value**> as determined according to NFRC 200.

3. Condensation Resistance: Fixed glazing and framing areas as a system shall have an NFRC-certified condensation resistance rating of no less than 49 frame and 69 glass as determined according to NFRC 500.

G. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 3 for basic protection.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.

H. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.03 ENTRANCE DOOR SYSTEMS

A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.

1. Door Construction: 2- to 2-1/4-inch (50.8- to 57.2-mm) overall thickness, with minimum 0.125-inch- (3.2-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.

a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior .

2. Door Design: Medium stile; 3-1/2-inch (88.9-mm) nominal width.

3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.

a. Provide nonremovable glazing stops on outside of door.

B. Framing Members: Manufacturer's standard extruded aluminum, minimum 0.125 inch (3.2 mm) thick and reinforced as required to support imposed loads.

C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

E. Materials:

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

a. Sheet and Plate: ASTM B209 (ASTM B209M).

b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).

c. Extruded Structural Pipe and Tubes: ASTM B429/B429M.

d. Structural Profiles: ASTM B308/B308M.

2. Steel Reinforcement:

a. Structural Shapes, Plates, and Bars: ASTM A36/A36M.

b. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.

c. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

d. Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.

2.04 ENTRANCE DOOR HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."

2.05 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

C. Glazing Sealants: Comply with Section 088000 "Glazing."

2.06 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.

2. Reinforce members as required to receive fastener threads.

3. Use exposed fasteners with countersunk Phillips screw heads, fabricated from 300 series stainless steel.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch (25.4 mm) that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M or ASTM A153/A153M requirements.

C. Concealed Flashing: Dead-soft, 0.018-inch- (0.457-mm-) thick stainless steel, complying with ASTM A240/A240M, of type recommended by manufacturer.

D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

E. Rigid PVC Filler.

2.07 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.

2. Accurately fitted joints with ends coped or mitered.

3. Physical and thermal isolation of glazing from framing members.

4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.

5. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

1. At interior and exterior doors, provide compression weather stripping at fixed stops.

E. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.

2. At exterior doors, provide weather sweeps applied to door bottoms.

F. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.08 ALUMINUM FINISHES

A. High-Performance Organic Finish: Three-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 50 percent PVDF or FEVE resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

3.00 EXECUTION

3.01 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.

2. Do not install damaged components.

3. Fit joints to produce hairline joints free of burrs and distortion.

4. Rigidly secure nonmovement joints.

5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

6. Seal perimeter and other joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or installing nonconductive spacers.

2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation.

D. Install components plumb and true in alignment with established lines and grades.

E. Install glazing as specified in Section 088000 "Glazing."

F. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.

2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.03 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Field Quality-Control Testing: Perform the following test on aluminum-framed entrances.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

2. Air Infiltration: ASTM E783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. (0.45 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).

3. Water Penetration: ASTM E1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft. (300 Pa), and shall not evidence water penetration.

C. Aluminum-framed entrances will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION

SECTION 084413 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Conventionally glazed aluminum curtain walls.

B. Related Requirements:
1. Section 079200 "Joint Sealants" for installation of joint sealants installed with glazed aluminum curtain walls and for sealants to the extent not specified in this Section.
2. Section 088000 "Glazing" for curtain wall glazing.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For glazed aluminum curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
2. Include full-size isometric details of each type of vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:

a. Joinery, including concealed welds.
b. Anchorage.
c. Expansion provisions.
d. Glazing.
e. Flashing and drainage.

3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch (300-mm) lengths of full-size components and showing details of the following:

1. Joinery, including concealed welds.
2. Anchorage.
3. Expansion provisions.
4. Glazing.
5. Flashing and drainage.

E. Delegated-Design Submittal: For glazed aluminum curtain walls, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Preconstruction Laboratory Mockup Testing Submittals:

1. Testing Program: Developed specifically for Project.
2. Test Reports: Prepared by a qualified preconstruction testing agency for each mockup test.
3. Record Drawings: As-built drawings of preconstruction laboratory mockups showing changes made during preconstruction laboratory mockup testing.

B. Qualification Data:

1. For Installer and laboratory mockup testing agency.
2. For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the state in which Project is located.

C. Energy Performance Certificates: For glazed aluminum curtain walls, accessories, and components from manufacturer.

1. Basis for Certification: NFRC-certified energy performance values for each glazed aluminum curtain wall.

D. Product Test Reports: For glazed aluminum curtain walls, for tests performed by manufacturer and witnessed by a qualified testing agency.

E. Quality-Control Program: Developed specifically for Project, including fabrication and installation, according to recommendations in ASTM C1401. Include periodic quality-control reports.

F. Source quality-control reports.

G. Field quality-control reports.

H. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For glazed aluminum curtain walls to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Laboratory Mockup Testing Agency Qualifications: Qualified according to ASTM E699 for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025.

C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.8 MOCKUPS

A. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical wall area as shown on Drawings.
2. Testing shall be performed on mockups according to requirements in "Field Quality Control" Article.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 WARRANTY

A. Special Assembly Warranty: Manufacturer agrees to repair or replace components of glazed aluminum curtain wall that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Structural failures including, but not limited to, excessive deflection.
    b. Noise or vibration created by wind and thermal and structural movements.
    c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
    d. Water penetration through fixed glazing and framing areas.
    e. Failure of operating components.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked enamel, powder coat, or organic finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

    a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
    b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
    c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazed aluminum curtain walls.

B. General Performance: Comply with performance requirements specified, as determined by testing of glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Glazed aluminum curtain walls shall withstand movements of supporting structure, including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

    a. Thermal stresses transferring to building structure.
    b. Glass breakage.
    c. Noise or vibration created by wind and thermal and structural movements.
    d. Loosening or weakening of fasteners, attachments, and other components.
    e. Failure of operating units.

C. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.

D. Deflection of Framing Members: At design wind pressure, as follows:

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans of greater than 13 feet 6 inches (4.1 m) or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.

E. Structural: Test according to ASTM E330/E330M as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

F. Air Infiltration: Test according to ASTM E283 for infiltration as follows:

1. Fixed Framing and Glass Area:

a. Maximum air leakage of 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 6.24 lbf/sq. ft. (300 Pa).

G. Water Penetration under Static Pressure: Test according to ASTM E331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 12 lbf/sq. ft. (575 Pa).

H. Water Penetration under Dynamic Pressure: Test according to AAMA 501.1 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 12 lbf/sq. ft. (575 Pa).

I. Energy Performance: Certify and label energy performance according to NFRC as follows:

1. Thermal Transmittance (U-factor): Fixed glazing and framing areas as a system shall have U-factor of not more than 0.50 Btu/sq. ft. x h x deg F (2.84 W/sq. m x K) as determined according to NFRC 100.
2. SHGC: Fixed glazing and framing areas as a system shall have a SHGC of no greater than **[0.22]** **[0.25]** **[0.26]** **[0.29]** **[0.40]** **[0.45]** <**Insert value**> as determined according to NFRC 200.

3. Condensation Resistance: Fixed glazing and framing areas as a system shall have an NFRC-certified condensation resistance rating of no less than **[29] [35] [45] [55] [65] [80] <Insert value>** as determined according to NFRC 500.

J. Windborne-Debris Impact Resistance: Pass ASTM E1886 missile-impact and cyclic-pressure tests according to ASTM E1996 for Wind Zone 3 for basic protection.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.

K. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.

a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F (82 deg C).
b. Low Exterior Ambient-Air Temperature: 0 deg F (minus 18 deg C).

2.2 SOURCE LIMITATIONS

A. Obtain all components of curtain-wall system and storefront system, including framing spandrel panels entrances and accessories, from single manufacturer.

2.3 GLAZED ALUMINUM CURTAIN WALL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Basis of Design Product: 1600 Wall System™1 IR Curtain Wall – 2-1/2" (63.5), outside glazed pressure plate format. System depth: 7-13/16" (198.4) for 1-5/16" (33.3) insulating glazing.

2. EFCO Corporation.
3. Graham Architectural Products Corporation.
4. Oldcastle, Inc.
5. Pittco Architectural Metals, Inc.
6. Trulite Glass & Aluminum Solutions, LLC.
7. Tubelite Inc.
8. U.S. Aluminum; a brand of C.R. Laurence.
9. Wausau Window and Wall Systems; Apogee Wausau Group, Inc.

B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: Front.
4. Finish: Superior-performance organic finish.
5. Fabrication Method: Field-fabricated stick system.
6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
7. Steel Reinforcement: As required by manufacturer.

C. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.

1. Include snap-on aluminum trim that conceals fasteners.

D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

E. Glazing: As specified in Section 088000 "Glazing".

F. Entrance Door Systems: Comply with Section 084213 "Aluminum-Framed Entrances".

2.4 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

2.5 MATERIALS

A. Sheet and Plate: ASTM B209 (ASTM B209M).

B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).

C. Extruded Structural Pipe and Tubes: ASTM B429/B429M.

D. Structural Profiles: ASTM B308/B308M.

E. Steel Reinforcement:

1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

F. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.

2.6 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads, fabricated from 300 series stainless steel.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch (25.4 mm) that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M or ASTM A153/A153M requirements.

C. Concealed Flashing: Dead-soft, 0.018-inch- (0.457-mm-) thick stainless steel, ASTM A240/A240M of type recommended by manufacturer.

D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

2.7 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from exterior.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
7. Components curved to indicated radii.

D. Fabricate components to resist water penetration as follows:

1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
2. Pressure-equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.

E. Curtain-Wall Framing: Fabricate components for assembly using manufacturer's standard assembly method.

F. Factory-Assembled Frame Units:

1. Rigidly secure nonmovement joints.
2. Prepare surfaces that are in contact with structural sealant according to sealant manufacturer's written instructions, to ensure compatibility and adhesion.
3. Preparation includes, but is not limited to, cleaning and priming surfaces.
4. Seal joints watertight unless otherwise indicated.
5. Install glazing to comply with requirements in Section 088000 "Glazing."

G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.8 ALUMINUM FINISHES

A. Superior-Performance Organic Finish, Three-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions, to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

3.3 INSTALLATION, GENERAL

A. Comply with manufacturer's written instructions.

B. Do not install damaged components.

C. Fit joints to produce hairline joints free of burrs and distortion.

D. Rigidly secure nonmovement joints.

E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

F. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.

G. Seal joints watertight unless otherwise indicated.

H. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

I. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

J. Install components plumb and true in alignment with established lines and grades.

3.4 INSTALLATION OF GLAZING

A. Install glazing as specified in Section 088000 "Glazing."

1. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions, to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

3.5 INSTALLATION OF WEATHERSEAL SEALANT

A. Install weatherseal sealant according to Section 079200 "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

3.6 ERECTION TOLERANCES

A. Install glazed aluminum curtain walls to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
3. Alignment:

    a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
    b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
    c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).

4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm) over total length.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Test Area: Perform tests on one bay at least 30 feet (9.1 m), by one story.

C. Field Quality-Control Testing: Perform the following test on representative areas of glazed aluminum curtain walls.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

    a. Perform a minimum of three tests in areas as directed by Architect.

2. Air Infiltration: ASTM E783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. (0.45 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).

    a. Perform a minimum of three tests in areas as directed by Architect.

3. Water Penetration: ASTM E1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft. (300 Pa), and shall not evidence water penetration.

D. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 084413

08 45 23 FIBERGLASS-SANDWICH-PANEL ASSEMBLIES

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes aluminum-framed assemblies incorporating fiberglass-sandwich panels as follows:

1. Wall assemblies.
2. Roof assemblies.
3. Canopy assemblies.

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.04 ACTION SUBMITTALS

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum components of panel assemblies.

C. Shop Drawings: For panel assemblies.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include details of provisions for assembly expansion and contraction and for draining moisture within the assembly to the exterior.

D. Samples: In manufacturer's standard size.

1. For each type of fiberglass-sandwich panel.

2. For each type of exposed finish for framing members.

E. Fabrication Samples: Of each framing system intersection and adjacent panels, made from 12-inch (305-mm) lengths of full-size framing members and showing details of the following:

1. Joinery.

2. Anchorage.

3. Expansion provisions.

4. Fiberglass-sandwich panels.

5. Flashing and drainage.

F. Delegated-Design Submittal: For panel assemblies indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Product Test Reports: For each fiberglass-sandwich-panel assembly, for tests performed by a qualified testing agency.

C. Evaluation Reports: For fiberglass-sandwich-panel assemblies from ICC-ES.

D. Field quality-control reports.

E. Sample Warranties: For special warranties.

1.06 CLOSEOUT SUBMITTALS

A. Maintenance Data: For panel assemblies to include in maintenance manuals.

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications: For fiberglass-sandwich panels, a qualified manufacturer whose facilities, processes, and products are monitored by an independent, accredited quality-control agency for compliance with applicable requirements in ICC-ES AC04 or ICC-ES AC177.

B. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical panel assemblies as shown on Drawings.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.08 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of panel assemblies that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.

b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

c. Water leakage.

2. Warranty Period: Two years from date of Substantial Completion.

B. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace fiberglass-sandwich panels that exhibit defects in materials or workmanship within specified warranty period.

1. Defects include, but are not limited to, the following:

a. Fiberbloom.

b. Delamination of coating, if any, from exterior face sheet.

c. Color change exceeding requirements.

d. Delamination of panel face sheets from panel cores.

2. Warranty Period: 10 years from date of Substantial Completion.

C. Special Aluminum-Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.

1. Failures include, but are not limited to, checking, crazing, peeling, chalking, and fading of finishes.

2. Warranty Period: Five years from date of Substantial Completion.

2.00 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design fiberglass-sandwich-panel assemblies.

B. Structural Loads: As indicated on Drawings.

C. Deflection Limits:

1. Vertical Panel Assemblies: Limited to 1/60 of clear span for each assembly component.

2. Overhead Panel Assemblies: Limited to 1/60 of clear span for each assembly component.

D. Structural-Test Performance: Provide panel assemblies tested according to ASTM E330, as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not show evidence of deflection exceeding specified limits.

2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not show evidence of material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.

3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

E. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 3 for basic protection.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.

F. Water Penetration under Static Pressure: Provide panel assemblies that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than [**6.24 lbf/sq. ft. (300 Pa)**] [**10 lbf/sq. ft. (480 Pa)**] [**15 lbf/sq. ft. (720 Pa)**] <**Insert value**>.

G. Water Penetration under Dynamic Pressure: Provide panel assemblies that do not evidence water leakage through fixed glazing and framing areas when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than [**6.24 lbf/sq. ft. (300 Pa)**] <**Insert value**>.

1. Maximum Water Leakage: [**According to AAMA 501.1**] [**No uncontrolled water penetrating aluminum-framed systems or water appearing on systems' normally exposed interior surfaces from sources other than condensation**]. Water leakage does not include water that is controlled by flashing and gutters and drained to the exterior, or water that cannot damage adjacent materials or finishes.

H. Thermal Movements: Allow for thermal movements from ambient- and surface-temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): [**120 deg F (67 deg C), ambient; 180 deg F (100 deg C)**] <**Insert temperature range**>, material surfaces.

I. Energy Performance: Provide panel assemblies with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below[**and certified and labeled according to NFRC**]:

1. Thermal Transmittance (U-Factor): Fixed glazing and framing areas shall have U-factor of not more than [**0.80 Btu/sq. ft. x h x deg F (4.54 W/sq. m x K)**] [**0.65 Btu/sq. ft. x h x deg F (3.69 W/sq. m x K)**] <**Insert value**> as determined according to NFRC 100.

2. Solar Heat Gain Coefficient (SHGC): Fixed glazing and framing areas shall have a SHGC of no greater than [**0.6**] [**0.7**] <**Insert value**> as determined according to NFRC 200.

3. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of [**0.30 cfm/sq. ft. (1.50 L/s per sq. m)**] <**Insert value**> of fixed wall area as determined according to ASTM E283 at a minimum static-air-pressure differential of [**1.57 lbf/sq. ft. (75 Pa)**] [**6.24 lbf/sq. ft. (300 Pa)**] <**Insert value**>.

2.02 FIBERGLASS-SANDWICH-PANEL ASSEMBLIES

A. Fiberglass-Sandwich-Panel Assemblies: Translucent assemblies that are supported by aluminum framing and glazed with fiberglass-sandwich panels.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

2.03 FIBERGLASS-SANDWICH PANELS

A. Fiberglass-Sandwich Panels: Uniformly colored, translucent, thermoset, fiberglass-reinforced-polymer face sheets bonded to both sides of a grid core.

1. Core Insulation: Fill panel cores with aerogel.

B. Panel Thickness: [**2-3/4 inches (70 mm)**] [**1-1/2 to 1-9/16 inches (38 to 40 mm)**] <**Insert thickness**>.

C. Grid Core: Mechanically interlocked, extruded-aluminum I-beams, with a minimum flange width of 7/16 inch (11.1 mm).

1. Extruded Aluminum: ASTM B221 (ASTM B221M), in alloy and temper recommended in writing by manufacturer.

2. I-Beam Construction: [**One piece, extruded aluminum**] [**Thermally broken, extruded aluminum**].

3. Grid Pattern: [**Inline rectangle, nominal 12 by 24 inches (305 by 610 mm)**] [**Staggered rectangle, nominal 12 by 24 inches (305 by 610 mm)**] [**Square, nominal 12 inches (305 mm)**] [**As indicated on Drawings**] <**Insert pattern**>.

D. Exterior Face Sheet:

1. Thickness: [**0.070 inch (1.78 mm)**] [**0.060 inch (1.52 mm)**] [**0.052 inch (1.32 mm)**].

2. Color: [**White**] [**Crystal**] [**As selected by Architect from manufacturer's full range**] <**Insert color**>.

3. Protective Weathering Surface: [**Manufacturer's standard**] [**Integral, embedded-glass erosion barrier**] [**Surface-applied, polyvinyl-fluoride film not less than 1.0 mils (0.03 mm) thick**].

E. Interior Face Sheet:

1. Thickness: [**0.045 inch (1.14 mm)**] [**0.060 inch (1.52 mm)**].

2. Color: [**White**] [**Crystal**] [**As selected by Architect from manufacturer's full range**] <**Insert color**>.

F. Fiberglass-Sandwich-Panel Adhesive: Manufacturer's standard for permanent adhesion of facings to cores.

G. Panel Strength:

1. Maximum Panel Deflection: 3-1/2 inches (89 mm) when a 4-by-12-foot (1.2-by-3.6-m) panel is tested according to ASTM E72 at 34 lbf/sq. ft. (1.6 kPa), with a maximum 0.090-inch (2.3-mm) set deflection after five minutes.

2. Panel Support Strength: Capable of supporting, without failure, a 300-lbf (1334-N) concentrated load when applied to a 3-inch- (76-mm-) diameter disk according to ASTM E661.

H. Panel Performance:

1. Self-Ignition Temperature: 650 deg F (343 deg C) or more according to ASTM D1929.

2. Smoke-Developed Index: 450 or less according to ASTM E84, or 75 or less according to ASTM D2843.

3. Combustibility Classification: [**Class CC1**] [**Class CC2**] based on testing according to ASTM D635.

4. Roof-Covering Classification: [**Class B**] [**Class B, Burning Brand Test**] [**Class C**] according to ASTM E108 or UL 790.

5. Interior Finish Classification: [**Class A**] [**Class B**] [**Class C**] based on testing according to ASTM E84.

6. Color Change: Not more than 3.0 units Delta E, when measured according to ASTM D2244, after outdoor weathering compliant with procedures in ASTM D1435.

   a. Outdoor Weathering Conditions: Sixty months in southern Florida.

7. Impact Resistance: No fracture or tear at impact of [**60 ft. x lbf (81 J)**] [**70 ft. x lbf (95 J)**] [**230 ft. x lbf (312 J)**] by a 3-1/4-inch- (83-mm-) diameter, 5-lb (2.3-kg) freefalling ball according to UL 972 test procedure.

8. Haze Factor: Greater than 90 percent when tested according to ASTM D1003.

2.04 ALUMINUM FRAMING SYSTEMS

A. Components: Manufacturer's standard extruded-aluminum members of thickness required and reinforced as required to support imposed loads.

1. Construction: [**One piece, extruded aluminum**] [**Thermally broken, extruded aluminum**] <**Insert description**>.

B. Aluminum: Alloy and temper recommended in writing by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B209 (ASTM B209M).
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).
3. Extruded Structural Pipe and Tubes: ASTM B429 (/B 429M).
4. Structural Profiles: ASTM B308 (/B 308M).

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning skylight components.

D. Fasteners and Accessories: Manufacturer's standard, corrosion-resistant, nonstaining, and nonbleeding fasteners and accessories; compatible with adjacent materials.

1. At closures, retaining caps, or battens, use ASTM A193 (/A 193M), 300 series stainless-steel screws.
2. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
3. At movement joints, use slip-joint linings, spacers, and sleeves of material and type recommended in writing by manufacturer.

E. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123 (/A 123M) or ASTM A153 (/A 153M)requirements.

F. Anchor Bolts: ASTM A307, Grade A, galvanized steel.

G. Concealed Flashing: Corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

H. Exposed Flashing and Closures: Aluminum sheet not less than [**0.040 inch (1.02 mm)**] [**0.050 inch (1.27 mm)**] [**0.063 inch (1.60 mm)**] <**Insert dimension**> thick, finished to match framing.

I. Framing Gaskets: [**Manufacturer's standard**] <**Insert requirements**>.

J. Frame-System Sealants: As [**recommended in writing by manufacturer.**] [**specified in Section 079200 "Joint Sealants."**]

1. <Double click to insert sustainable design text for sealants.>

2. <Double click to insert sustainable design text for sealants.>

K. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.05 FABRICATION

A. Frame System Fabrication:

1. Fabricate components that, when assembled, have the following characteristics:

a. Profiles that are sharp, straight, and free of defects or deformations.

b. Accurately fitted joints with ends coped or mitered.

c. Internal guttering systems or other means to drain water passing through joints, and moisture migrating within assembly to exterior.

2. Fabricate sill closures with weep holes and for installation as continuous component.

3. Reinforce components as required to receive fastener threads.

B. Panel Fabrication: Factory assemble and seal panels.

1. Laminate face sheets to grid core under a controlled process using heat and pressure to produce straight adhesive bonding lines that cover width of core members and that have sharp edges.

a. White spots indicating lack of bond at intersections of grid-core members are limited in number to four for every 40 sq. ft. (3.7 sq. m) of panel and limited in diameter to 3/64 inch (1.2 mm).

2. Fabricate with grid pattern that is symmetrical about centerlines of each panel.

3. Fabricate panel to allow condensation within panel to escape.

4. Reinforce panel corners.

2.06 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, [**AA-M12C22A41, Class I, 0.018 mm**] [**AA-M12C22A31, Class II, 0.010 mm**] or thicker.

B. Color Anodic Finish: AAMA 611, [**AA-M12C22A42/A44, Class I, 0.018 mm**] [**AA-M12C22A32/A34, Class II, 0.010 mm**] or thicker.

1. Color: [**Light bronze**] [**Medium bronze**] [**Dark bronze**] [**Black**] [**Match Architect's sample**] [**As selected by Architect from full range of industry colors and color densities**] <**Insert color**>.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match Architect's sample**] [**As selected by Architect from manufacturer's full range**] <**Insert color and gloss**>.

D. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with [**AAMA 2604**] [**AAMA 2605**] and containing not less than [**50**] [**70**] percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match Architect's sample**] [**As selected by Architect from manufacturer's full range**] <**Insert color and gloss**>.

E. High-Performance Organic Finish: [**Three**] [**Four**]-coat fluoropolymer finish complying with AAMA 2605 and containing not less than [**50**] [**70**] percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match Architect's sample**] [**As selected by Architect from manufacturer's full range**] <**Insert color and gloss**>.

3.00 EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General: Comply with manufacturer's written instructions.

1. Do not install damaged components.
2. Fit joints between aluminum components to produce hairline joints free of burrs and distortion.
3. Rigidly secure nonmovement joints.
4. Install anchors with separators and isolators to prevent metal corrosion, electrolytic deterioration, and immobilization of moving joints.
5. Seal joints watertight unless otherwise indicated.

B. Metal Protection: Where aluminum components will contact dissimilar materials, protect against galvanic action by painting contact surfaces with corrosion-resistant coating or by installing nonconductive spacers as recommended in writing by manufacturer for this purpose.

C. Install components plumb and true in alignment with established lines and elevations.

D. Skylight Assemblies: Install continuous aluminum sill closures with weatherproof expansion joints and locked and sealed corners. Locate weep holes at rafters. Install components to drain water passing through joints and moisture migrating within assembly to exterior.

E. Erection Tolerances: Install panel assemblies to comply with the following maximum tolerances:

1. Alignment: Limit offset from true alignment to 1/32 inch (0.8 mm) where surfaces abut in line, edge to edge, at corners, or where a reveal or protruding element separates aligned surfaces by less than 3 inches (76 mm); otherwise, limit offset to 1/8 inch (3.2 mm).

2. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet (3.2 mm in 3.7 m), but no greater than 1/2 inch (13 mm) over total length.

3.03 FIELD QUALITY CONTROL

A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections.

1. Water-Spray Test: Before installation of interior finishes has begun, panel assemblies shall be tested according to AAMA 501.2 and shall not show evidence of water penetration.

2. Water Penetration under Static Pressure: Before installation of interior finishes has begun, areas shall be tested according to ASTM E1105.

a. Test Procedures: Test under [**uniform**] [**and**] [**cyclic**] static-air pressure.

b. Static-Air-Pressure Difference: <**Insert pressure**>.

c. Water Penetration: None.

B. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

D. Prepare test and inspection reports.

END OF SECTION

08 71 00 DOOR HARDWARE

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware for:

a. Swinging doors.

b. Sliding doors.

2. Electronic access control system components, including:

a. Electronic access control devices.

3. Field verification, preparation and modification of existing doors and frames to receive new door hardware.

B. Exclusions: Unless specifically listed in hardware sets, hardware is not specified in this section for:

1. Windows

2. Cabinets (casework), including locks in cabinets

3. Signage

4. Toilet accessories

5. Overhead doors

C. Related Sections:

1. Division 07 Section “Joint Sealants” for sealant requirements applicable to threshold installation specified in this section.

2. Division 09 sections for touchup finishing or refinishing of existing openings modified by this section.

3. Division 26 sections for connections to electrical power system and for low-voltage wiring.

4. Division 28 sections for coordination with other components of electronic access control system.

1.03 REFERENCES

A. UL - Underwriters Laboratories

1. UL 10B - Fire Test of Door Assemblies

2. UL 10C - Positive Pressure Test of Fire Door Assemblies

3. UL 1784 - Air Leakage Tests of Door Assemblies

4. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule

2. Recommended Locations for Builders Hardware

3. Key Systems and Nomenclature

C. ANSI - American National Standards Institute

1. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties

1.04 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 requirements.

2. Highlight, encircle, or otherwise specifically identify on submittals deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

3. Prior to forwarding submittal, comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, “EXAMINATION” article, herein.

B. Action Submittals:

1. Product Data: Product data including manufacturers' technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.

2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:

    a. Wiring Diagrams: For power, signal, and control wiring and including:

        1) Details of interface of electrified door hardware and building safety and security systems.

        2) Schematic diagram of systems that interface with electrified door hardware.

        3) Point-to-point wiring.

        4) Risers.

3. Samples for Verification: If requested by Architect, submit production sample or sample installations of each type of exposed hardware unit in finish indicated, and tagged with full description for coordination with schedule.

    a. Samples will be returned to supplier in like-new condition. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.

4. Door Hardware Schedule: Submit schedule with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Indicate complete designations of each item required for each door or opening, include:

    a. Door Index; include door number, heading number, and Architects hardware set number.

    b. Opening Lock Function Spreadsheet: List locking device and function for each opening.

    c. Type, style, function, size, and finish of each hardware item.

    d. Name and manufacturer of each item.

    e. Fastenings and other pertinent information.

    f. Location of each hardware set cross-referenced to indications on Drawings.

    g. Explanation of all abbreviations, symbols, and codes contained in schedule.

    h. Mounting locations for hardware.

i. Door and frame sizes and materials.

j. Name and phone number for local manufacturer's representative for each product.

k. Operational Description of openings with any electrified hardware (locks, exits, electromagnetic locks, electric strikes, automatic operators, door position switches, magnetic holders or closer/holder units, and access control components). Operational description should include how door will operate on egress, ingress, and fire and smoke alarm connection.

1) Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work that is critical in Project construction schedule.

5. Key Schedule:

a. After Keying Conference, provide keying schedule listing levels of keying as well as explanation of key system's function, key symbols used and door numbers controlled.

b. Use ANSI/BHMA A156.28 “Recommended Practices for Keying Systems” as guideline for nomenclature, definitions, and approach for selecting optimal keying system.

c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.

d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.

e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion.

1) Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.

f. Prepare key schedule by or under supervision of supplier, detailing Owner’s final keying instructions for locks.

6. Templates: After final approval of hardware schedule, provide templates for doors, frames and other work specified to be factory prepared for door hardware installation.

C. Informational Submittals:

1. Qualification Data: For Supplier, Installer and Architectural Hardware Consultant.

2. Product Certificates for electrified door hardware, signed by manufacturer:

    a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.

3. Certificates of Compliance:

    a. Certificates of compliance for fire-rated hardware and installation instructions if requested by Architect or Authority Having Jurisdiction.

    b. Installer Training Meeting Certification: Letter of compliance, signed by Contractor, attesting to completion of installer training meeting specified in "QUALITY ASSURANCE" article, herein.

    c. Electrified Hardware Coordination Conference Certification: Letter of compliance, signed by Contractor, attesting to completion of electrified hardware coordination conference, specified in "QUALITY ASSURANCE" article, herein.

4. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by qualified testing agency, for door hardware on doors located in accessible routes.

5. Warranty: Special warranty specified in this Section.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:

    a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.

    b. Catalog pages for each product.

    c. Name, address, and phone number of local representative for each manufacturer.

    d. Parts list for each product.

    e. Final approved hardware schedule, edited to reflect conditions as-installed.

    f. Final keying schedule

    g. Copies of floor plans with keying nomenclature

    h. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

i. Copy of warranties including appropriate reference numbers for manufacturers to identify project.

1.05 QUALITY ASSURANCE

A. Product Substitutions: Comply with product requirements stated in Division 01 and as specified herein.

1. Where specific manufacturer's product is named and accompanied by "No Substitute," including make or model number or other designation, provide product specified. (Note: Certain products have been selected for their unique characteristics and particular project suitability.)

a. Where no additional products or manufacturers are listed in product category, requirements for "No Substitute" govern product selection.

2. Where products indicate "acceptable manufacturers" or "acceptable manufacturers and products", provide product from specified manufacturers, subject to compliance with specified requirements and "Single Source Responsibility" requirements stated herein.

B. Supplier Qualifications and Responsibilities: Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that provides certified Architectural Hardware Consultant (AHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.

1. Warehousing Facilities: In Project's vicinity.

2. Scheduling Responsibility: Preparation of door hardware and keying schedules.

3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

4. Coordination Responsibility: Coordinate installation of electronic security hardware with Architect and electrical engineers and provide installation and technical data to Architect and other related subcontractors.

a. Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.

C. Installer Qualifications: Qualified tradesmen, skilled in application of commercial grade hardware with record of successful in-service performance for installing door hardware similar in quantity, type, and quality to that indicated for this Project.

D. Architectural Hardware Consultant Qualifications: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:

1. For door hardware, DHI-certified, Architectural Hardware Consultant (AHC).

2. Can provide installation and technical data to Architect and other related subcontractors.

3. Can inspect and verify components are in working order upon completion of installation.

4. Capable of producing wiring diagrams.

5. Capable of coordinating installation of electrified hardware with Architect and electrical engineers.

E. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated.

2. Manufacturers that perform electrical modifications and that are listed by testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

F. Fire-Rated Door Openings: Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and are identical to products tested by Underwriters Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.

G. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.

1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.

H. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.

I. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release latch. Locks do not require use of key, tool, or special knowledge for operation.

J. Accessibility Requirements: For door hardware on doors in an accessible route, comply with governing accessibility regulations cited in “REFERENCES” article, herein.

1. Provide operating devices that do not require tight grasping, pinching, or twisting of wrist and that operate with force of not more than 5 lbf (22.2 N).

2. Maximum opening-force requirements:

   a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.

   b. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.

   c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

3. Bevel raised thresholds with slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.

4. Adjust door closer sweep periods so that, from open position of 70 degrees, door will take at least 3 seconds to move to 3 inches (75 mm) from latch, measured to leading edge of door.

K. Keying Conference: Conduct conference at Project site to comply with requirements in Division 01.

1. Attendees: Owner, Contractor, Architect, Installer, **Owner's security consultant,** and Supplier's Architectural Hardware Consultant.

2. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:

   a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.

   b. Preliminary key system schematic diagram.

   c. Requirements for key control system.

   d. Requirements for access control.

   e. Address for delivery of keys.

L. Pre-installation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

2. Inspect and discuss preparatory work performed by other trades.

3. Inspect and discuss electrical roughing-in for electrified door hardware.

4. Review sequence of operation for each type of electrified door hardware.

5. Review required testing, inspecting, and certifying procedures.

M. Coordination Conferences:

1. Installation Coordination Conference: Prior to hardware installation, schedule and hold meeting to review questions or concerns related to proper installation and adjustment of door hardware.

a. Attendees: Door hardware supplier, door hardware installer, Contractor.

b. After meeting, provide letter of compliance to Architect, indicating when meeting was held and who was in attendance.

2. Electrified Hardware Coordination Conference: Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

a. Attendees: electrified door hardware supplier, doors and frames supplier, electrified door hardware installer, electrical subcontractor, Owner, **Owner's security consultant,** Architect and Contractor.

b. After meeting, provide letter of compliance to Architect, indicating when coordination conference was held and who was in attendance.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

1. Deliver each article of hardware in manufacturer's original packaging.

C. Project Conditions:

1. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.

2. Provide secure lock-up for door hardware delivered to Project, but not yet installed. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.

D. Protection and Damage:

1. Promptly replace products damaged during shipping.

2. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work.

3. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

E. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

F. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.07 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

E. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

F. Direct shipments not permitted, unless approved by Contractor.

1.08 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Years from date of Substantial Completion, for durations indicated.

a. Closers:

1) Mechanical: 30 years.

b. Exit Devices:

1) Mechanical: 3 years.

c. Locksets:

1) Mechanical: 3 years.

2) Electrified: 1 year.

d. Hinges: 1 year.

e. Other hardware: 2 years.

f. Key Blanks: Lifetime

2. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.

1.09 MAINTENANCE

B. Extra Materials:

1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

a. Door Hardware: 1 each of each lock type

1 each of each closer type

C. Maintenance Tools:

1. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

2.00 PRODUCTS

2.01 MANUFACTURERS

A. The Owner requires use of certain products for their unique characteristics and particular project suitability to insure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: “No Substitute.”

1. Where “No Substitute” is noted, submittals and substitution requests for other products will not be considered.

B. Approval of manufacturers and/or products other than those listed as ”Scheduled Manufacturer ” or “Acceptable Manufacturers” in the individual article for the product category shall be in accordance with QUALITY ASSURANCE article, herein.

C. Approval of products from manufacturers indicated in “Acceptable Manufacturers” is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer’s product.

D. Hand of Door: Drawings show direction of slide, swing, or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.

E. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.02 MATERIALS

A. Fasteners

1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.

2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.

3. Provide concealed fasteners for hardware units exposed when door is closed except when no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless thru-bolts are required to fasten hardware securely. Review door specification and advise Architect if thru-bolts are required.

4. Install hardware with fasteners provided by hardware manufacturer.

B. Modification and Preparation of Existing Doors: Where existing door hardware is indicated to be removed and reinstalled.

1. Provide necessary fillers, Dutchmen, reinforcements, and fasteners, compatible with existing materials, as required for mounting new opening hardware and to cover existing door and frame preparations.

2. Use materials which match materials of adjacent modified areas.

3. When modifying existing fire-rated openings, provide materials permitted by NFPA 80 as required to maintain fire-rating.

C. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

D. Cable and Connectors: Hardwired Electronic Access Control Lockset and Exit Device Trim:

1. Data: 24AWG, 4 conductor shielded, Belden 9843, 9841 or comparable.

2. DC Power: 18 AWG, 2 conductor, Belden 8760 or comparable.

3. Provide type of data and DC power cabling required by access control device manufacturer for this installation.

4. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with sufficient number and wire gauge with standardized Molex plug connectors to accommodate electric function of specified hardware. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.03 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Ives 5BB series

2. Acceptable Manufacturers and Products: Hager BB series, McKinney TB/T4B series

B. Requirements:

1. Provide five-knuckle, ball bearing hinges conforming to ANSI/BHMA A156.1.

2. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:

a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high

b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high

3. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:

a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high

b. Interior: Heavy weight, steel, 5 inches (127 mm) high

4. 2 inches or thicker doors:

    a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high

    b. Interior: Heavy weight, steel, 5 inches (127 mm) high

5. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.

6. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to hinge preparation present in existing door or existing frame.

7. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:

    a. Steel Hinges: Steel pins

    b. Non-Ferrous Hinges: Stainless steel pins

    c. Out-Swinging Exterior Doors: Non-removable pins

    d. Out-Swinging Interior Lockable Doors: Non-removable pins

    e. Interior Non-lockable Doors: Non-rising pins

8. Width of hinges: 4-1/2 inches (114 mm) at 1-3/4 inch (44 mm) thick doors, and 5 inches (127 mm) at 2 inches (51 mm) or thicker doors. Adjust hinge width as required for door, frame, and wall conditions to allow proper degree of opening.

9. Doors 36 inches (914 mm) wide or less furnish hinges 4-1/2 inches (114 mm) high; doors greater than 36 inches (914 mm) wide furnish hinges 5 inches (127 mm) high, heavy weight or standard weight as specified.

2.04 ELECTRIC POWER TRANSFER

A. Manufacturers:

    a. Scheduled Manufacturer: Von Duprin EPT-10

    b. Acceptable Manufacturers: ABH PT1000, Securitron CEPT-10

B. Provide power transfer with electrified options as scheduled in the hardware sets. Provide with number and gage of wires sufficient to accommodate electric function of specified hardware.

C. Locate electric power transfer per manufacturer's template and UL requirements, unless interference with operation of door or other hardware items.

2.05 FLUSH BOLTS

A. Manufacturers:

1. Scheduled Manufacturer: Ives

2. Acceptable Manufacturers: Burns, Trimco

B. Requirements:

1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

2.06 COORDINATORS

A. Manufacturers:

1. Scheduled Manufacturer: Ives

2. Acceptable Manufacturers: Burns, Trimco

B. Requirements:

1. Where pairs of doors are equipped with automatic flush bolts, an astragal, or other hardware that requires synchronized closing of the doors, provide bar-type coordinating device, surface applied to underside of stop at frame head.

2. Provide filler bar of correct length for unit to span entire width of opening, and appropriate brackets for parallel arm door closers and surface vertical rod exit device strikes. Factory-prep coordinators for vertical rod devices if required.

2.07 MORTISE LOCKS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Schlage L9000 series

2. Acceptable Manufacturers and Products: Best 45H series, Sargent 8200 series

B. Requirements:

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1 Operational, Grade 1 Security, and manufactured from heavy gauge steel, containing

components of steel with a zinc dichromate plating for corrosion resistance. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to "KEYING" article, herein.

2. Indicators: Where specified, provide indicator window. Provide messages color-coded with full text and/or symbols, as scheduled, for easy visibility.

    a. Inside Security Indicator: Provide indicator above cylinder for visibility during lockdown that identifies the trim as locked/unlocked status of the door. Indicator in unlocked state has a white background with black text and icon. Indicator in the locked state has a red background with white text and icon.

    b. Outside Status Indicator: Provide indicator above cylinder for visibility that identifies the trim as locked/unlocked status of the door. Indicator in unlocked state has a white background with black text and icon. Indicator in the locked state has a red background with white text and icon.

    c. Occupied Indicator: Provide indicator above cylinder for visibility while operating the lock that identifies the trim as occupied/unoccupied status of the door. Indicator in unoccupied state has a white background with black text and icon. Indicator in the occupied state has a red background with white text and icon.

3. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1 inch (25 mm) throw, constructed of stainless steel.

4. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.

5. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide a request to exit (RX) switch that is actuated with rotation of inside lever.

6. Provide motor based electrified locksets with electrified options as scheduled in the hardware sets and comply with the following requirements:

    a. Universal input voltage – single chassis accepts 12 or 24V DC to allow for changes in the field without changing lock chassis.

    b. Fail Safe/Fail Secure – changing mode between electrically locked (fail safe) and electrically unlocked (fail secure) is field selectable without opening the lock case

    c. Low maximum current draw – maximum 0.4 amps to allow for multiple locks on a single power supply.

    d. Low holding current – maximum 0.01 amps to produce minimal heat, eliminate "hot levers" in electrically locked applications, and to provide reliable operation in wood doors that provide minimal ventilation and air flow.

e. Request to Exit Switch (RX) –

1) Modular Design – provide electrified locks capable of using, adding, or changing a modular RX switch without opening the lock case.

2) Monitoring – where scheduled, provide a request to exit (RX) switch that detects rotation of the inside lever.

f. Connections – provide quick-connect Molex system standard.

g. UL Listed – 3 hour fire door

7. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.

a. Lever Design: Schlage 17A.

b. Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.

2.08 EXIT DEVICES

A. Manufacturers and Products:

Scheduled Manufacturer and Product: Von Duprin 98/35 series
Acceptable Manufacturers and Products: Sargent 19-43-GL-80 series, Precision Apex series

B. Requirements:

Provide exit devices tested to ANSI/BHMA A156.3 Grade 1, and UL listed for Panic Exit or Fire Exit Hardware. Cylinders: Refer to “KEYING” article, herein.
Provide touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
Touchpad: Extend minimum of one half of door width. Match exit device finish, stainless steel for US26, US26D, US28, US32, and US32D finishes; and for all other finishes, provide compatible finish to exit device. No plastic inserts are allowed in touchpads.
Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
Provide flush end caps for exit devices.
Provide exit devices with manufacturer’s approved strikes.
Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.

Mount mechanism case flush on face of doors, or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.

Provide cylinder dogging at non-fire-rated exit devices.

Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.

Where lever handles are specified as outside trim for exit devices, provide heavy-duty lever trims with forged or cast escutcheon plates. Provide vandal-resistant levers that will travel to 90-degree down position when more than 35 pounds of torque are applied, and which can easily be re-set.

a. Lever Style: Match lever style of locksets.
b. Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.

Provide UL labeled fire exit hardware for fire rated openings.

Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.

Provide electrified options as scheduled.

8.

2.09 CYLINDERS

A. Manufacturers:

1. Scheduled Manufacturer: Best

2. Acceptable Manufacturers: No Substitute

B. Requirements:

1. Provide permanent interchangeable small format interchangeable core (SFIC) cylinders/cores to match Owner's existing key system, compliant with ANSI/BHMA A156.5; latest revision, Section 12, Grade 1; permanent cylinders; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.

2. Replaceable Construction Cores.

a. Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.

1) 3 construction control keys

2) 12 construction change (day) keys.

b. Owner or Owner's Representative will replace temporary construction cores with permanent cores.

2.10 KEYING

A. Provide cylinders/cores keyed into Owner's existing factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

B. Requirements:

1. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.

a. Master Keying system as directed by the Owner.

2. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements shall be cause for replacement of cylinders/cores involved at no additional cost to Owner.

3. Provide keys with the following features:

a. Material: Nickel silver; minimum thickness of .107-inch (2.3mm)

b. Patent Protection: Keys and blanks protected by one or more utility patent(s)

4. Identification:

a. Mark permanent cylinders/cores and keys with applicable blind code per DHI publication "Keying Systems and Nomenclature" for identification. Blind code marks shall not include actual key cuts.

b. Identification stamping provisions must be approved by the Architect and Owner.

c. Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.

d. Failure to comply with stamping requirements shall be cause for replacement of keys involved at no additional cost to Owner.

e. Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.

5. Quantity: Furnish in the following quantities.

a. Change (Day) Keys: 3 per cylinder/core.

b. Permanent Control Keys: 3.

c. Master Keys: 6.

2.11 KEY CONTROL SYSTEM

A. Manufacturers:

1. Scheduled Manufacturer: Telkee

2. Acceptable Manufacturers: HPC, Lund

B. Requirements:

1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.

a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.

b. Provide hinged-panel type cabinet for wall mounting.

2.12 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: LCN 4010/4110/4020 series

2. Acceptable Manufacturers and Products: Sargent 281/281P10/281TJ series factory assembled (without PRV)

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. Stamp units with date of manufacture code.

2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.

3. Cylinder Body: 1-1/2 inch (38 mm) diameter, with 5/8 inch (16 mm) diameter double heat-treated pinion journal.

4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.

5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.

6. Hydraulic Regulation: By tamper-proof, non-critical valves with separate adjustment for latch speed, general speed, and backcheck.

7. Provide closers with a solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.

8. Pressure Relief Valve (PRV) Technology: Not permitted.

9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI/BHMA Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).

10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

11.

2.13 DOOR TRIM

A. Manufacturers:

1. Scheduled Manufacturer: Ives

2. Acceptable Manufacturers: Burns, Trimco

B. Requirements:

1. Provide push plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick and beveled 4 edges. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to fit.

2. Provide push bars of solid bar stock, diameter and length as scheduled. Provide push bars of sufficient length to span from center to center of each stile. Where required, mount back to back with pull.

3. Provide offset pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.

4. Provide flush pulls as scheduled. Where required, provide back-to-back mounted model.

5. Provide pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.

6. Provide pull plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick, beveled 4 edges, and prepped for pull. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to fit.

7. Provide wire pulls of solid bar stock, diameter and length as scheduled.

8. Provide decorative pulls as scheduled. Where required, mount back to back with pull.

2.14 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer: Ives

2. Acceptable Manufacturers: Burns, Trimco

B. Requirements:

1. Provide kick plates, mop plates, and armor plates minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.

2. Sizes of plates:

a. Kick Plates: 10 inches (254 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs

b. Mop Plates: 4 inches (102 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs

c. Armor Plates: 36 inches (914 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs

2.15 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers: Glynn-Johnson

2. Acceptable Manufacturers: Rixson, Sargent

B. Requirements:

1. Provide heavy duty concealed mounted overhead stop or holder as specified for exterior and interior vestibule single acting doors.

2. Provide heavy duty concealed mounted overhead stop or holder as specified for double acting doors.

3. Provide heavy or medium duty and concealed or surface mounted overhead stop or holder for interior doors as specified. Provide medium duty surface mounted overhead stop for interior doors and at any door that swings more than 140 degrees before striking wall, open against equipment, casework, sidelights, and where conditions do not allow wall stop or floor stop presents tripping hazard.

4. Where overhead holders are specified provide friction type at doors without closer and positive type at doors with closer.

2.16 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer: Ives

2. Acceptable Manufacturers: Burns, Trimco

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide convex type where mortise type locks are used and concave type where cylindrical type locks are used.

2. Where a wall stop cannot be used, provide universal floor stops for low or high rise options.

3. Where wall or floor stop cannot be used, provide medium duty surface mounted overhead stop.

2.17 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Scheduled Manufacturer: Zero International

2. Acceptable Manufacturers: National Guard, Reese

B. Requirements:

1. Provide thresholds, weather-stripping (including door sweeps, seals, and astragals) and gasketing systems (including smoke, sound, and light) as specified and per architectural details. Match finish of other items.

2. Size of thresholds:

a. Saddle Thresholds: 1/2 inch (13 mm) high by jamb width by door width

b. Bumper Seal Thresholds: 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width

3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.

2.18 SILENCERS

A. Manufacturers:

1. Scheduled Manufacturer: Ives

2. Acceptable Manufacturers: Burns, Trimco

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.

2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.

3. Omit where gasketing is specified.

2.19 MAGNETIC HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer: LCN

2. Acceptable Manufacturers: Rixson, Sargent

B. Requirements:

1. Provide wall or floor mounted electromagnetic door release as specified with minimum of 25 pounds of holding force. Coordinate projection of holder and armature with other hardware and wall conditions to ensure that door sits parallel to wall when fully open. Connect magnetic holders on fire-rated doors into the fire control panel for fail-safe operation.

2.20 DOOR POSITION SWITCHES

A. Manufacturers:

1. Scheduled Manufacturer: Schlage

2. Acceptable Manufacturers: GE-Interlogix, Sargent

B. Requirements:

1. Provide recessed or surface mounted type door position switches as specified.

2. Coordinate door and frame preparations with door and frame suppliers. If switches are being used with magnetic locking device, provide minimum of 4 inches (102 mm) between switch and magnetic locking device.

2.21 FINISHES

A. Finish: BHMA 626/652 (US26D); except:

1. Hinges at Exterior Doors: BHMA 630 (US32D)

2. Continuous Hinges: BHMA 630 (US32D)

3. Continuous Hinges: BHMA 628 (US28)

4. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)

5. Protection Plates: BHMA 630 (US32D)

6. Overhead Stops and Holders: BHMA 630 (US32D)

7. Door Closers: Powder Coat to Match

8. Wall Stops: BHMA 630 (US32D)

9. Latch Protectors: BHMA 630 (US32D)

10. Weatherstripping: Clear Anodized Aluminum

11. Thresholds: Mill Finish Aluminum

12.

2.22 SPECIAL FINISHES

A. Antimicrobial coatings

1. Furnish with antimicrobial coated hardware items designed with AM suffix to the finish, 626AM and /or 630AM. The non-toxic coating to be natural inorganic sliver-ion based antimicrobial added to the clear coating. The powder coat containing the antimicrobial compound to be electro-statically applied to a minimum thickness of 1.5 mils. The antimicrobial coatings are to protect the surface of the hardware item by inhibiting the growth of bacteria, mold, mildew, and odor. The antimicrobial coating shall pass the BHMA clear coat requirements and be registered with the EPA and FDA listed.

3.00 EXECUTION

3.01 EXAMINATION

A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Existing Door and Frame Compatibility: Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.

C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Where on-site modification of doors and frames is required:

1. Carefully remove existing door hardware and components being reused. Clean, protect, tag, and store in accordance with storage and handling requirements specified herein.

2. Field modify and prepare existing door and frame for new hardware being installed.

3. When modifications are exposed to view, use concealed fasteners, when possible.

4. Prepare hardware locations and reinstall in accordance with installation requirements for new door hardware and with:

a. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

b. Wood Doors: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."

c. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.

3.03 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.

2. Custom Steel Doors and Frames: HMMA 831.

3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

B. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.

C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

D. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

H. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches (750 mm) of door height greater than 90 inches (2286 mm).

I. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as indicated in keying section.

2. . OPTION: Furnish permanent cores to Owner for installation.

J. Lead Protection: Lead wrap hardware penetrating lead-lined doors. Levers and roses to be lead lined. Apply kick and armor plates on lead-lined doors with adhesive as recommended by manufacturer.

K. Wiring: Coordinate with Division 26, ELECTRICAL sections for:

1. Conduit, junction boxes and wire pulls.

2. Connections to and from power supplies to electrified hardware.

3. Connections to fire/smoke alarm system and smoke evacuation system.

4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.

5. Testing and labeling wires with Architect's opening number.

L. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

M. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Closers shall not be visible in corridors, lobbies and other public spaces unless approved by Architect.

N. Closer/Holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.

O. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.

1. Configuration: Provide [one power supply for each door opening][least number of power supplies required to adequately serve doors] with electrified door hardware.

P. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

Q. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.

R. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

S. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

T. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.04 FIELD QUALITY CONTROL

A. Architectural Hardware Consultant: Engage qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.

1. Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.05 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 30 degrees.

2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.

3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately six, (6) months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.06 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.07 DEMONSTRATION

A. Provide training for Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Division 01 Section "Demonstration and Training."

3.08 DOOR HARDWARE SCHEDULE

A. Locksets, exit devices, and other hardware items are referenced in the following hardware sets for series, type and function. Refer to the above-specifications for special features, options, cylinders/keying, and other requirements.

B. Hardware Sets:

HARDWARE GROUP NO. 00

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

NOTE: NO DRAWINGS ISSUED

HARDWARE GROUP NO. 101A

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050HD 17L L583-363	630	SCH
1	EA	PEMANENT IC CORE	IC-7 PIN CORE	630	BES
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ (AS REQ'D)	695	LCN
1	EA	FLOOR/ WALL STOP	FS436/ WS401 (AS REQ'D)	626	IVE
3	EA	SILENCER / SEALS (AS REQ'D)	SR64 / SEAL BY FRAME SUPPLIER	GRY	IVE

HARDWARE GROUP NO. 201A

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080HD 17A	630	SCH
1	EA	PEMANENT IC CORE	IC-7 PIN CORE	630	BES
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ (AS REQ'D)	695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER / SEALS (AS REQ'D)	SR64 (1 SET 188S-BK @ RATED OPENINGS)	GRY	IVE

HARDWARE GROUP NO. 201AG

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080HD 17A	630	SCH
1	EA	PEMANENT IC CORE	IC-7 PIN CORE	630	BES
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ (AS REQ'D)	695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	DOOR BOTTOM	369AA-Z49	AA	ZER
1	EA	THRESHOLD	164A-V3-226	A	ZER
3	EA	SILENCER / SEALS (AS REQ'D)	SR64 / SEAL BY FRAME SUPPLIER	GRY	IVE

HARDWARE GROUP NO. 201G

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM W/DEADBOLT	L9480HD 17A	630	SCH
1	EA	PEMANENT IC CORE	IC-7 PIN CORE	630	BES
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ (AS REQ'D)	695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	GASKETING	188FSBK PSA	BK	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A-V3-223	A	ZER

HARDWARE GROUP NO. 341G

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PRIVACY W/DEADBOLT	L9440 17A L583-363 L283-722	630	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ (AS REQ'D)	695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	GASKETING SET	188SBK PSA	BK	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A-223	A	ZER

HARDWARE GROUP NO. 343A

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PRIVACY W/DEADBOLT	L9440 17A L583-363 L283-722	630	SCH
1	EA	FLOOR STOP	FS18S	BLK	IVE
3	EA	SILENCER / SEALS (AS REQ'D)	SR64 / SEAL BY FRAME SUPPLIER	GRY	IVE

HARDWARE GROUP NO. 720CM

PROVIDE EACH PR DOOR(S) WITH THE FOLLOWING:

6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	REMOVABLE MULLION	KR4954 STAB	689	VON
1	EA	PANIC HARDWARE	LD-98-EO-SNB	630	VON
1	EA	PANIC HARDWARE	LD-98-L-NL-17SS-SNB-SEC	630	VON
1	EA	MULLION STORAGE KIT	MT54	689	VON
2	EA	PEMANENT IC CORE	IC-7 PIN CORE	630	BES
1	EA	SFIC RIM CYLINDER	C953-7CCA	630	FAL
1	EA	MUL MORT. CYLINDER	C987-7CCA X A12667-003-00 X A08790-001	626	FAL
2	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING SET	188SBK PSA	BK	ZER
1	EA	MULLION SEAL	139N PSA		ZER
2	EA	WIRE HARNESS	CON-(LENGTH AS REQ'D) FROM LOCK TO EPT		SCH
2	EA	WIRE HARNESS	CON-6W (FROM CON TO POWER SUPPLY)		SCH
1	EA	CREDENTIAL READER	BY SECURITY CONTRACTOR		B/O
2	EA	DOOR CONTACT (AS REQ'D)	679-05 (BY SECURITY CONTRACTOR)	BLK	SCE
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		B/O

HARDWARE GROUP NO. 801A

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	DOOR PULL, 1" ROUND	8103EZHD 10" STD	630	IVE
1	EA	PUSH PLATE	8200 8" X 16"	630	IVE
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ (AS REQ'D)	695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR/ WALL STOP	FS436/ WS401 (AS REQ'D)	626	IVE
3	EA	SILENCER / SEALS (AS REQ'D)	SR64 / SEAL BY FRAME SUPPLIER	GRY	IVE

HARDWARE GROUP NO. 801AC

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	DOOR PULL, 1" ROUND	8103EZHD 10" STD	630	IVE
1	EA	PUSH PLATE	8200 8" X 16"	630	IVE
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER / SEALS (AS REQ'D)	SR64 / SEAL BY FRAME SUPPLIER	GRY	IVE

HARDWARE GROUP NO. C201

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	EU MORTISE LOCK	L9092HDEU 17A CON	630	SCH
1	EA	PEMANENT IC CORE	IC-7 PIN CORE	630	BES
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ (AS REQ'D)	695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR/ WALL STOP	FS436/ WS401 (AS REQ'D)	626	IVE
1	EA	GASKETING SET	188SBK PSA	BK	ZER
1	EA	WIRE HARNESS	CON-(LENGTH AS REQ'D) FROM LOCK TO EPT		SCH
1	EA	WIRE HARNESS	CON-6W (FROM CON TO POWER SUPPLY)		SCH
1	EA	CREDENTIAL READER	BY SECURITY CONTRACTOR		B/O
1	EA	DOOR POSITION SWITCH	BY SECURITY CONTRACTOR		B/O
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		B/O
		NOTE:	5BB1HW 5 X 4.5 @ DOORS > 3'0"		

OPERATIONAL DESCRIPTION: ENTRANCE BY CREDENTIAL READER OR MANUAL KEY OVER-RIDE. ALWAYS FREE EGRESS. FAIL SAFE.

HARDWARE GROUP NO. C201A

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	EU MORTISE LOCK	L9092HDEU 17A CON	630	SCH
1	EA	PEMANENT IC CORE	IC-7 PIN CORE	630	BES
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ (AS REQ'D)	695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR/ WALL STOP	FS436/ WS401 (AS REQ'D)	626	IVE
3	EA	SILENCER / SEALS (AS REQ'D)	SR64 / SEAL BY FRAME SUPPLIER	GRY	IVE
1	EA	WIRE HARNESS	CON-(LENGTH AS REQ'D) FROM LOCK TO EPT		SCH
1	EA	WIRE HARNESS	CON-6W (FROM CON TO POWER SUPPLY)		SCH
1	EA	CREDENTIAL READER	BY SECURITY CONTRACTOR		B/O
1	EA	DOOR POSITION SWITCH	BY SECURITY CONTRACTOR		B/O
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		B/O
		NOTE:	5BB1HW 5 X 4.5 @ DOORS > 3'0"		

OPERATIONAL DESCRIPTION: ENTRANCE BY CREDENTIAL READER OR MANUAL KEY OVER-RIDE. ALWAYS FREE EGRESS. FAIL SAFE.

HARDWARE GROUP NO. CD205

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	EU MORTISE LOCK	L9092HDEU 17A CON	630	SCH
1	EA	PEMANENT IC CORE	IC-7 PIN CORE	630	BES
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ (AS REQ'D)	695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS18L	BLK	IVE
1	EA	RAIN DRIP	142AA (AS REQ'D)	AA	ZER
1	EA	GASKETING SET	188SBK PSA	BK	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A-V3-223	A	ZER
1	EA	WIRE HARNESS	CON-(LENGTH AS REQ'D) FROM LOCK TO EPT		SCH
1	EA	WIRE HARNESS	CON-6W (FROM CON TO POWER SUPPLY)		SCH
1	EA	CREDENTIAL READER	BY SECURITY CONTRACTOR		B/O
1	EA	DOOR POSITION SWITCH	BY SECURITY CONTRACTOR		B/O
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		B/O
		NOTE:	5BB1HW 5 X 4.5 @ DOORS > 3'0"		

OPERATIONAL DESCRIPTION: ENTRANCE BY CREDENTIAL READER OR MANUAL KEY OVER-RIDE. ALWAYS FREE EGRESS. FAIL SAFE.

HARDWARE GROUP NO. CD715

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-98-L-NL-17SS-CON-SNB-SEC	630	VON
1	EA	PEMANENT IC CORE	IC-7 PIN CORE	630	BES
1	EA	SFIC RIM CYLINDER	C953-7CCA	630	FAL
1	EA	SURFACE CLOSER	4040XP EDA SRI TBSRT	689	LCN
1	EA	PA MOUNTING PLATE	4040XP-18PA SRI (AS REQ'D)	689	LCN
1	EA	CUSH SHOE SUPPORT	4040XP-30 (AS REQ'D)	689	LCN
1	EA	BLADE STOP SPACER	4040XP-61 (AS REQ'D)	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS18L	BLK	IVE
1	EA	RAIN DRIP	142AA (AS REQ'D)	AA	ZER
1	EA	GASKETING SET	188SBK PSA	BK	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A-V3-223	A	ZER
1	EA	WIRE HARNESS	CON-(LENGTH AS REQ'D) FROM LOCK TO EPT		SCH
1	EA	WIRE HARNESS	CON-6W (FROM CON TO POWER SUPPLY)		SCH
1	EA	DOOR CONTACT (AS REQ'D)	679-05 (BY SECURITY CONTRACTOR)	BLK	SCE
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		B/O

OPERATIONAL DESCRIPTION: ENTRANCE BY CREDENTIAL READER OR MANUAL KEY OVER-RIDE. ALWAYS FREE EGRESS. FAIL SECURE.

HARDWARE GROUP NO. CD724AM

PROVIDE EACH PR DOOR(S) WITH THE FOLLOWING:

2	EA	CONT. HINGE	112HD / 224HD EPT (AS REQ'D)	628	IVE
2	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	REMOVABLE MULLION	KR4954 STAB	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-98-L-DT-17SS-CON-SNB-SEC	630	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-98-L-NL-17SS-CON-SNB-SEC	630	VON
1	EA	MULLION STORAGE KIT	MT54	689	VON
2	EA	PEMANENT IC CORE	IC-7 PIN CORE	630	BES
1	EA	SFIC RIM CYLINDER	C953-7CCA	630	FAL
1	EA	MUL MORT. CYLINDER	C987-7CCA X A12667-003-00 X A08790-001	626	FAL
2	EA	SURFACE CLOSER	4040XP EDA SRI TBTRX	689	LCN
2	EA	PA MOUNTING PLATE	4040XP-18PA SRI (AS REQ'D)	689	LCN
2	EA	CUSH SHOE SUPPORT	4040XP-30 (AS REQ'D)	689	LCN
2	EA	BLADE STOP SPACER	4040XP-61 (AS REQ'D)	689	LCN
2	EA	FLOOR STOP	FS18L	BLK	IVE
1	SET	SEAL	PERIMETER SEAL BY DOOR/FRAME MANUFACTURER		
1	EA	MULLION SEAL	139N PSA		ZER
2	EA	WIRE HARNESS	CON-(LENGTH AS REQ'D) FROM LOCK TO EPT		SCH
2	EA	WIRE HARNESS	CON-6W (FROM CON TO POWER SUPPLY)		SCH
1	EA	CREDENTIAL READER	BY SECURITY CONTRACTOR		B/O
2	EA	DOOR CONTACT (AS REQ'D)	679-05 (BY SECURITY CONTRACTOR)	BLK	SCE

1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR	B/O

OPERATIONAL DESCRIPTION: ENTRANCE BY CREDENTIAL READER, MANUAL KEY OVER-RIDE OR BY SECURITY SYSTEM. ALWAYS FREE EGRESS. FAIL SECURE.

HARDWARE GROUP NO. CD724M

PROVIDE EACH PR DOOR(S) WITH THE FOLLOWING:

2	EA	CONT. HINGE	112HD / 224HD EPT (AS REQ'D)	628	IVE
2	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	REMOVABLE MULLION	KR4954 STAB	689	VON
1	EA	ELEC PANIC HARDWARE	LD-RX-98-EO-CON-SNB-SEC	630	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-98-L-NL-17SS-CON-SNB-SEC	630	VON
1	EA	MULLION STORAGE KIT	MT54	689	VON
2	EA	PEMANENT IC CORE	IC-7 PIN CORE	630	BES
1	EA	SFIC RIM CYLINDER	C953-7CCA	630	FAL
1	EA	MUL MORT. CYLINDER	C987-7CCA X A12667-003-00 X A08790-001	626	FAL
2	EA	SURFACE CLOSER	4040XP EDA SRI TBTRX	689	LCN
2	EA	PA MOUNTING PLATE	4040XP-18PA SRI (AS REQ'D)	689	LCN
2	EA	CUSH SHOE SUPPORT	4040XP-30 (AS REQ'D)	689	LCN
2	EA	BLADE STOP SPACER	4040XP-61 (AS REQ'D)	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
2	EA	FLOOR STOP	FS18L	BLK	IVE
1	EA	GASKETING SET	188SBK PSA	BK	ZER
1	EA	MULLION SEAL	139N PSA		ZER
2	EA	WIRE HARNESS	CON-(LENGTH AS REQ'D) FROM LOCK TO EPT		SCH
2	EA	WIRE HARNESS	CON-6W (FROM CON TO POWER SUPPLY)		SCH
1	EA	CREDENTIAL READER	BY SECURITY CONTRACTOR		B/O
2	EA	DOOR CONTACT (AS REQ'D)	679-05 (BY SECURITY CONTRACTOR)	BLK	SCE

1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		B/O

OPERATIONAL DESCRIPTION: ENTRANCE BY CREDENTIAL READER OR MANUAL KEY OVER-RIDE. ALWAYS FREE EGRESS. FAIL SECURE.

HARDWARE GROUP NO. D00K

PROVIDE EACH RU DOOR(S) WITH THE FOLLOWING:

1	EA	SFIC MORTISE CYL. W/ COLLAR	80-110 X 36-079-025 X K510-730 138	630	SCH
1	EA	SFIC CONST. CORE	C607CCA	622	FAL
1	EA	PEMANENT IC CORE	IC-7 PIN CORE	630	BES
1	EA	DOOR POSITION SWITCH (AS REQ'D)	BY SECURITY CONTRACTOR		B/O
1	EA	KEY SWITCH	653-0404	630	SCE

NOTE: BALANCE OF HARDWARE BY OTHERS

END OF SECTION

08 80 00 GLAZING

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes:

1. Glass for windows, doors, interior borrowed lites and storefront framing.

2. Glazing sealants and accessories.

1.03 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C1036.

C. IBC: International Building Code.

D. Interspace: Space between lites of an insulating-glass unit.

1.04 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.05 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

2. Review temporary protection requirements for glazing during and after installation.

1.06 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.

C. Glazing Accessory Samples: For sealants, in 12-inch (300-mm) lengths. Install sealant Samples between two strips of material representative in color of the adjoining framing system.

D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

E. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.07 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For glass.

C. Product Test Reports: For tinted glass, insulating glass and glazing sealants, for tests performed by a qualified testing agency.

1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

D. Preconstruction adhesion and compatibility test report.

E. Sample Warranties: For special warranties.

1.08 QUALITY ASSURANCE

A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.

B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

E. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Install glazing in mockups specified in Section 084113 "Aluminum-Framed Entrances and Storefronts" to match glazing systems required for Project, including glazing methods.

2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.09 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.

2. Use ASTM C1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.

3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.

4. Schedule enough time for testing and analyzing results to prevent delaying the Work.

5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.11 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F (4.4 deg C).

1.12 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of

laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: 10 years from date of Substantial Completion.

C. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

2.00 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Basis of Design Product – Solarban 70XL by Vitro Architectural Glass. Subject to compliance with requirements, provide basis of design product, or equal products by one of the following:

1. AGC Glass Company North America, Inc.
2. Cardinal Glass Industries.
3. Cristacurva.
4. Dlubak Corporation.
5. Gardner Glass, Inc.
6. GGI; General Glass International.
7. Glasswerks LA, Inc.
8. GTI; Glaz-Tech Industries.

9. Guardian Glass; SunGuard.

10. Hartung Glass Industries.

11. JE Berkowitz, LP.

12. Northwestern Industries, Inc.

13. Oldcastle BuildingEnvelope™.

14. Pilkington North America.

15. Schott North America, Inc.

16. Tecnoglass.

17. Trulite Glass & Aluminum Solutions, LLC.

18. Vetrotech Saint-Gobain.

19. Viracon, Inc.

B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.

1. Obtain tinted glass from single source from single manufacturer.

2. Obtain reflective-coated glass from single source from single manufacturer.

C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.02 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.

C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E1300.

1. Design Wind Pressures: As indicated on Drawings.

2. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.

    a. Wind Design Data: As indicated on Drawings.

3. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch (25 mm), whichever is less.

4. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

D. Windborne-Debris Impact Resistance: Exterior glazing shall pass ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 3 for enhanced protection.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.

E. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

F. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.

2. For laminated-glass lites, properties are based on products of construction indicated.

3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.

4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).

5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.

6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.03 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."

2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."

3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."

4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.

1. Minimum Glass Thickness for Exterior Lites: 6 mm.

2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.

E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-

strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.04 GLASS PRODUCTS

A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.

B. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

C. Heat-Strengthened Float Glass: ASTM C1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

COATING IN "PYROLYTIC-COATED, LOW-MAINTENANCE GLASS" PARAGRAPH BELOW IS AVAILABLE ONLY ON CLEAR FLOAT GLASS AND IS APPLIED PYROLYTICALLY ON THE FLOAT LINE. CONSEQUENTLY, IF A REFLECTIVE OR LOW-E COATING IS REQUIRED (WHICH WOULD BE ON THE SECOND SURFACE, WHICH WAS EXPOSED TO THE MOLTEN TIN BATH ON THE FLOAT LINE), IT MUST BE A SPUTTERED COATING.

2.05 LAMINATED GLASS

A. Windborne-Debris-Impact-Resistant Laminated Glass: Comply with requirements specified above for laminated glass except laminate glass with the following to comply with interlayer manufacturer's written instructions:

1. Polyvinyl butyral interlayer.

2.06 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E2190.

1. Sealing System: Dual seal, with polyisobutylene and silicone primary and secondary sealants.

2. Perimeter Spacer: Manufacturer's standard spacer material and construction.

3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.07 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 100/50, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Dow Corning Corporation; 790

b. GE Construction Sealants; Momentive Performance Materials Inc.

c. May National Associates, Inc.; a subsidiary of Sika Corporation.

d. Pecora Corporation.

e. Sika Corporation.

2.08 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.09 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks:

1. EPDM with a Shore A durometer hardness of 85, plus or minus 5.
2. Type recommended by sealant or glass manufacturer.

D. Spacers:

1. EPDM blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks:

1. EPDM with a Shore A durometer hardness per manufacturer's written instructions.

F. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.10 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

a. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

3.00 EXECUTION

3.01 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.

2. Presence and functioning of weep systems.

3. Minimum required face and edge clearances.

4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.03 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.

2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.04 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.05 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.06 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.07 CLEANING AND PROTECTION

A. Immediately after installation remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.08 MONOLITHIC GLASS SCHEDULE

A. Glass Type G1: Clear fully tempered float glass.

1. Minimum Thickness: 6 mm.

2. Safety glazing required.

3.09 LAMINATED GLASS SCHEDULE

A. Glass Type G2: Clear laminated glass with two plies of fully tempered float glass.

1. Minimum Thickness of Each Glass Ply: 6 mm.

2. Interlayer Thickness: 0.090 inch (2.29 mm).

3. Safety glazing required.

3.10 INSULATING-LAMINATED-GLASS SCHEDULE

A. Glass Type G3: Low-E-coated, tinted, insulating laminated glass.

1. Basis-of-Design Product: Vitro Architectural Glass Solarban 70 XL Pacifica.

2. Overall Unit Thickness: 1-3/16 inch (30 mm).

3. Minimum Thickness of Outdoor Lite: 6 mm.

4. Outdoor Lite: Tinted fully tempered float glass.

5. Tint Color: Blue-green.

6. Interspace Content: Air.

7. Indoor Lite: Clear laminated glass with two plies of fully tempered float glass.

a. Minimum Thickness of Each Glass Ply: 6 mm.

b. Interlayer Thickness: 0.090 inch (2.29 mm).

8. Low-E Coating: Pyrolytic on second surface.

9. Winter Nighttime U-Factor: 0.28 maximum.

10. Visible Light Transmittance: 32 percent minimum.

11. Solar Heat Gain Coefficient: 0.19 maximum.

12. Safety glazing required.

END OF SECTION

08 91 19 FIXED LOUVERS

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

B. Section Includes:

1. Fixed extruded-aluminum louvers.

C. Related Requirements:

1. Section 081113 "Hollow Metal Doors and Frames" for louvers in hollow-metal doors.
2. Section 081416 "Flush Wood Doors" for louvers in flush wood doors.

1.03 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

B. Horizontal Louver: Louver with horizontal blades (i.e., the axis of the blades are horizontal).

C. Vertical Louver: Louver with vertical blades (i.e., the axis of the blades are vertical).

D. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

E. Wind-Driven-Rain-Resistant Louver: Louver that provides specified wind-driven-rain performance, as determined by testing according to AMCA 500-L.

F. Windborne-Debris-Impact-Resistant Louver: Louver that provides specified windborne-debris-impact resistance, as determined by testing according to AMCA 540.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1. Show weep paths, gaskets, flashings, sealants, and other means of preventing water intrusion.

2. Show mullion profiles and locations.

C. Samples: For each type of metal finish required.

D. Delegated-Design Submittal: For louvers indicated to comply with structural performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.05 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

B. Windborne-debris-impact-resistance test reports.

C. Sample Warranties: For manufacturer's special warranties.

1.06 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

FIELD CONDITIONS

B. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.07 WARRANTY

A. Special Finish Warranty: Manufacturer agrees to repair or replace components on which finishes fail in materials or workmanship within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D2244.

b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.

c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: Five years from date of Substantial Completion.

2.00 PRODUCTS

2.01 MANUFACTURERS

A. Source Limitations: Obtain fixed and operable louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.02 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural performance requirements and design criteria indicated.

B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1. Wind Loads: Determine loads based on pressures as indicated on Drawings.

C. Windborne-Debris-Impact Resistance: Louvers located within 30 feet (9.1 m) of grade shall pass enhanced protection, when tested according to AMCA 540.

D. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

F. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

2.03 FIXED EXTRUDED-ALUMINUM LOUVERS

A. Horizontal, Drainable-Blade, Windborne-Debris-Impact-Resistant Louver:

1. Basis-of-Design Product: Subject to compliance with requirements, provide model ELF6375DXD as manufactured by Ruskin Company or comparable product by one of the following:

a. Air Balance Inc.; a Mestek company.

b. Air Flow Company, Inc.

c. Airolite Company, LLC (The).

d. All-Lite Architectural Products.

e. American Warming and Ventilating, Inc.; a Mestek company.

f. Arrow United Industries; a division of Mestek, Inc.

g. Construction Specialties, Inc.

h. Greenheck Fan Corporation.

i. Industrial Louvers, Inc.

j. NCA Manufacturing, Inc.

k. Nystrom Building Products.

l. Reliable Products, Inc.

m. United Enertech Corp.

2. Louver Depth: 6 inches (150 mm).

3. Frame and Blade Nominal Thickness: Not less than 0.080 inch (2.03 mm).

4. Mullion Type: Exposed.

5. Louver Performance Ratings:

a. Free Area: Not less than 5.0 sq. ft. (0.46 sq. m) for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.

b. Air Performance: Not more than 0.10-inch wg (25-Pa) static pressure drop at 600-fpm (3.0-m/s) free-area intake velocity.

c. Wind-Driven Rain Performance: Not less than 99 percent effectiveness when subjected to a rainfall rate of 3 inches (75 mm) per hour and a wind speed of 29 mph (13 m/s) at a core-area intake velocity of 300 fpm (1.5 m/s).

6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.04 LOUVER SCREENS

A. General: Provide screen at each exterior louver.

1. Screen Location for Fixed Louvers: Interior face.

2. Screening Type: Insect screening.

B. Secure screen frames to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches (150 mm) from each corner and at 12 inches (300 mm) o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

1. Metal: Same type and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.

2. Finish: Same finish as louver frames to which louver screens are attached.

3. Type: Rewirable frames with a driven spline or insert.

D. Louver Screening for Aluminum Louvers:

1. Insect Screening: Aluminum, 18-by-16 (1.4-by-1.6-mm) mesh, 0.012-inch (0.30-mm) wire.

2.05 MATERIALS

A. Aluminum Extrusions: ASTM B221 (ASTM B221M), Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B209 (ASTM B209M), Alloy 3003 or 5005, with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Fasteners: Use types and sizes to suit unit installation conditions.

1. Use hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.

2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.

3. For color-finished louvers, use fasteners with heads that match color of louvers.

D. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, fabricated from stainless-steel components, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as

determined by testing according to ASTM E488/E488M conducted by a qualified testing agency.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.06 FABRICATION

A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.

1. Continuous Vertical Assemblies: Fabricate units without interrupting blade-spacing pattern.

2. Horizontal Mullions: Provide horizontal mullions at joints.

C. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

E. Include supports, anchorages, and accessories required for complete assembly.

F. Provide vertical mullions of type and at spacings indicated, but not more than is recommended by manufacturer, or 72 inches (1830 mm) o.c., whichever is less.

1. Exposed Mullions: Where indicated, provide units with exposed mullions of same width and depth as louver frame. Where length of louver exceeds fabrication and handling limitations, provide interlocking split mullions designed to permit expansion and contraction.

G. Provide subsills made of same material as louvers for recessed louvers.

H. Join frame members to each other and to fixed louver blades with fillet welds concealed from view unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.07 ALUMINUM FINISHES

A. Finish louvers after assembly.

B. High-Performance Organic Finish: Three-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 50 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

3.00 EXECUTION

3.01 EXAMINATION

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.03 INSTALLATION

A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Protect unpainted galvanized- and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

3.04 ADJUSTING AND CLEANING

A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Restore louvers damaged during installation and construction, so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION

DIVISION 9

FINISHES

09 22 16 NON-STRUCTURAL METAL FRAMING

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior partitions.
2. Suspension systems for interior ceilings and soffits.
3. Grid suspension systems for gypsum board ceilings.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.04 QUALITY ASSURANCE

A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association the Steel Framing Industry Association or the Steel Stud Manufacturers Association.

2.00 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

C. Horizontal Deflection: For composite wall assemblies, limited to 1/240 of the wall height based on horizontal loading of 5 lbf/sq. ft. (239 Pa).

2.02 FRAMING SYSTEMS

A. Framing Members, General: Comply with ASTM C754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C645 requirements for steel unless otherwise indicated.

2. Protective Coating: ASTM A653/A653M, G60 (Z180), hot-dip galvanized unless otherwise indicated.

B. Studs and Tracks: ASTM C645. Use either conventional steel studs and tracks or embossed, high-strength steel studs and tracks.

1. Steel Studs and Tracks:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) CEMCO; California Expanded Metal Products Co.

2) ClarkDietrich.

3) Custom Stud.

4) Jaimes Industries.

5) MarinoWARE.

6) MBA Building Supplies.

7) MRI Steel Framing, LLC.

8) Phillips Manufacturing Co.

9) SCAFCO Steel Stud Company.

10) Steel Construction Systems.

11) Telling Industries.

a. Minimum Base-Steel Thickness: 0.0179 inch (0.455 mm).

b. Depth: As indicated on Drawings.

1. Embossed, High Strength Steel Studs and Tracks: Roll-formed and embossed with surface deformations to stiffen the framing members so that they are structurally comparable to conventional ASTM C645 steel studs and tracks.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) CEMCO; California Expanded Metal Products Co.

2) ClarkDietrich.

3) MarinoWARE.

4) MBA Building Supplies.

5) Phillips Manufacturing Co.

6) SCAFCO Steel Stud Company.

7) Steel Construction Systems.

8) Telling Industries.

b. Minimum Base-Steel Thickness: 0.0147 inch (0.373 mm).

c. Depth: As indicated on Drawings.

C. Slip-Type Head Joints: Where indicated, provide[**one of**] the following:

1. Clip System: Clips designed for use in head-of-wall deflection conditions that provide a positive attachment of studs to tracks while allowing 1-1/2-inch (38-mm) minimum vertical movement.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) CEMCO; California Expanded Metal Products Co.

2) ClarkDietrich.

3) Fire Trak Corp.

4) MarinoWARE.

5) SCAFCO Steel Stud Company.

6) Steel Construction Systems.

7) Super Stud Building Products Inc.

2. Single Long-Leg Track System: ASTM C645 top track with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top track and with continuous bridging located within 12 inches (305 mm) of the top of studs to provide lateral bracing.

D. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CEMCO; California Expanded Metal Products Co.

b. ClarkDietrich.

c. Fire Trak Corp.

d. MarinoWARE.

e. Metal-Lite.

f. Perfect Wall, Inc.

g. SCAFCO Steel Stud Company.

h. Steel Construction Systems.

E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ClarkDietrich.

b. MarinoWARE.

c. MBA Building Supplies.

d. MRI Steel Framing, LLC.

e. SCAFCO Steel Stud Company.

2. Minimum Base-Steel Thickness: 0.0179 inch (0.455 mm).

F. Cold-Rolled Channel Bridging: Steel, 0.0538-inch (1.367-mm) minimum base-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ClarkDietrich.

b. MarinoWARE.

c. MBA Building Supplies.

d. MRI Steel Framing, LLC.

e. SCAFCO Steel Stud Company.

2. Depth: 1-1/2 inches (38 mm).

3. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.

G. Hat-Shaped, Rigid Furring Channels: ASTM C645.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. ClarkDietrich.

    b. Jaimes Industries.

    c. MarinoWARE.

    d. MBA Building Supplies.

    e. MRI Steel Framing, LLC.

    f. SCAFCO Steel Stud Company.

2. Minimum Base-Steel Thickness: 0.0179 inch (0.455 mm).

3. Depth: As indicated on Drawings.

2.03 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

B. Hanger Attachments to Concrete:

1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, AC193, AC58 or AC308 as appropriate for the substrate.

    a. Uses: Securing hangers to structure.

    b. Type: Torque-controlled, expansion anchor, torque-controlled, adhesive anchor or adhesive anchor.

    c. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.

2. Power-Actuated Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

C. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.

D. Flat Hangers: Steel sheet, 1 by 3/16 inch (25 by 5 mm) by length indicated.

E. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch (1.367 mm) and minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: 2-1/2 inches (64 mm).

F. Grid Suspension System for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armstrong World Industries, Inc.

b. Rockfon (Rockwool International).

1.2 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide one of the following:

1. Asphalt-Saturated Organic Felt: ASTM D226/D226M, Type I (No. 15 asphalt felt), nonperforated.

2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

INSERT ADDITIONAL AUXILIARY MATERIALS, SUCH AS PARTITION AND OUTLET BOX ISOLATION PADS TO MAINTAIN ACOUSTIC ISOLATION, HERE.

3.00 EXECUTION

3.01 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

B. Coordination with Sprayed Fire-Resistive Materials:

1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling tracks to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches (610 mm) o.c.

2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that are required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.03 INSTALLATION, GENERAL

A. Installation Standard: ASTM C754.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.04 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Single-Layer Application: 16 inches (406 mm) o.c. unless otherwise indicated.
2. Multilayer Application: 16 inches (406 mm) o.c. unless otherwise indicated.
3. Tile Backing Panels: 16 inches (406 mm) o.c. unless otherwise indicated.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.

2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.

    a. Install two studs at each jamb unless otherwise indicated.

    b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.

    c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

    a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

6. Curved Partitions:

    a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.

    b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches (150 mm) o.c.

E. Direct Furring:

1. Screw to wood framing.

2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.05 INSTALLING CEILING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Hangers: 48 inches (1219 mm) o.c.
2. Carrying Channels (Main Runners): 48 inches (1219 mm) o.c.
3. Furring Channels (Furring Members): 16 inches (406 mm) o.c.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

    a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

    a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate

for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.

5. Do not attach hangers to steel roof deck.

6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.

7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.

8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION

09 29 00 GYPSUM BOARD

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Interior gypsum board.

B. Related Requirements:

1. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.
2. Section 093013 "Ceramic Tiling" for cementitious backer units installed as substrates for ceramic tile.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.

1.04 QUALITY ASSURANCE

A. Mockups: Build mockups of at least 100 sq. ft. (9 sq. m) in surface area to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Build mockups for the following:

a. Each level of gypsum board finish indicated for use in exposed locations.

b. Each texture finish indicated.

2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.

3. Simulate finished lighting conditions for review of mockups.

4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.05 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.06 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

2.00 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.02 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.03 INTERIOR GYPSUM BOARD

A. Gypsum Wallboard: ASTM C1396/C1396M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Gypsum.

b. CertainTeed Corporation.

c. Continental Building Products, LLC.

d. Georgia-Pacific Gypsum LLC.

e. National Gypsum Company.

f. PABCO Gypsum.

2. Thickness: 5/8 inch (15.9 mm) .

3. Long Edges: Tapered.

B. Gypsum Board, Type X: ASTM C1396/C1396M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Gypsum.

    b. CertainTeed Corporation.

    c. Continental Building Products, LLC.

    d. Georgia-Pacific Gypsum LLC.

    e. National Gypsum Company.

    f. PABCO Gypsum.

2. Thickness: 5/8 inch (15.9 mm).

3. Long Edges: Tapered.

C. Flexible Gypsum Board: ASTM C1396/C1396M. Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. CertainTeed Corporation.

    b. Continental Building Products, LLC.

    c. Georgia-Pacific Gypsum LLC.

    d. National Gypsum Company.

    e. PABCO Gypsum.

2. Thickness: 1/4 inch (6.4 mm).

3. Long Edges: Tapered.

D. Gypsum Ceiling Board: ASTM C1396/C1396M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Gypsum.

    b. CertainTeed Corporation.

    c. Continental Building Products, LLC.

    d. Georgia-Pacific Gypsum LLC.

    e. National Gypsum Company.

    f. PABCO Gypsum.

2. Thickness: 1/2 inch (12.7 mm).

3. Long Edges: Tapered.

E. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Gypsum.

    b. CertainTeed Corporation.

    c. Continental Building Products, LLC.

    d. Georgia-Pacific Gypsum LLC.

    e. National Gypsum Company.

    f. PABCO Gypsum.

2. Core: 5/8 inch (15.9 mm), Type X.

3. Long Edges: Tapered.

4. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.04 TRIM ACCESSORIES

A. Interior Trim: ASTM C1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.

2. Shapes:

a. Cornerbead.

b. Bullnose bead.

c. LC-Bead: J-shaped; exposed long flange receives joint compound.

d. L-Bead: L-shaped; exposed long flange receives joint compound.

e. U-Bead: J-shaped; exposed short flange does not receive joint compound.

f. Expansion (control) joint.

g. Curved-Edge Cornerbead: With notched or flexible flanges.

2.05 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C475/C475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.

2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.

a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use drying-type, all-purpose compound.

4. Finish Coat: For third coat, use drying-type, all-purpose compound.

5. Skim Coat: For final coat of Level 5 finish, use high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.

2.06 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.

2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

E. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E90.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Accumetric LLC.

b. Everkem Diversified Products, Inc.

c. Franklin International.

d. Grabber Construction Products.

e. Hilti, Inc.

f. Pecora Corporation.

g. Specified Technologies, Inc.

F. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

G. Vapor Retarder: As specified in Section 072600 "Vapor Retarders."

3.00 EXECUTION

3.01 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.

2. Fit gypsum panels around ducts, pipes, and conduits.

3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.

J. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

K. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.03 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Wallboard Type: As indicated on Drawings.

2. Type X: Where required for fire-resistance-rated assembly and at vertical surfaces unless otherwise indicated.

3. Flexible Type: Apply in double layer at curved assemblies.

4. Ceiling Type: Ceiling surfaces.

5. Mold-Resistant Type: As indicated on Drawings.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.

2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

a. Stagger abutting end joints not less than one framing member in alternate courses of panels.

b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.

4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.

2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.

3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.

4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.

E. Curved Surfaces:

1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch- (300-mm-) long straight sections at ends of curves and tangent to them.

2. For double-layer construction, fasten base layer to studs with screws 16 inches (400 mm) o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches (300 mm) o.c.

3.04 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to ASTM C840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners unless otherwise indicated.
2. LC-Bead: Use at exposed panel edges.
3. L-Bead: Use where indicated.
4. Curved-Edge Cornerbead: Use at curved openings.

3.05 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for tile.
3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
    a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
4. Level 5: Where indicated on Drawings.

a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

3.06 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

09 30 13 CERAMIC TILING

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Porcelain tile.
2. Glazed wall tile.
3. Stone thresholds.
4. Tile backing panels.
5. Crack isolation membrane.
6. Metal edge strips.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.

1.03 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in its "Specifications for Installation of Ceramic Tile."

C. Face Size: Actual tile size, excluding spacer lugs.

D. Module Size: Actual tile size plus joint width indicated.

1.04 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

C. Samples for Initial Selection: For tile, grout, and accessories involving color selection.

D. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required.
2. Full-size units of each type of trim and accessory for each color and finish required.
3. Stone thresholds in 6-inch (150-mm) lengths.
4. Metal edge strips in 6-inch (150-mm) lengths.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

C. Product Certificates: For each type of product.

D. Product Test Reports: For tile-setting and -grouting products and certified porcelain tile.

1.07 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of each type of floor tile installation.
2. Build mockup of each type of wall tile installation.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

1.09 FIELD CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

2.00 PRODUCTS

2.01 MANUFACTURERS

A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.

1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.
2. Obtain crack isolation membrane, except for sheet products, from manufacturer of setting and grouting materials.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:

1. Stone thresholds.
2. Waterproof membrane.
3. Crack isolation membrane.
4. Cementitious backer units.
5. Metal edge strips.

2.02 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard grade requirements unless otherwise indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.

1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

2.03 TILE PRODUCTS

A. Ceramic Tile Type FT01: Glazed porcelain tile.

1. Manufacturers: Subject to compliance with requirements, provide Arizona Tile Savannah, or comparable product by one of the following:

a. American Marazzi Tile, Inc.
b. American Olean; a division of Dal-Tile Corporation.
c. Crossville, Inc.
d. Daltile.
e. Florida Tile, Inc.
f. Florim USA.
g. Grupo Porcelanite.
h. Interceramic.
i. Iris US.

2. Certification: Tile certified by the Porcelain Tile Certification Agency.
3. Face Size: 6 by 24 inches (150 by 600 mm).
4. Face Size Variation: Rectified.
5. Face: Plain with cushion edges.
6. Tile Color, Glaze, and Pattern: Dust.
7. Grout Color: As selected by Architect from manufacturer's full range.

2.04 THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch (1.5 mm) above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch (12.7 mm) or less above adjacent floor surface.

B. Marble Thresholds: ASTM C503/C503M, with a minimum abrasion resistance of 12 according to ASTM C1353 or ASTM C241/C241M and with honed finish.

1. Description: Uniform, fine- to medium-grained white stone with gray veining.

2.05 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 or ASTM C1325, Type A, in maximum lengths available to minimize end-to-end butt joints.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. C-Cure.
b. Custom Building Products.
c. FinPan, Inc.
d. Georgia-Pacific Gypsum LLC.

2. Thickness: 5/8 inch (15.9 mm).

2.06 CRACK ISOLATION MEMBRANE

A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.12 for high performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and fabric reinforcement.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Boiardi Products Corporation; a QEP company.
b. Bonsal American, an Oldcastle company.
c. Bostik, Inc.
d. Custom Building Products.
e. H.B. Fuller Construction Products Inc. / TEC.
f. LATICRETE SUPERCAP, LLC.
g. MAPEI Corporation.
h. Merkrete; a Parex USA, Inc. brand.
i. Southern Grouts & Mortars, Inc.

C. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Bostik, Inc.
b. C-Cure.
c. Custom Building Products.
d. H.B. Fuller Construction Products Inc. / TEC.
e. Jamo Inc.
f. LATICRETE SUPERCAP, LLC.
g. MAPEI Corporation.
h. Merkrete; a Parex USA, Inc. brand.
i. Siena Products; Omega.

D. Latex-Portland Cement Crack-Resistant Mortar: Flexible mortar consisting of cement-based mix and latex additive.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ARDEX Americas.
b. Boiardi Products Corporation; a QEP company.
c. C-Cure.
d. H.B. Fuller Construction Products Inc. / TEC.

2.07 SETTING MATERIALS

A. Standard Dry-Set Mortar (Thinset): ANSI A118.1.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Boiardi Products Corporation; a QEP company.
b. Bonsal American, an Oldcastle company.
c. Bostik, Inc.
d. C-Cure.
e. Custom Building Products.
f. H.B. Fuller Construction Products Inc. / TEC.
g. Jamo Inc.
h. LATICRETE SUPERCAP, LLC.
i. MAPEI Corporation.
j. Siena Products; Omega.
k. Southern Grouts & Mortars, Inc.

2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.1.

2.08 GROUT MATERIALS

A. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L or less.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ARDEX Americas.
b. Atlas Minerals & Chemicals, Inc.
c. Boiardi Products Corporation; a QEP company.
d. Bonsal American, an Oldcastle company.
e. Bostik, Inc.
f. C-Cure.
g. Custom Building Products.
h. H.B. Fuller Construction Products Inc. / TEC.
i. Jamo Inc.
j. LATICRETE SUPERCAP, LLC.
k. MAPEI Corporation.
l. Merkrete; a Parex USA, Inc. brand.
m. Sauereisen.
n. Siena Products; Omega.
o. Southern Grouts & Mortars, Inc.

2. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F (60 and 100 deg C), respectively, and certified by manufacturer for intended use.

2.09 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Vapor-Retarder Membrane: Polyethylene sheeting, ASTM D4397, 4.0 mils (0.1 mm) thick.

C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

1.2 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

3.00 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that concrete substrates for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

    a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
    b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.

3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from

other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.03 INSTALLATION OF CERAMIC TILE

C. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:

    a. Tile floors in wet areas.
    b. Tile floors consisting of tiles 8 by 8 inches (200 by 200 mm) or larger.
    c. Tile floors consisting of rib-backed tiles.

D. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

E. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

F. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

G. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.

H. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

I. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:

1. Glazed Wall Tile: 1/8 inch (3.2 mm).
2. Porcelain Tile: 3/8 inch (9.5 mm).

J. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

K. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.

1. Do not extend crack isolation membrane under thresholds set in standard dry-set mortar. Fill joints between such thresholds and adjoining tile set on crack isolation membrane with elastomeric sealant.

3.04 INSTALLATION OF TILE BACKING PANEL

A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use modified dry-set mortar for bonding material unless otherwise directed in manufacturer's written instructions.

3.05 INSTALLATION OF CRACK ISOLATION MEMBRANE

A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.

B. Allow crack isolation membrane to cure before installing tile or setting materials over it.

3.06 ADJUSTING AND CLEANING

A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.

B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect

metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.07 PROTECTION

A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.08 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor:

1. Ceramic Tile Installation: TCNA F115; thinset mortar; epoxy grout.

a. Thinset Mortar: Standard dry-set mortar.
b. Grout: Water-cleanable epoxy grout.

B. Interior Wall Installations, Wood or Metal Studs or Furring:

1. Ceramic Tile Installation: TCNA W244C or TCNA W244F; thinset mortar on cementitious backer units or fiber-cement backer board.

a. Thinset Mortar: Standard dry-set mortar.
b. Grout: Water-cleanable epoxy grout.

C. Bathtub/Shower Wall Installations, Wood or Metal Studs or Furring:

1. Ceramic Tile Installation: TCNA B412; thinset mortar on cementitious backer units or fiber-cement backer board.

a. Thinset Mortar: Standard dry-set mortar.

b. Grout: Water-cleanable epoxy grout.

END OF SECTION

09 51 13 ACOUSTICAL PANEL CEILINGS

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes acoustical panels and exposed suspension systems for interior ceilings.

B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified, 6 inches (150 mm) in size.

C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:

1. Acoustical Panels: Set of 6-inch- (150-mm-) square Samples of each type, color, pattern, and texture.
2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch- (150-mm-) long Samples of each type, finish, and color.

1.05 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.06 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockup of typical ceiling area.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

1.08 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

2.00 PRODUCTS

2.01 MANUFACTURERS

A. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

2.02 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Class A according to ASTM E1264.
2. Smoke-Developed Index: 450 or less.

B. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL or from the listings of another qualified testing agency.

2.03 ACOUSTICAL PANELS AC01

A. Manufacturers: Subject to compliance with requirements, provide Armstrong Ultima or comparable product by one of the following:

1. American Gypsum.
2. CertainTeed Corporation.
3. Rockfon (Rockwool International).
4. Tectum Inc.

B. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.

C. Classification: Provide panels as follows:

1. Type and Form: Type IV, mineral base with membrane-faced overlay; Form 2; with factory applied latex paint finish.
2. Pattern: E (lightly textured)

D. Color: White.

E. Light Reflectance (LR): Not less than 0.90.

F. Ceiling Attenuation Class (CAC): Not less than 40.

G. Noise Reduction Coefficient (NRC): Not less than 0.60.

H. Edge/Joint Detail: Reveal sized to fit flange of exposed suspension-system members.

I. Thickness: 3/4 inch (19 mm).

J. Modular Size: 24 by 24 inches (610 by 610 mm).

K. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing

no mold, mildew, or bacterial growth when tested according to ASTM D3273, ASTM D3274, or ASTM G21 and evaluated according to ASTM D3274 or ASTM G21.

2.04 METAL SUSPENSION SYSTEM

A. Manufacturers: Subject to compliance with requirements, provide Armstrong Suprafine XL 9/16”, or comparable product by one of the following:

1. CertainTeed Corporation.
2. Rockfon (Rockwool International).

B. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C635/C635M and designated by type, structural classification, and finish indicated.

1. High-Humidity Finish: Where indicated, provide coating tested and classified for "severe environment performance" according to ASTM C635/C635M.

C. Narrow-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 (Z90) coating designation; with prefinished 9/16-inch- (15-mm-) wide metal caps on flanges.
1. Structural Classification: Intermediate-duty system.
2. End Condition of Cross Runners: Override (stepped) type.
3. Face Design: Flat, flush.
4. Cap Material: Cold-rolled steel.
5. Cap Finish: Painted white.

2.05 ACCESSORIES

A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E488/E488M or ASTM E1512 as applicable, conducted by a qualified testing and inspecting agency.

a. Type: Postinstalled expansion anchors.
b. Corrosion Protection: Carbon-steel components zinc plated according to ASTM B633, Class SC 1 (mild) service condition.

c. Corrosion Protection: Stainless-steel components complying with ASTM F593 and ASTM F594, Group 1 Alloy 304 or 316.

d. Corrosion Protection: Components fabricated from nickel-copper-alloy rods complying with ASTM B164 for UNS No. N04400 alloy.

2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E1190, conducted by a qualified testing and inspecting agency.

B. Wire Hangers, Braces, and Ties: Provide wires as follows:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
2. Stainless-Steel Wire: ASTM A580/A580M, Type 304, nonmagnetic.
3. Nickel-Copper-Alloy Wire: ASTM B164, nickel-copper-alloy UNS No. N04400.
4. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch- (2.69-mm-) diameter wire.

C. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.

D. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed with 0.04-inch- (1-mm-) thick, galvanized-steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch- (8-mm-) diameter bolts.

2.06 METAL EDGE MOLDINGS AND TRIM

A. Manufacturers: Subject to compliance with requirements, provide Armstrong Suprafine XL 9/16”, or comparable product by one of the following:

1. CertainTeed Corporation.
2. Fry Reglet Corporation.
3. Gordon, Inc.
4. Rockfon (Rockwool International).

B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

1. Edge moldings shall fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

2.07 ACOUSTICAL SEALANT

A. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

3.00 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.

B. Layout openings for penetrations centered on the penetrating items.

3.03 INSTALLATION

A. Install acoustical panel ceilings according to ASTM C636/C636M and manufacturer's written instructions.

1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.

4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
8. Do not attach hangers to steel deck tabs.
9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
10. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends. Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.

1. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
2. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

3.04 ERECTION TOLERANCES

A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m), non-cumulative.

B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m), non-cumulative.

3.05 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

09 65 13 RESILIENT BASE AND ACCESSORIES

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Thermoplastic-rubber base.

2. Rubber molding accessories.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches (300 mm) long.

C. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

1.04 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Coordinate mockups in this Section with mockups specified in other Sections.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.06 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following periods:

1. 48 hours before installation.

2. During installation.

3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

C. Install resilient products after other finishing operations, including painting, have been completed.

2.00 PRODUCTS

2.01 THERMOPLASTIC-RUBBER BASE RB01

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allstate Rubber Corp.

2. Armstrong World Industries, Inc.

3. Burke Mercer Flooring Products; a division of Burke Industries Inc.

4. Flexco.

5. Nora Systems, Inc.

6. Roppe Corporation, USA.

B. Product Standard: ASTM F1861, Type TP (rubber, thermoplastic).

1. Group: I (solid, homogeneous).

2. Style and Location:

a. Style A, Straight: Provide in areas with carpet.

b. Style B, Cove: Provide in areas with resilient floor coverings and sealed concrete flooring.

C. Thickness: 0.125 inch (3.2 mm).

D. Height: 4 inches (102 mm).

E. Lengths: Cut lengths 48 inches (1219 mm) long or coils in manufacturer's standard length.

F. Outside Corners: Preformed.

G. Inside Corners: Preformed.

H. Colors: As selected by Architect from manufacturer’s full range of colors.

2.02 RUBBER MOLDING ACCESSORY

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Roppe Corporation, USA.

B. Description: Rubber carpet edge for glue-down applications, reducer strip for resilient floor covering, joiner for tile and carpet, transition strips.

C. Locations: At transitions between floor finishes.

D. Colors and Patterns: As selected by Architect from manufacturer’s full range of colors.

2.03 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

3.00 EXECUTION

3.01 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.02 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install resilient products until materials are the same temperature as space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.03 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

3.04 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.05 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Perform the following operations immediately after completing resilient-product installation:

1. Remove adhesive and other blemishes from surfaces.

2. Sweep and vacuum horizontal surfaces thoroughly.

3. Damp-mop horizontal surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION

09 91 13 EXTERIOR PAINTING

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following exterior substrates:

1. Concrete.
2. Concrete masonry units (CMUs).
3. Steel and iron.
4. Galvanized metal.
5. Aluminum (not anodized or otherwise coated).
6. Portland cement plaster (stucco).

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for shop priming of metal substrates.
2. Section 055000 "Metal Fabrications" for shop priming metal fabrications.

1.03 DEFINITIONS

A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.

B. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.

C. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.

D. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.

E. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.

F. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
2. Indicate VOC content.

B. Samples for Initial Selection: For each type of topcoat product.

C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.05 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.07 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

2.00 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Behr Process Corporation.
2. Benjamin Moore & Co.
3. California Paints.
4. Conco Paints.
5. Coronado Paint; Benjamin Moore Company.
6. Diamond Vogel Paints.
7. Dulux Canada; a licensed product of PPG Architectural Coatings.
8. Dunn-Edwards Corporation (a Nippon Paint Holdings Co. Ltd. company).
9. HEMPEL A/S.
10. Insl-X Products; Benjamin Moore & Co.
11. Kelly-Moore Paint Company Inc.
12. McCormick Paints.
13. PPG Paints.
14. Pratt & Lambert.
15. Rodda Paint Co.
16. Rust-Oleum Corporation; a subsidiary of RPM International, Inc.
17. Sherwin-Williams Company (The).
18. Valspar Corporation (The).
19. Vista Paint Corporation.

B. Products: Subject to compliance with requirements, provide one of the products listed in the Exterior Painting Schedule for the paint category indicated.

2.02 PAINT, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

C. Colors: Match Architect's samples.

2.03 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

3.00 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Masory (Clay and CMUs): 12 percent.
3. Portland Cement Plaster: 12 percent.

C. Portland Cement Plaster Substrates: Verify that plaster is fully cured.

D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

E. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.02 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer.

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

I. Aluminum Substrates: Remove loose surface oxidation.

3.03 APPLICATION

J. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
4. Paint entire exposed surface of window frames and sashes.
5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

K. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.

L. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

M. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.04 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.05 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.06 EXTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces:

1. Latex System MPI EXT 3.1A:

a. Prime Coat: Latex, exterior, matching topcoat.
b. Intermediate Coat: Latex, exterior, matching topcoat.
c. Topcoat: Latex, exterior, semi-gloss (MPI Gloss Level 5).

A. CMU Substrates:

1. Latex System MPI EXT 4.2A:

a. Prime Coat: Block filler, latex, interior/exterior.
b. Intermediate Coat: Latex, exterior, matching topcoat.
c. Topcoat: Latex, exterior, semi-gloss (MPI Gloss Level 5).

B. Steel and Iron Substrates:

1. Alkyd System MPI EXT 5.1D:

a. Prime Coat: Primer, alkyd, anticorrosive, for metal.
b. Intermediate Coat: Exterior, alkyd enamel, matching topcoat.
c. Topcoat: Alkyd, exterior, semi-gloss (MPI Gloss Level 5).

C. Galvanized-Metal Substrates:

1. Alkyd System MPI EXT 5.3B:

a. Prime Coat: Primer, galvanized, cementitious.
b. Intermediate Coat: Exterior, alkyd enamel, matching topcoat.
c. Topcoat: Alkyd, exterior, semi-gloss (MPI Gloss Level 5).

D. Portland Cement Plaster Substrates:

1. Latex System MPI EXT 9.1A:

a. Prime Coat: Latex, exterior, matching topcoat.
b. Intermediate Coat: Latex, exterior, matching topcoat.
c. Topcoat: Latex, exterior, semi-gloss (MPI Gloss Level 5).

END OF SECTION

09 91 23 INTERIOR PAINTING

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following interior substrates:

1. Concrete.
2. Concrete masonry units (CMUs).
3. Steel and iron.
4. Galvanized metal.
5. Aluminum (not anodized or otherwise coated).
6. Gypsum board.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for shop priming structural steel.
2. Section 055000 "Metal Fabrications" for shop priming metal fabrications.

1.03 DEFINITIONS

A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.

B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.

C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.

D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.

E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.

F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.

G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

2. Indicate VOC content.

B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches (200 mm) square.

2. Apply coats on Samples in steps to show each coat required for system.

3. Label each coat of each Sample.

4. Label each Sample for location and application area.

C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.05 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).

b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.

2. Remove rags and waste from storage areas daily.

1.2 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

2.00 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Behr Process Corporation.

2. Benjamin Moore & Co.

3. California Paints.

4. Conco Paints.

5. Coronado Paint; Benjamin Moore Company.

6. Diamond Vogel Paints.

7. Dulux Canada; a licensed product of PPG Architectural Coatings.

8. Dunn-Edwards Corporation (a Nippon Paint Holdings Co. Ltd. company).

9. HEMPEL A/S.

10. Insl-X Products; Benjamin Moore & Co.

11. Kelly-Moore Paint Company Inc.

12. McCormick Paints.

13. PPG Paints.

14. Pratt & Lambert.

15. Rodda Paint Co.

16. Rust-Oleum Corporation; a subsidiary of RPM International, Inc.

17. Sherwin-Williams Company (The).
18. United Gilsonite Laboratories (UGL).
19. Valspar Corporation (The).
20. Vista Paint Corporation.

B. Products: Subject to compliance with requirements, provide one of the products listed in the Interior Painting Schedule for the paint category indicated.

2.02 PAINT, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

C. Colors: As selected by Architect from manufacturer's full range.

2.03 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

3.00 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Masonry (Clay and CMUs): 12 percent.
3. Gypsum Board: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

E. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.02 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

I. Aluminum Substrates: Remove loose surface oxidation.

3.03 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.

2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.

3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

3.04 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.05 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces:

1. Latex System MPI INT 3.1E:

a. Prime Coat: Latex, interior, matching topcoat.

b. Intermediate Coat: Latex, interior, matching topcoat.

c. Topcoat: Latex, interior (MPI Gloss Level 3)

2. Alkyd System MPI INT 3.1D:

a. Prime Coat: Primer, alkali resistant, water based.

b. Intermediate Coat: Alkyd, interior, matching topcoat.

c. Topcoat: Alkyd, interior (MPI Gloss Level 3).

B. CMU Substrates:

1. Latex System MPI INT 4.2A:

a. Block Filler: Block filler, latex, interior/exterior.

b. Intermediate Coat: Latex, interior, matching topcoat.

c. Topcoat: Latex, interior (MPI Gloss Level 3).

2. Institutional Low-Odor/VOC Latex System MPI INT 4.2E:

a. Block Filler: Block filler, latex, interior/exterior.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.

c. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3).

3. Alkyd System MPI INT 4.2C:

a. Block Filler: Block filler, latex, interior/exterior.

b. Sealer Coat: Primer sealer, latex, interior.

c. Intermediate Coat: Alkyd, interior, matching topcoat.

d. Topcoat: Alkyd, interior (MPI Gloss Level 3).

C. Steel Substrates:

1. Latex System, Alkyd Primer MPI INT 5.1Q:

a. Prime Coat: Primer, alkyd, anti-corrosive, for metal.

b. Intermediate Coat: Latex, interior, matching topcoat.

c. Topcoat: Latex, interior (MPI Gloss Level 3).

2. Institutional Low-Odor/VOC Latex System MPI INT 5.1S:

a. Prime Coat: Primer, rust inhibitive, water based MPI #107.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.

c. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3).

3. High-Performance Architectural Latex System MPI INT 5.1R:

a. Prime Coat: Primer, alkyd, anti-corrosive, for metal.

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3).

4. Alkyd System MPI INT 5.1E:

a. Prime Coat: Primer, alkyd, anti-corrosive, for metal.

b. Intermediate Coat: Alkyd, interior, matching topcoat.

c. Topcoat: Alkyd, interior (MPI Gloss Level 3).

D. Galvanized-Metal Substrates:

1. Institutional Low-Odor/VOC Latex System MPI INT 5.3N:

a. Prime Coat: Primer, galvanized, water based, MPI #134.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.

c. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3).

2. Alkyd over Cementitious Primer System MPI INT 5.3C:

a. Prime Coat: Primer, galvanized, cementitious.

b. Intermediate Coat: Alkyd, interior, matching topcoat.

c. Topcoat: Alkyd, interior (MPI Gloss Level 3).

3. Aluminum Paint System (Cementitious Primer) MPI INT 5.3G:

a. Prime Coat: Primer, galvanized, cementitious.

b. Intermediate Coat: Aluminum paint, matching topcoat.

c. Topcoat: Aluminum paint.

E. Aluminum (Not Anodized or Otherwise Coated) Substrates:

1. Latex System MPI INT 5.4H:

a. Prime Coat: Primer, quick dry, for aluminum.

b. Intermediate Coat: Latex, interior, matching topcoat.

c. Topcoat: Latex, interior (MPI Gloss Level 3).

2. Institutional Low-Odor/VOC Latex System MPI INT 5.4G:

a. Prime Coat: Primer, quick dry, for aluminum.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.

c. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3).

F. Wood Substrates: Architectural woodwork.

1. Latex over Latex Primer System MPI INT 6.3T:

a. Prime Coat: Primer, latex, for interior wood.

b. Intermediate Coat: Latex, interior, matching topcoat.

c. Topcoat: Latex, interior (MPI Gloss Level 3).

2. Institutional Low-Odor/VOC Latex System MPI INT 6.3V:

a. Prime Coat: Primer, latex, for interior wood.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.

c. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3).

3. Alkyd System MPI INT 6.3B:

a. Prime Coat: Primer sealer, alkyd, interior.

b. Intermediate Coat: Alkyd, interior, matching topcoat.

c. Topcoat: Alkyd, interior (MPI Gloss Level 3).

G. Gypsum Board Substrates:

1. Latex over Latex Sealer System MPI INT 9.2A:

   a. Prime Coat: Primer sealer, latex, interior.

   b. Intermediate Coat: Latex, interior, matching topcoat.

   c. Topcoat: Latex, interior (MPI Gloss Level 3).

2. Institutional Low-Odor/VOC Latex System MPI INT 9.2M:

   a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.

   b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.

   c. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3).

3. Alkyd over Latex Sealer System MPI INT 9.2C:

   a. Prime Coat: Primer sealer, latex, interior.

   b. Intermediate Coat: Alkyd, interior, matching topcoat.

   c. Topcoat: Alkyd, interior (MPI Gloss Level 3).

END OF SECTION

09 96 00.01 HIGH-PERFORMANCE COATINGS

1.00 GENERAL

1.01 WORK INCLUDED

A. Furnish labor, materials, equipment and incidentals necessary to apply protective coatings to material and equipment as specified herein, including the preparation of surfaces prior to application of coatings.

B. Protective coatings are special coatings to be used at specific locations or on specific surfaces as indicated herein and are complementary to the coating surfaces specified in Section 09 91 00 “Painting” in that every surface of every description, except those which are specifically noted not to receive a coating finish, shall be covered by a paint system as specified in this Section or in Section 09 91 00 “Painting.”

C. Protective coatings must be applied to the following surfaces:

1. Metal surfaces located outside of buildings and other structures anywhere on the Site.
2. Structural steel located in the following areas:
    a. All structural steel not otherwise specifically designated otherwise.
3. Hot-Dip Galvanized Steel
    a. All structural steel not otherwise specifically designated otherwise.
4. New piping,
5. Concrete surfaces at the following locations:
    a. Chemical Facilities

D. The following shall not be coated and shall be protected from drips, overspray, etc. unless indicated otherwise

1. Stainless steel piping, materials and equipment
2. Galvanized steel piping, materials and equipment unless specifically indicated to be coated.
3. Aluminum materials and equipment
4. Interior electrical items

E. Special applications for painting include the following:

1. Buried pipe and valves shall receive a shop applied protective coating as described in the appropriate section of the specifications.

F. Special applications for painting include the following:

1. Aluminum surfaces in contact with or embedded in concrete shall be treated in accordance with Section 03 30 00 “Cast-In-Place Concrete.”
2. Buried pipe and valves shall receive a shop applied protective coating as described in the appropriate section of the Specifications.

G. Contain, treat, and dispose of any dust, spray, drainage, or spillage resulting from coating operations. It shall be the Contractor's responsibility to determine if the materials to be disposed of are classified as Hazardous Waste. Disposed of waste, hazardous or otherwise, shall be in accordance with applicable regulations. The Contractor shall be aware of and understand the regulations concerning disposal of waste generated by coating operations.

1.02 QUALITY ASSURANCE

A. Acceptable Manufacturers: Products which comply with the Contract Documents and are manufactured by the following companies will be acceptable:

1. Tnemec Company, Inc.
2. Carboline.
3. PPG Protective & Marine Coatings
4. The Sherwin-Williams Company.
5. Akzo Nobel / International Paint, LLC.
6. ICI Devoe High Performance Coatings.
7. Plasite Protective Coatings.

It is desired that the paint products be furnished by as few manufacturers as possible to meet the requirements of the Specifications. Coating products of the same type shall be supplied by the same manufacturer. Do not mix products from different sources.

B. Applicator's Qualifications: Applicators must be qualified in this line of work and have a minimum of 5 years' experience in the application of the protective coatings of the types specified herein. Submit a list of recent projects and names of references for those projects.

C. Product Quality:

1. Use only the coatings specified in this Section. Use only those thinners and solvents recommended by the manufacturer, only in the amounts necessary to produce the manufacturer's recommended spreading rate, and in amounts not exceeding the maximum quantities stated in the manufacturer's literature.
2. The coating material shall not show excessive settling in a freshly opened full can and shall be easily re-dispersed with a paddle to a smooth, homogeneous state. It shall show no curdling, livering, caking, or color separation and shall be free of lumps or skim surfaces.

D. Inspection

1. Inspect and provide substrate surfaces prepared in accordance with the Contract Documents and the printed directions and recommendations of paint manufacturer whose product is to be applied.
2. Provide Engineer minimum 3 days' notice prior to start of surface preparation work or coating application work.
3. Perform Work only in the presence of Engineer, unless Engineer grants prior approval to perform such Work in Engineer's absence. Approval to perform Work in the Engineer's

absence is limited to the current day unless specifically noted to extend beyond the completion of the work day.

4. Inspection by the Engineer, or the waiver of inspection of any particular portion of the Work, shall not be construed to relieve the Contractor of responsibility to perform the Work in accordance with the Contract Documents.

5. The Contractor shall be solely responsible for testing for this Section, at no further cost to the Owner. The Engineer shall also make such tests if it is considered necessary. Cooperate with the Engineer, providing equipment, scaffolds, and other equipment as requested by the Engineer.

E. Testing Equipment: Furnish the testing apparatus necessary for testing coatings, including the following:

1. One set of U.S. Department of Commerce thickness calibration plates, certified by the National Bureau of Standards, to test dry film thickness.

2. Wet-film thickness gauges. Give one to Owner's representative. Each painter must keep one to test paint as it is applied.

3. One electronic dry-film thickness gauge capable or measuring 0-200 mils with calibration standards approved by the Bureau of Standards.

4. One Elcometer 319 Dewpoint Meter

5. One Tinker and Rasor Model M 1 Holiday Detector and recommended wetting agent and/or High Voltage Holiday Detector if required for interior coating thickness specified.

6. One set of SSPC VIS 1**,** 3 and 4 **-** Visual Standards as applicable.

F. Testing Reports: Submit an inspection report for each coating applied on the Project. The testing report shall be completed on a form furnished by the Engineer and shall bear the signature of the Contractor and the Owner's representative.

G. The Contractor must schedule a construction conference prior to any field work being completed. The meeting will be onsite and will include the Owner, Contractor, painting superintendent, Engineer, Owner's Representative and Coating Manufacturer's Representative. At this meeting the coating plan and schedule will be reviewed in detail.

1.03 SUBMITTALS

A. Submittals must be in accordance with Section 01 33 00 "Submittal Procedures."

B. The following Record Data for products, including manufacturer's data sheets, are due prior to ordering coating and surface preparation materials:

1. Coating Manufacturer's color selection literature for coating materials and caulk.

2. Sample warranty document for products.

3. Provide certification from the manufacturer that all coatings will not contain more than 0.06% by weight of lead in the cured coating for each coat applied.

4. Coating Manufacturer's Product Information and Safety Data Sheets (SDS) for each coating and caulk material. Product Information must include the following:

a. The Manufacturer's published instructions for use in specifying and applying all proposed coatings.

b. Application instructions written and published by the Coating Manufacturer.

c. All limitations, precautions and requirements that may adversely affect the coating, that may cause unsatisfactory results after the application or that may cause the coating not to serve the purpose for which it was intended, must be clearly and completely stated in the instructions. Limitations and requirements must include, but are not necessarily limited to the following:

1) Surface preparation

2) Method(s) of application

3) Thickness of each coat (maximum and minimum DFT)

4) Drying and curing time of each coat

5) Time (minimum and maximum) allowed between coats

6) Thinner and use of thinner

7) Proper mixing of coating before application

8) Weather limitations during and after application (temperature and humidity, time weighted)

9) Physical properties of coating, including percent solids content by volume

10) Equipment settings (air cap, fluid tip, equipment pressure settings, etc.)

11) Pot life at various temperature and humidity conditions.

12) Provide documentation that interior coating system is compatible with the cathodic protection system.

C. The following samples are required prior to ordering the materials:

1. Three (3) samples of selected exterior finish colors for approval on 6" x 6" swatches. Label each swatch with the manufacturer's name, coating name/type, color name and number.

D. The following Record Data is required prior to coating work:

1. Coating Plan:

a. Anticipated coating process schedule by date, including dates when hold-point inspections are anticipated. Schedule must indicate detailed activities on a daily basis.

b. Detailed procedures and schedule for all pre-cleaning, surface preparation and application of coating, including touch-up and repair procedures for all coating systems.

c. Recoat schedule on the submitted coating materials.

d. Data sheets complete with a graduated scale or curve, produced by the Coating Manufacturer, with curing characteristics and recommendations regarding complete

coating curing. The data sheets and scales or curves must include specific cure times over a wide range of temperatures and humidity.

e. Provide a written plan documenting how spent cleaning debris and/or paint over spray or droplets will be contained/confined to the jobsite and tank site during the surface preparation and coating application operations. Reasonable care must be exercised by the Contractor to prevent damage, nuisance, or hazardous conditions to adjacent or nearby property Owners. Include all materials and method to be used for protection of exterior surfaces, and allow for recovery and disposal of paint scraps and blast media.

2. Provide documentation on proposed containment system methods for blasting and coating operations.

3. The Contractor must submit evidence of notification of the appropriate office of the Texas Commission on Environmental Quality (TCEQ) prior to abrasive blasting as required. Submit copies of any obtained permits.

4. Coating Manifest - Within 48 hours of coating delivery to the job site, the Contractor must record the batch number stamped on each coating container and submit a typed list to the Owner's Representative. Minimum information required is listed below.

a. Date of delivery to job site

b. Name and signature of Superintendent recording the data

c. List of batch number including corresponding coating identification, color, date of manufacture and volume of each container

E. The following Certified Test Report(s) are required prior to coating work:

1. SDS sheets for all abrasive to be used on the project.

2. Certification and laboratory test results indicating recycled metallic abrasive per SSPC-AB 2 or 4 and atomic absorption test results.

1.04 STANDARDS

A. The applicable provisions of the following standards shall apply as if written here in their entirety. Adhere to the latest standards and codes published by the following organizations.

B. In the event of a conflict between the published standards, codes, and this Section, the more stringent requirement shall govern.

C. Standards

1. ANSI (American National Standards Institute)

ANSI/NSF Standard 61	Drinking Water Components

2. ASTM (American Society for Testing and Materials)

ASTM D 523	Standard Test Method for Specular Gloss
ASTM D 610	Standard Test Method for Evaluating Degree of Rusted on Painted Surfaces
ASTM D 2244	Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates

ASTM D 3359	Standard Test Methods for Rating Adhesion by Tape Test
ASTM D 4214	Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D 4263	Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D 4285	Standard Test Method of Indicating Oil and Water in Compressed Air
ASTM D 4541	Standard Method for Pull-Off Strength of Coatings Testing Adhesion of Applied Coating Using Portable Adhesion Tester
ASTM D 6386	Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting
ASTM E 337	Standard Practice Test Method for Measuring Humidity with a Psychrometer
ASTM F 1869	Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

3. AWWA (American Water Works Association)

AWWA C210	Liquid-Epoxy Coating Systems for Interior and Exterior of Steel Water Pipelines
AWWA C222	Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings

4. Consumer Product Safety Act, Part 1303

5. International Concrete Repair Institute (ICRI)

ICRI Technical Guideline No. 03732	Selecting and Specifying Concrete Surface Preparation for Coatings, Sealers and Polymer Overlays

6. NACE International (National Association of Corrosion Engineers)

NACE TPC2	Coating and Lining for Immersion Service: Chapter Safety, Chapter 2 Surface Preparation, Chapter 3 Curing, and Chapter 4 Inspection
NACE SP0178	Fabrication Details, Surface Finish Requirements, and Proper Design Considerations for Tanks and Vessels to be Lined for Immersion Service
NACE SP0188	Discontinuity (Holiday) Testing of Protective Coatings on Conductive Substrates
NACE RP0178	Plastic Weld Comparator
NACE RP0287	Field Measurement of Surface Profile of Abrasive Blast Cleaned Steel Surfaces Using a Replica Tape

7. National Association of Pipe Fabricators (NAPF)

NAPF 500-03	Surface Preparation Standard for Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings and/or Special Internal Linings

8. OSHA (Occupational Safety & Health Administration)

1915.35 Standards - 29CFR	Painting

1926.62 Standards – 29 CFR	Lead

9. SSPC (Society for Protective Coatings)

SSPC-VIS 1	Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning
SSPC-VIS 3	Guide and Reference Photographs for Steel Surfaces Prepared by Power and Hand Tool Cleaning
SSPC Vol. 1	Good Painting Practices
SSPC-AB1	Mineral and Slag Abrasives
SSPC-AB2	Cleanliness of Recycled Ferrous Metallic Abrasives
SSPC-AB3	Ferrous Metallic Abrasives
SSPC-AB4	Recyclable Encapsulated Abrasive Media in a Compressible Matrix
SSPC-SP1	Solvent Cleaning
SSPC-SP2	Hand Tool Cleaning
SSPC-SP3	Power Tool Cleaning
SSPC-SP11	Power Tool Cleaning to Bare Metal
SSPC-PA-1	Shop, Field and Maintenance Painting
SSPC-PA-2	Measurement of Dry Film Thickness with Magnetic Gages
SSPC-PA-3	Guide to Safety in Paint Application
SSPC-Guide 6 (CON)	Guide for Containing Surface Preparation Debris Generated During Paint Removal Operations
SSPC-Guide 12	Guide for Illumination of Industrial Painting
SSPC-Guide 15	Field Methods for Retrieval and Analysis of Soluble Salts on Steel and Other Nonporous Substrates

10. SSPC/NACE International Joint Standards

SSPC-SP5/NACE 1	White Metal Blast Cleaning
SSPC-SP6/NACE 3	Commercial Blast Cleaning
SSPC-SP7/NACE 4	Brush - Off Blast Cleaning
SSPC-SP10/NACE 2	Near - White Metal Blast Cleaning
SSPC-SP13/NACE 6	Surface Preparation of Concrete

11. Texas Commission on Environmental Quality (TCEQ)

30 TAC Chapter 290 Subchapter D	Rules and Regulations for Public Water Systems

1.05 DELIVERY AND STORAGE

A. Deliver coating products to the Site in original unopened containers, with manufacturer's label and batch number attached. Do not apply products until the Owner's field representative has approved the product for use.

B. Use one location at each site for the storage of coating products. Protect the floor from spills and other damage. Protect the products from extreme heat or cold. Keep containers covered. Keep the storage rooms clean of trash and debris. Dispose of oily or used rags daily. Under no circumstances shall they be allowed to accumulate. Take precautions to prevent fires. The storage of flammable liquids shall comply with the City, State, or other fire codes.

C. Storage of coatings and other products must be in accordance with the manufacturer's requirements. Coatings that have been damage or not stored properly must not be applied and must be removed from the site.

D. All products and coatings that are not approved for the project must be removed from the site and must not be stored at the site.

E. All materials must be delivered to the job site in original sealed containers with the date of manufacture and batch number stamped thereon by the Coating Manufacturer. Materials shall be subject to random observations by the Owner's Representative at the job site.

1.06 ENVIRONMENTAL CONDITIONS:

A. Do not apply coatings under conditions that are unsuitable for the production of good results. Remove trash and debris from enclosed buildings and thoroughly clean prior to application of coatings. Do not begin application of coatings in areas where other trades are working, or where construction activities result in airborne dust or other debris. Do not apply coatings in conditions which do not conform to the recommendations of the coatings manufacturer.

B. Coatings shall only be applied when conditions fall within the parameters listed in the manufacturer's printed data.

C. Contractor shall provide dehumidification equipment sized to maintain dew point temperature 5 degrees F or more below surface temperature of metal surfaces to be cleaned and painted.

D. Do not apply any coatings when weather conditions are unfavorable. In the event that climatic conditions are not conducive for best results, postpone application of coatings until conditions conform to the manufacturer's recommendations and the provisions of this Section.

E. Do not apply coatings to a wet or damp surface in wet or damp weather conditions, or when there is dust in the air. Surfaces exposed to direct sunlight must be shaded by awnings or other protective devices while coatings are being applied, if recommended by coating manufacturer. When necessary, provide temporary heating devices of a type that produces no fumes which will discolor the paint system.

F. Heating and Dehumidification

1. Dehumidification equipment must be used to control the environment during surface preparation, rehabilitation, coating application and coating curing at no additional cost to the Owner, if acceptable environmental conditions cannot be met.

   If the Contractor cannot meet the required environmental conditions to apply the interior coating system per this specification and the coating manufacturer's written recommendations, Contractor will cease operations until approved dehumidification equipment has been provided and acceptable environmental conditions are achieved.

   If coating system is applied without dehumidification or in conditions not acceptable by this specification and by the coating manufacturer's written requirements, Contractor must fully remove coating system applied and replace per the Engineer's direction.

2. The Contractor must furnish all labor, materials, equipment, fabrication and quality control inspections, and all other incidentals required to control and maintain the environment of the reservoir within the parameters stated in this specification and must incorporate these and any other expenses into their bid.
3. The Owner reserves the rights, in the event the dehumidification equipment is not performing to the minimum requirements stated in this specification, to require the Contractor to modify and or add additional equipment to satisfy the conditions of this specification, at the sole cost to the Contractor.
4. It is the Contractor's responsibility to provide adequate dehumidification equipment to meet this specification and Coating Manufacturer's requirements. The Coating Manufacturer's limits of surface temperature, tank inside air temperature and relative humidity requirements will govern, if more stringent than the requirements stated within this specification.

G. Forced Ventilation

1. Provide continuous forced fresh air ventilation when working inside of containment systems or enclosed areas that are not openly vented from the beginning of surface preparation through final coating operations and coating curing.
2. Forced ventilation must be supplied per the recoat time required by the coating manufacturer and at least 48 hours after the final coat has been applied.
3. From the beginning of interior wet and/or dry coating application and until this coating is cured, the Contractor must monitor the air for the lower explosion limit (LEL) as published in the Coating Manufacturer's product SDS's.
4. Contractor is responsible for supplying, installing and maintaining the forced ventilation system.

H. Containment System

1. Contractor must provide containment methods, either full or partial, which allows for the containment of the environmentally sensitive waste, dust and paint over spray that will be generated during the abrasive blasting and painting operation.
2. The ground surrounding the project area must be protected from all debris, emissions, dust, and other materials generated in the cleaning operations with a minimum of two layers of polyethylene covered with plywood or the same material used for the perimeter containment system.
3. Containment is not required when blasting on the interior of a completely enclosed area (i.e. roof is in place) as long as no visible emissions are created.
4. The Contractor must ensure that no spent cleaning/blasting debris, dust, overspray, coating droplets, or emissions of any kind, escape to the atmosphere, or to adjacent buildings, private property, work sites, parking lots, etc.
5. The Owner reserves the right to stop work or require containment, additional containment or different containment methods if the Contractor's operations create a nuisance beyond the tank site property line in the sole opinion of the Owner, the Engineer, the Owner's Representative, any regulatory agency, or neighbor. All costs of

providing an adequate containment system must be included by the Contractor in the Base Bid.

6. The Contractor must be responsible for all materials that are used and for any apparatus used to contain dust emissions, debris, overspray, and coating droplets. The containment system attachments to existing or proposed structures must be designed by a professional engineer (P.E.) registered in the State of Texas not to impose excessive loading on the structure. The Contractor must submit the P.E. designed and sealed details of the containment system on the tank.

   Any damage to the structure(s) as a direct or indirect result of the containment system must be repaired or sections replaced by the Contractor at no additional cost to the Owner. Neither the Owner nor the Owner's Engineer assumes any responsibility for the structural ability of the structure to support the containment system.

7. If tarps are used as part of the containment system, the tarps must be an impervious, solid, flame-resistant material, reinforced with a fiber mesh and must allow as much light as possible to pass through the material.

I. Visible Emissions

1. Contractor must control visible emissions and releases while dust producing activities are underway.

2. Visible emissions more than SSPC Guide 6, Level 1 (1% of the workday or 5 minutes in an 8-hour shift) are unacceptable. Sustained emissions of more than 1 minute, regardless of the total time of emissions for the day is unacceptable. If unacceptable emissions are observed, Contractor must shut down immediately and correct the situation and clean up any debris generated from the release to the satisfaction of the Engineer before continuing work.

1.07 WORKING CONDITIONS:

A. Provide adequate lighting at any location that coatings are being applied or testing is performed. Illumination shall be of sufficient intensity to achieve good results. Provide explosion-proof lighting when required.

B. Temporary ladders and scaffolds shall conform to applicable safety requirements. Erect temporary scaffolds where needed to cover large areas. Provide ladders or scaffolding during testing procedures.

1.08 GUARANTEES

A. Protective coating shall be guaranteed for a period of 1-year from the date of the Owner's acceptance of the Project.

B. A warranty inspection must be conducted prior to the end of the warranty period. Any defective work discovered at this date must be corrected by the Contractor in accordance with the Contract Documents at no additional cost to the Owner.

2.00 PRODUCTS

2.01 GENERAL COATING REQUIREMENTS

A. All coatings must be free of heavy metals such as arsenic, barium, chromium, selenium, silver, lead, mercury and cadmium.

B. All coatings in contact with potable water must be certified by the National Sanitation Foundation (NSF), Standard 61.

C. No coating submitted or used on this project must have a VOC (volatile organic content) in excess of 360 grams/liter or 3.0 lbs./gal.

D. Finish coatings must be from the same batch.

2.02 MATERIALS

A. Materials shall be the manufacturer's top of line quality products, as listed herein. Products used on this project shall be as indicated below. Products shall be as follows:

Type A - Alkyd-Phenolic Universal Primer	
Manufacturer	**Approved Coating**
Tnemec	Series 1 Purple Prime
Sherwin-Williams	Kem Kromik Universal
Akzo Nobel / International Paint, LLC	Interlac 573
Devoe Coatings	Devprime 1403
Carboline	Carbocoat 150UP
PPG	Multiprime 4160

Type B - Epoxy-Polyamide Primer	
Manufacturer	**Approved Coating**
Tnemec	Series 66
Sherwin-Williams	Copoxy Primer
Akzo Nobel / International Paint, LLC	Intergard 251; Intergard 269 for valves and gates, submerged structural steel and misc. metals, and submerged piping
Devoe Coatings	Devran 201V Series
Carboline	890
PPG	Amercoat One Single Component Epoxy for valves and gates, structural steel and misc. metals, and piping

Type C – Alkyd Enamel	
Manufacturer	**Approved Coating**
Tnemec	Series 23 Enduratone
Sherwin-Williams	DTM Alkyd Enamel
Akzo Nobel / International Paint, LLC	Interlac 665
Devoe Coatings	Devlac 1431

Carboline	Carbocoat 8225
PPG	Fast Dry 35

Type D - Epoxy-Polyamide Coatings	
Manufacturer	**Approved Coating**
Tnemec	Series 66
Sherwin-Williams	Macropoxy 646 Epoxy
Akzo Nobel / International Paint, LLC	Intergurd 475HS; Interseal 670HS for valves and gates, PVC pipe and conduit, submerged structural steel and misc. metals, and submerged piping
Devoe Coatings	Bar-Rust 235
Carboline	Carboguard 60
PPG	Amercoat One for valves and gates, PVC pipe and conduit, structural steel and misc. metals, and piping

Type E - Epoxy-Polyamide Coatings for Potable Water	
Manufacturer	**Approved Coating**
Tnemec	Series N140 Pota-Pox Plus
Sherwin-Williams	Tank Clad Epoxy
Akzo Nobel / International Paint, LLC	Interline 850 or Interseal 670HS (NSF colors)
Devoe Coatings	Bar-Rust 233H Series
Carboline	Carboguard 61
PPG	Amerlock 2/400

Type F - Aliphatic Polyurethane Enamel	
Manufacturer	**Approved Coating**
Tnemec	Series 1074 Endura-Shield II
Sherwin-Williams	Hi-Solids Polyurethane
Akzo Nobel / International Paint, LLC	Interthane 990 Series
Devoe Coatings	Devthane 379 Series
Carboline	Carbothane 133HB (Satin) or Carbothane 134HG (High Gloss)
PPG	PSX One Single Component Polysiloxane- No Isocyanates

Type G – High Build Acrylic Polyurethane Enamel	
Manufacturer	**Approved Coating**
Tnemec	Series 73 Endura-Shield

Sherwin-Williams	Hi-Solids Polyurethane
International Paint, LLC	Interthane 870HS
ICI Devoe	Devthane 359
Carboline	Carbothane 133HB
Ameron	Amercoat 450H

Type H- Epoxy Concrete Coating	
Manufacturer	**Approved Coating**
Tnemec	Series 64H-413 Hi-Build Tneme-Tar
Sherwin-Williams	Tar Guard Epoxy
Akzo Nobel / International Paint, LLC	Interzone 954
Devoe Coatings	Devtar 5A Series
PPG	Amercoat 78HB Coal Tar Epoxy
Carboline	Bitumastic 300M

Type I - Epoxy Concrete Coating – HFS	
Manufacturer	**Approved Coating**
Tnemec	Series 434/435 Perma-Shield System
Akzo Nobel / International Paint, LLC	Ceilcote 380/242GF Flakeline System
PPG	Amercoat 100A
Carboline	Carboguard 510 Series / Plasite 4500 Series

Type J - Inorganic Zinc Primer	
Manufacturer	**Approved Coating**
Carboline	Carbozinc 859
Sherwin-Williams	Corothane I Galvapac
PPG	Amercoat 68HS
Approved Manufacturer	Approved Equal

Type K - High Solids Epoxy Siloxane	
Manufacturer	**Approved Coating**
Carboline	Carboxane 2000
Sherwin-Williams	Polysiloxane XLE-80
PPG	PSX 700 Polysiloxane

Approved Manufacturer	Approved Equal

Type L - Epoxy Mastic	
Manufacturer	**Approved Coating**
Carboline	Carbomastic 15
Sherwin-Williams	Epoxy Mastic II
PPG	Amerlock 2/400 AL
Tnemec	Chembuild Series 135
AkzoNobel/International Paint, LLC	Interseal 670HS

Type M – Elastomeric Polyurethane Hybrid	
Manufacturer	**Approved Coating**
Carboline	Reactamine 760 Series
Sherwin-Williams	Sherflex S
PPG	Amerthane 490
Tnemec	Elasto-Shield Series 406
AkzoNobel/International Paint, LLC	Polibrid 705E Elastomeric

Type N – Glass Flake Reinforced Epoxy	
Manufacturer	**Approved Coating**
Carboline	Approved Equal
Sherwin-Williams	Sher-Glass FF
PPG	Approved Equal
Tnemec	Approved Equal
AkzoNobel/International Paint, LLC	Approved Equal

2.03 COLOR SELECTION

A. The color chart shall include the complete available range of colors, including tints and shades. The Owner shall select the colors.

B. Use a multi-color system coating for any surface receiving more than one coat. Each coat shall be tinted differently from the preceding coat in a manner that will allow the various coats to be easily distinguished. Colors shall generally be from light to dark shades, but the Contractor may have the option to select tint shades to insure coats will receive adequate coverage without bleeding or otherwise showing through the preceding coat.

C. Piping and equipment shall be color coded in accordance with the requirements of the Texas Commission on Environmental Quality (TCEQ).

3.00 EXECUTION

3.01 GENERAL

A. All coatings must be applied in strict conformance with the Coating Manufacturer's published specifications, this specification or as approved by the Engineer.

B. Surfaces which will be inaccessible after installation shall be coated prior to installation, or shall be coated and approved in stages as the work is installed.

C. The Engineer shall approve surfaces for application of coatings at each stage. Any material that is coated prior to the Engineer's approval shall be stripped back to bear metal and repainted.

D. At least 7-days or as required by the coating manufacturer, must be allowed for drying of finished surfaces before any machinery can be placed into service.

E. The number of coats called for in this specification are considered the minimum required. If more coats are required for complete coverage and uniform appearance they shall be provided at no additional cost to the Owner.

3.02 STEEL SURFACE PREPARATION

A. The adequacy of the preparation of steel surfaces will be determined by comparing the surface with SSPC VIS 1 "Pictorial Surface Preparation Standards for Painting Steel Surfaces" and SSPC VIS 3 "Guide and Reference Photographs for Steel Surfaces Prepared by Power and Hand Tool Cleaning." Prepare surfaces in accordance with the following requirements:

1. SSPC-SP1 "Solvent Cleaning"
2. SSPC-SP2 "Hand Tool Cleaning"
3. SSPC-SP3 "Power Tool Cleaning"
4. SSPC-SP5 / NACE 1 "White Metal Blast Cleaning"
5. SSPC-SP6 / NACE 3 "Commercial Blast Cleaning"
6. SSPC-SP7 / NACE 4 "Brush-Off Blast Cleaning"
7. SSPC-SP10 / NACE 2 "Near-White Blast Cleaning"
8. SSPC-SP11 "Power Tool Cleaning to Bare Metal"

B. The resulting surface profile must be in accordance with the coating manufacturer's recommendations.

C. All surface preparation of new equipment and surfaces shall be assumed to be on a SSPC Grade A steel surface condition, unless specifically noted otherwise.

D. "Solvent Cleaning" must be performed prior to subsequent surface preparation, including abrasive blast cleaning.

E. All sharp edges and welds must be ground smooth to a rounded contour and all weld splatter must be removed prior to abrasive blasting. Edges of metal to be coated must be rounded to a minimum of 1/16" radius of chamfered a minimum of 1/16" at an angle of 45-degrees.

F. Welds and adjacent areas:

1. Prepared such that there is:

a. No undercutting or reverse ridges on the weld bead.

b. No weld spatter on or adjacent to the weld or any other area to be painted.

c. No sharp peaks or ridges along the weld bead.

d. Grind embedded pieces of electrode or wire flush with the adjacent surface of the weld bead.

2. Weld profiles must conform to NACE RP0178, Profile 'D'.

3.03 DUCTILE IRON PIPE AND FITTINGS SURFACE PREPARATION

A. Prepare surfaces in accordance with the following requirements:

1. NAPF 500-03-01 "Solvent Cleaning"

2. NAPF 500-03-02 "Hand Tool Cleaning"

3. NAPF 500-03-03 "Power Tool Cleaning"

4. NAPF 500-03-04 "Abrasive Blast Cleaning for Ductile Iron Pipe"

5. NAPF 500-03-05 "Abrasive Blast Cleaning for Cast Ductile Iron Fittings"

B. "Solvent Cleaning" must be performed prior to subsequent surface preparation as specified in NAPF 500-03.

3.04 CONCRETE SURFACE PREPARATION

A. The adequacy of the preparation of concrete surfaces will be determined by comparing the surface with ICRI Surface Finish Comparators. Prepare surfaces in accordance with the following requirements:

SSPC-SP13 / NACE 6 – Surface Preparation of Concrete

B. Allow a minimum of 28-days curing time to elapse before coatings are applied. Concrete surfaces which are scheduled to receive coatings must be in accordance with the coating manufacturer's moisture requirements.

C. Bug holes, air pockets, and other voids in the concrete will be filled or patched in chemical exposure areas, secondary containment, and where specifically required.

D. Concrete Surface Preparation Inspection:

1. Adhesion Testing:

a. Tensile testing of the surface preparation shall be performed by the Engineer as necessary using Type 4 or Type 5 pneumatic adhesion testing equipment in accordance with ASTM D4541 using 2-inch diameter dollies for concrete surface adhesion testing.

b. Concrete surface or applied coating shall be scored for concrete adhesion testing.

c. Adhesive failure greater than 50 percent of the dolly surface area shall indicate inadequate surface preparation.

d. Cohesive failures which results in loss of sound concrete will be acceptable provided the loss is greater than 50 percent of the dolly surface area.

e. Low adhesion cohesive failures with a thin layer of concrete due to weak concrete or laitance over 50 percent of the dolly surface will be rejected.

2. Concrete Soundness:

Concrete soundness shall be determined using the scratching or hammer impact methods as defined in SSPC SP-13.

3. Moisture Content:

Moisture shall be tested as specified in SSPC SP-13 and in accordance with ASTM D 4263 and F 1869. Moisture content cannot exceed the moisture content recommended by the coating manufacturer.

3.05 SURFACE PREPARATION

A. Clean and degrease surfaces prior to abrasive blasting by solvent cleaning as specified using solvents, detergent/water, emulsions, and steam. Proposed method must be documented in the coating plan. Contractor must contain and properly dispose of all runoff and debris from cleaning.

B. If the following conditions exist or are prevalent, surface preparation and coating must be delayed or postponed until conditions are favorable. Each day's coating must be completed in time to permit the film sufficient drying time prior to damage by atmospheric conditions or changes. No surface preparation shall begin or coating applied:

1. When the surface, air or material is below or above the Manufacturer's printed instructions.

2. When surfaces are wet or damp.

3. During weather conditions of rain, snow, fog or mist.

4. When the air and steel temperature is less-than or equal to 5^{o} F above the dew point temperature.

5. If the relative humidity is above 85%.

6. When it is expected that the air and/or surface temperature will be below or above the Coating Manufacturer's recommended temperatures within four (4) hours after applications of coating, minimum. Coating manufacturer may require additional time between application and temperature and weather changes.

C. Shop Surface Preparation

1. Notify Engineer at least 7 days prior to start of shop blast cleaning to allow for inspection of the Work during surface preparation and shop application of paints. Work shall be subject to the Engineer's approval before shipment to the jobsite.

2. Items such as structural steel, metal doors and frames, metal louvers, and similar items as reviewed by the Engineer may be shop prepared and primed. Centrifugal wheel blast cleaning is an acceptable alternate to shop blast cleaning. Blast clean and prime in accordance with the Specifications.

3. Prepare surfaces by abrasive blasting as specified and apply shop prime coat. Shop primed steel plates must not have primer extended within 4-inches along all edges to be welded. All primer within 4-inches of an area to be welded must be removed prior to welding. Welding of painted surfaces will not be allowed.

D. All pre-assembled shop primed items must be prepared in accordance with these specifications and inspected by the Owner's Representative before and after priming.

E. Abrasive Blasting

1. Prior to extensive abrasive blasting operations, the Contractor must perform a test blast to verify that the surface cleanliness and profile meet the requirements of the specification and meet the coating manufacturer's requirements for the coating to be applied. If the test section does not meet the requirements, the Contract must make changes to the abrasive materials and methods to provide suitable blast.

2. Abrasive blast only the amount of surface area which can be primed the same day or before any rust starts to form, whichever occurs first. Areas which are not painted the same day must be re-blasted on the day the prime coat is applied.

3. Shrouding or recovery of all blast material will be mandatory during all exterior blasting.

4. The CONTRACTOR must contain all waste and process discharge in accordance with the accepted methods for the process and materials that are in abatement.

5. Where abrasive blast cleaning will not remove or properly prepare metal surfaces, hand and/or power tool cleaning must be used to remove such conditions as weld splatter, laminations and radius-sharp edges. Hand tool or power tool must be used on areas less than two (2) foot diameter or smaller or on corners and edges.

6. All abrasive blast equipment must be equipped with, including but not limited to the following:

    a. Noise reducing devices

    b. Hose coupling safety devices

    c. Electrical grounding devices

    d. Moisture traps and filters

    e. Fresh air hoods for all blasters

    f. "Dead Man" switches on all blast hoses

    g. Air Dryers

F. Surface profile must be in accordance with manufacturer's printed requirements.

G. The adequacy of the preparation of surfaces must be determined by comparing the surface with SSPC VIS 1, SSPC VIS 3, NACE RP0178 and ICRI Surface Finish Comparators.

H. Wherever the words "solvent cleaning", "hand tool cleaning", "wire brushing", or "blast cleaning", or similar words of equal intent are used in the specifications or in paint manufacturer's specifications, they shall be understood to refer to the applicable specifications indicated.

I. Where OSHA or EPA regulations preclude standard abrasive blast cleaning, wet or vacuum-blasting methods may be required. Coating manufacturers' recommendations for wet blast additives and first coat application will apply.

J. Clean surfaces of dust and residual particles from cleaning operations by dry (no oil or water vapor) air blast cleaning or other method prior to painting. Vacuum clean enclosed areas and other areas where dust settling is a problem and wiped with a tack cloth.

3.06 PREPARATION OF HOT-DIP GALVANIZED COATED IRON OR STEEL PRODUCTS

A. Remove all soluble and insoluble contaminants. Prepare hot-dip galvanized coated iron and steel products in accordance with ASTM D 6386 and abrasive blast per ASTM D 6386 to achieve an angular anchor profile as required by the coating manufacturer.

B. Contractor is responsible for coordinating with the coating manufacturer to verify compatibility of the specified coating system with the provided surface preparation.

3.07 PREPARATION OF EXISTING COATED OR SHOP PRIMED SURFACES:

A. General:

1. Factory-applied primers to equipment must be those specified or verified by the Contractor to be compatible with the specified coating systems. Where possible, notify manufacturers which shop prime coats will be required in order to be compatible with field-applied finish coats.

   Where equipment is purchased which has the manufacturer’s standard primer or a factory finish which is other than as specified in this section, remove the factory-applied paint system or apply passivators or other special coatings as required to make the surface compatible with the finish coat specified.

2. Do not apply any coating to machinery, piping, or other surfaces before testing has been completed and systems approved. Any damage to coatings resulting from subsequent corrective procedures shall be stripped back to bare metal and repainted with the appropriate paint system as directed by the Engineer.

3. Check for compatibility when applying coatings over existing coatings. Apply a test patch of the recommended coating system, covering at least 2 to 3 square feet or as directed by the Engineer. Allow to cure one week before testing adhesion per ASTM D3359 in the presence of the Engineer. If adhesion does not meet the manufacturer’s published data, consult with the Engineer.

4. Shop primed or coated surfaces shall be reviewed with the Engineer to determine if the extent of damage to the coating and suitability of finish coats to adhere to shop applied coats.

5. If a cured epoxy, polyurethane, or plural-component material is to be top coated provide brush-off blast as specified herein or as recommended by the coating manufacturer.

6. Surface preparation recommendations of coating manufacturer shall be subject to approval of the Engineer.

B. To be Recoated or Final Coated:

1. Solvent clean.
2. Perform touch-up repairs of existing coating.
3. Asphaltic coated ductile iron pipe will require an application of a seal coat prior to the application of a cosmetic finish coat.

C. Touch-up Repairs:

1. Clean loose, abraded, or damaged coatings to substrate by power tool to bare metal per SSPC-SP11 and/or NAPF 500-03-03 “Power Tool Cleaning.”
2. Feather surrounding intact coating.
3. Apply one spot coat of the specified primer to bare areas overlapping the prepared existing coating.
4. Apply one full finish coat of the specified primer or finish coat(s) overall.

D. Application of a Cosmetic Coat:

1. The exact nature of shop-applied coatings is not known in all cases.
2. Check compatibility by application to a small area prior to starting the coating.
3. If lifting or other problems occur, request disposition from the Engineer.

3.08 APPLICATION

A. After abrasive blast cleaning, dust and spent abrasive must be removed from the surfaces by air blasting and brush sweeping. The prime coat must be applied as soon as possible after the blasting and surface cleaning is completed, inspected and approved by the Inspector.

B. Blasted surfaces must be coated before rust forms on the surface. No prepared surface will be allowed to receive a coating if “rust bloom” or surface discoloration has occurred. All blasted surfaces must be coated to within 6-inches of the edge of a blasted area. No visible rust must be coated under any circumstances, including rust bloom or if discoloration has occurred, regardless of elapsed time between blasting and coating.

C. Provide mist coat if recommended by the Coating Manufacturer.

D. All weld seams, gaps, edges, bolts and difficult areas to coat must receive a stripe coat. Stripe coat must be a contrasting color.

E. The Contractor must apply each coat at the rate and in the manner specified by the Coating Manufacturer, except as may be modified herein. If material has thickened or must be diluted for application, coating must be built up to the same dry film thickness as specified for each coat of the complete system.

F. Maximum and minimum DFT must be per the supplied Coating Manufacturer’s printed requirements and as required by this specification. DFT will be measured per SSPC-PA 2, Level 2 with an allowable measurement of spot DFT of:

1. Minimum DFT as specified, no less than the minimum specified will be accepted.
2. 120% of maximum DFT specified.

G. The Contractor and painting technicians are responsible for the application of coating system and must have current applicator certifications from the Coating Manufacturer. Submit certifications with coating submittal.

H. No coating shall be used which has an expired shelf or pot life.

I. Coating must be applied by skilled workmen and must be brushed out or sprayed evenly, without runs, crazing, sags, or other blemishes.

J. Sand between coats to remove over spray and dry fall.

K. Apply the first coat to the surface, including cutting in around edges, before the second coat is applied. The second coat and any successive coats must not to be applied before notifying the Owner's field representative and obtaining approval. Each coat must be tested before the successive coat is applied.

L. The coating curing period must be adjusted to compensate for less than adequate weather conditions, as recommended by the Coating Manufacturer, for complete curing of the entire coating system. The full curing time recommended by the manufacturer shall be provided.

M. Coating must be continuous and must be accomplished in an orderly manner to facilitate proper inspection control.

N. Where a roller or brush is used to apply the coating, additional coats may be necessary to achieve the recommended dry film thickness and/or to achieve total coverage of the underlying surface. Coated surfaces must be totally free of all roller nap, roller marks, brush bristles and brush marks.

O. When using conventional coating spray equipment for coating operations, effective oil and water separators combined with after coolers or deliquescent dryers must be used in compressed air lines to remove detrimental oil and moisture from the air. Separators must be placed as far as practical from the compressor. Compressors may be tested periodically by the Owner's Representative for oil and water contamination of compressed air. Testing must follow ASTM D4285 "Standard Test Method of Indicating Oil and Water in Compressed Air". All compressor units found to produce unacceptable amounts of oil and or water, as determined by results of ASTM D4285 test data and interpretation of data by the Owner's Representative must be replaced with a compressor that is acceptable.

P. For porous surfaces, such as concrete or masonry, a prime coat may be thinned to provide maximum penetration and adhesion. The type and amount of thinning must be determined by the coating manufacturer and is dependent on surface density and type of coating.

3.09 WATER AND WASTEWATER PIPE COLORS

A. General coating colors in accordance with the TCEQ are as follows for general selection of pipe coatings. Contractor must provide samples for Engineer's approval prior to ordering as specified.

Pipe/Pumps/Valves System Description	Color
Backwash Waste/Drain	Dark Grey
Clarified Water	Green
Effluent after Clarification	Dark Green

Filter Effluent	Light Blue
Gray Water	Purple with Yellow Lettering
Heated Water	Blue with 6-inch Red Bands Spaced 30-inches apart
Potable Water/Treated Water	Light Blue
Power Conduits	In compliance with the National Fire Protection Association 70 National Electrical Code
Raw Water	Tan
Reclaimed Water	Purple with Black Lettering
Sewage	Grey
Waste Water/Sewage	Brown

Chemical Lines	Color
Liquid Alum	Yellow w/Orange Bands
Alum (solution)	Yellow w/ Green Bands
Ammonia	Yellow w/ Brown Bands
Chlorine (gas, liquid, or vent)	Yellow
Chlorine (solution)	Yellow w/ Red Bands
Chlorine Dioxide (solution)	Yellow with Blue Bands
Ferric Chloride	Brown with Red Bands
Ferric Sulfate	Brown with Yellow Bands
Fluoride	White with Yellow Bands
Liquid Caustic	White with Red Bands
Caustic (solution)	White with Orange Bands
Polymers	Orange w/ Green Bands or White with Green Bands (Varies for Water or WW applications)
Ozone	Stainless Steel with White Bands
Settled Water	Green
Sulfur Dioxide	Lime Green with Yellow Bands

Other Lines	Color
Compressed Air	Light Green
Instrument Air	Light Green with Dark Green Bands

3.10 FIELD QUALITY CONTROL

A. Field Tests: Make wet film tests during painting operations to assure proper thicknesses of coating are being applied. After each coat has been applied, test the paint film thickness with a nondestructive, magnetic type thickness gauge. The total dry-film thickness for each

coat shall not be less than 75 percent of the amount specified. If the thickness is less than 75 percent, apply additional coats until the total specified thickness is obtained. The total thickness after the final coat has been applied shall be 100 percent of the thickness specified, minimum. Apply additional coats until the specified thickness is reached or exceeded.

B. Holiday Testing: Test the entire surface of coated submerged metal structures with a holiday detector. For thickness between 10 and 20 mils (250 to 500 microns) a non-sudsing type wetting agent, as recommended by the holiday detector manufacturer shall be added to the water prior to wetting the detector sponge. Mark and repair pinholes in accordance with the manufacturer's printed instructions, then retest pinholes. No pinholes or other irregularities shall be permitted in the final coats. Areas containing holidays shall receive additional coats until tests indicate no holidays.

3.11 PROTECTION OF SURFACES NOT TO BE PAINTED

A. Remove, mask, or otherwise protect hardware, lighting fixtures, switch plates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not intended to be painted.

B. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces.

C. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process.

D. Mask openings in motors to prevent paint and other materials from entering the motors.

3.12 DAMAGED COATINGS, PINHOLES, AND HOLIDAYS:

A. Feather edges and repaired in accordance with the recommendations of the paint manufacturer.

B. Repair fusion bonded coatings to be as recommended by the original applicator. Applicator shall provide liquid repair kits for this purpose as recommended by the coating manufacturer.

C. Apply finish coats, including touchup and damage-repair coats in a manner that will present a uniform texture and color-matched appearance.

3.13 UNSATISFACTORY APPLICATION:

A. If the item has an improper finish color, or insufficient film thickness, clean and topcoat surface with specified paint material to obtain the specified color and coverage. Obtain specific surface preparation information from the coating manufacturer.

Hand or power sand visible areas of chipped, peeled, or abraded paint and feather the edges. Follow with primer and finish coat in accordance with the Specifications. Depending on the extent of repair and its appearance, a finish sanding and topcoat may be required.

B. Evidence of runs, bridges, shiners, laps, or other imperfections shall be cause for rejection.

C. Repair defects in coating system per written recommendations of coating manufacturer.

D. Leave all staging up until the Engineer has inspected the surface or coating. Replace staging removed prior to approval by Engineer.

3.14 COATING INSPECTION

A. General:

1. All coats will be subject to inspection by the Engineer and the coating manufacturer's representative.

2. Visually inspect concrete, nonferrous metal, plastic, and wood surfaces to ensure proper and complete coverage has been attained.

3. Give particular attention to edges, angles, flanges, and other areas where insufficient film thicknesses are likely to be present and ensure proper millage in these areas.

B. Coating Thickness Testing:

1. Engineer will conduct coating thickness testing as necessary and without limitation. Testing conformance to the requirements of SSPC PA-2 is specifically excluded from this Section.

2. Measure coating thickness specified in mils with an electronic type dry film thickness gauge as specified.

3. Check each coat for the correct millage. Do not make measurement before a minimum of 8 hours after application of the coating.

4. Tests for concrete coating thickness shall be with a Tooke Gauge, a destructive test. Contractor shall repair coating after thickness testing.

C. Coating Continuity Testing:

1. Test finish coat, except zinc primer, galvanizing, and elastomeric coatings in excess of 20 mils dry, for holidays and discontinuities with an electrical holiday detector, low voltage, wet sponge type as specified.

2. Holiday detect coatings in excess of 20 mils dry and concrete and secondary containment coatings with high voltage units recommended by the coating manufacturer in accordance with NACE RP0188.

3.15 CLEAN AND ADJUST

A. Promptly remove trash and debris resulting from painting operation from the Site. Remove drop cloths, masking tapes and other protective coverings. Remove paint spills, splatters, overlap of paint from adjacent material and other defects. Spot paint nicks and other defects.

B. Remove paint containers and waste products. Thoroughly clean paint storage rooms, removing spilled paint from walls and floors.

C. Damages due to over spray on buildings, vehicles, trees, or other surfaces not specified to be painted would be the responsibility of the Contractor.

3.16 SCHEDULES

Protective coatings shall be applied in accordance with the following paint schedule. If additional primers, etc. are recommended by the coating manufacturer for any of the coatings

specified, they must be provided at no additional cost to the Owner to provide a complete and compatible coating system.

PROTECTIVE COATINGS PAINT SCHEDULE

System	Application Description	Surface Prep:	Product Type	No. of Coats	DFT (mils)
No. 1	**Submerged Metal – Potable Water** All metal surfaces new and existing below a plane 1 foot above the maximum liquid surface, metal surfaces above the maximum liquid surface which are a part of the immersed equipment, concrete embedded surfaces of metallic items under submerged or buried conditions, such as wall pipes, pipes, wall or floor sleeves, access manholes, gate guides and thimbles, and structural steel.	SSPC-SP1 SSPC-SP10 NAPF 500-03-01 NAPF 500-03-04 NAPF 500-03-05	TYPE E – Epoxy-Polyamide TYPE E - Stripe Coat TYPE E – Epoxy-Polyamide TYPE E – Epoxy-Polyamide	1 2 3	4.0 4.0 4.0
				Total Minimum Dry Film Thickness	12 mils
No. 2	**Above-Grade Interior/Exterior Steel and D.I. Piping Non-Immersion/Non-Corrosive Environment** All metal surfaces new and existing, such as inside pump station buildings, exterior piping and valves, exterior structural steel, etc.	SSPC-SP1 SSPC-SP6 NAPF 500-03-01 NAPF 500-03-04 NAPF 500-03-05	TYPE J – Inorganic Zinc Primer TYPE D – Stripe Coat TYPE D – Epoxy-Polyamide TYPE G –Acrylic Polyurethane Enamel - Gloss	1 2 3	4.0 4.0 4.0
				Total Minimum Dry Film Thickness	12 mils
No. 3	**Concrete Floor Surfaces of Interior Chemical Storage Areas** All new and existing interior concrete floors, such as inside pump station buildings and chemical storage areas. All coatings must include skid-resistant additives.	SSPC-SP13 ICRI CSPS2-4	TYPE J – Epoxy/Vinyl Ester	1	25 mils
				Total Minimum Dry Film Thickness	25.0 mils
No. 4	**Electrical Equipment - Exterior** All new and existing exterior electrical panels and equipment with factory coatings. Not for pumps and motors.	SSPC-SP1 SSPC-SP2	TYPE A – Alkyd-Phenolic Universal Primer TYPE C – Stripe Coat TYPE C – Alkyd Enamel TYPE C – Alkyd Enamel	1 2 3	2.0 3.0 3.0
				Total Minimum Dry Film Thickness	8.0 mils

System	Application Description	Surface Prep:	Product Type	No. of Coats	DFT (mils)
No. 5	**High-Temperature Surfaces** Interior and exterior surfaces of surfaces with temperatures from 200˚ - 400˚F. **Note to Specifier: List and describe high temperature surfaces to be coated.**	SSPC-SP1 SSPC-SP10	TYPE I – Silicone Aluminum TYPE I – Silicone Aluminum	1 2	1.0 1.0
				Total Minimum Dry Film Thickness	2.0 mils
No. 5	**Above-Grade Interior and Exterior PVC Pipe** Exterior surfaces PVC piping.	SSPC-SP1 Light Sanding	TYPE B – Epoxy-Polyamide Primer TYPE F – Aliphatic Polyurethane Enamel	1 2	3.0 3.0
				Total Minimum Dry Film Thickness	6.0 mils
No. 6	**Metal Piping and Valves within Vaults and Under Insulation** All metal surfaces new and existing that will be installed in areas where temporary submerged conditions can occur, such as within vaults and for piping and valves covered with insulation.	SSPC-SP1 SSPC-SP6 NAPF 500-03-01 NAPF 500-03-04 NAPF 500-03-05	TYPE L – Epoxy Mastic TYPE E - Stripe Coat TYPE E – Epoxy-Polyamide TYPE E – Epoxy-Polyamide	1 2 3	5.0 5.0 5.0
				Total Minimum Dry Film Thickness	15 mils
No. 7	**Metal Piping and Valves** **Immersion – Moderate to Severe Environment** Exterior protection of submersed valves & pumps, penstocks, piping, sewer interceptors, wastewater vessels, settling tanks and buried piping connecting to them.	SSPC-SP1 SSPC-SP10 NAPF 500-03-01 NAPF 500-03-04 NAPF 500-03-05	Type M – Elastomeric Polyurethane Hybrid	1	30.0
				Total Minimum Dry Film Thickness	30 mils

END OF SECTION

09 97 16 PIPELINE COATINGS AND LININGS

1.00 GENERAL

1.01 WORK RESULTS

A. This Section covers the Work necessary to apply external polyurethane coating on steel pipe, field coating of joints, and field repair of coating damage, complete.

B. Concrete cylinder pipe shall be externally overcoated with polyurethane coating system where specifically indicated on the Drawings.

C. Exposed steel pipe will be coated as specified in Section 09 96 00.01 “High-Performance Coatings” unless specifically specified otherwise.

1.02 SUBMITTAL REQUIREMENTS

A. Contractor submittals shall be made in accordance with Section 01 33 00 “Submittal Procedures.”

B. Shop Drawings: Catalog cuts and other information for all products proposed. Provide copy of approved coating system submittals to the coating applicator.

C. Quality Control Submittals: Furnish the following:

1. Applicator's Experience with list of references substantiating compliance.

2. Coating manufacturer's certification stating the applicator meets or exceeds their coating application requirements and recommendations.

3. Coating manufacturer shall provide a copy of the manufacturer’s coating application quality assurance manual.

4. If the manufacturer of field-applied coating differs from that of the shop applied primer, provide written confirmation from both manufacturers’ that the two coating materials are compatible.

1.03 QUALITY ASSURANCE

A. Coating Applicator's Experience and Certification:

1. Coating Application Company and coating application supervisor (Certified Applicator) shall have a minimum of 5 years’ experience applying the specified coating system. Coating application personnel, whom have direct coating application responsibility, shall have a minimum of 2 years’ practical experience in application of the indicated coating system.

2. Coating applicator shall be certified by the coating manufacturer as an approved applicator.

B. Coating and/or lining manufacturer technical representative shall be present for a minimum of 3 days technical assistance and instruction at the start of coating and/or lining operations within the shop. During this visit, the technical representative shall observe surface preparation and coating application and conduct tests of the coating to insure conformance with application instructions, recommended methods, and conditions.

C. Coating and/or lining manufacturer's technical representative shall be on-Site for 3 working days, minimum, at the start of each construction season to inspect coating application and procedures in the field. During this visit, the technical representative shall observe surface preparation and coating application and conduct tests of the coating to insure conformance with application instructions, recommended methods, and conditions.

D. Coating and/or lining manufacturer shall include 8 hours per month of field or shop coating technical support when requested by the Engineer.

E. Technical representative shall provide a written report to the Engineer for each visit. Report shall include copies of test data collected, description of observations, and all recommended corrective actions. Report shall be submitted within 5 working days after the visit. When deemed necessary by the Engineer, Work will not be permitted to proceed until the recommended corrective actions have been implemented. After all corrective recommendations have been completed; the manufacturer representative shall return and certify that the application complies with the manufacturer's coating application recommendations.

F. Additional visits by the manufacturer's representative shall be made at sufficient intervals during surface preparation and coating or lining as may be required for product application quality assurance, and to determine compliance with manufacturer's instructions, and as may be necessary to resolve problems attributable to, or associated with, manufacturer's products furnished for this Project.

1.04 ABBREVIATIONS

A. The following abbreviations are used in this Section:

Abbreviations	
MDFT	Minimum Dry Film Thickness
Mil	Thousandths of an Inch

1.05 DEFINITIONS

A. Manufacturer's Representative: Employee of coating manufacturer who is factory trained and knowledgeable in all technical aspects of their products and systems. Sales representatives are not acceptable as a technical representative unless written authorization from the coating manufacture is provided which states the sales representative has full authority to act on the behalf of the coating manufacturer.

1.06 REFERENCE STANDARDS

A. The applicable provisions of the following standards shall apply as if written here in their entirety:

1. American National Standards Institute (ANSI) / NSF Standards:

ANSI/NSF 60	Drinking Water Treatment Chemicals – Health Effects
ANSI/NSF 61	Drinking Water System Components – Health Effects

2. American Society for Testing and Materials (ASTM) Standards:

ASTM C33	Standard Specification for Concrete Aggregates
ASTM C150	Standard Specification for Portland Cement
ASTM D412	Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension
ASTM D522	Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings
ASTM D570	Standard Test Method for Water Absorption of Plastics
ASTM D2240	Standard Test Method for Rubber Property – Durometer Hardness
ASTM D4060	Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
ASTM D4541	Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM E96	Standard Test Methods for Water Vapor Transmission of Materials
ASTM G14	Standard Test Method for Impact Resistance of Pipeline Coatings (Falling Weight Test)
ASTM G95	Standard Test Method for Cathodic Disbondment Test of Pipeline Coatings (Attached Cell Method)

3. American Water Works Association (AWWA) Standards:

AWWA C205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe-4-inch and Larger- Shop Applied
AWWA C209	Cold Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
AWWA C210	Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
AWWA C216	Heat-shrinkable Cross-linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
AWWA C217	Petrolatum and Petroleum Wax Tape Coatings for the Exterior of Connections and Fittings for Steel Water Pipelines
AWWA C222	Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings

4. National Association of Corrosion Engineers (NACE) Standards:

NACE RP 0274	High Voltage Electrical Inspection of Pipeline Coatings

5. Steel Structures Painting Council (SSPC) Standards:

SSPC-SP-1	Solvent Cleaning
SSPC-SP-2	Hand Tool Cleaning
SSPC-SP-3	Power Tool Cleaning
SSPC-SP-5	White Metal Blast Cleaning
SSPC-SP-6	Commercial Blast Cleaning
SSPC-SP-10	Near-White Blast Cleaning
SSPC-SP-11	Power Tool Cleaning to Bare Metal

1.07 SPECIAL WARRANTY REQUIREMENTS

A. The Contractor and coating applicator shall warrant to the Owner and guarantee the Work under this Section against defective workmanship and materials for a period of 2 years commencing on the date of final acceptance of the Work.

1.08 OBSERVATION OF WORK

A. The Contractor shall give the Owner Representative a minimum of 14 days advance notice of the start of any Work to allow scheduling for shop or field observation. Provide Owner Representative a minimum 3 days' notice for actual start of surface preparation and coating application Work.

B. Provisions shall be made to allow Owner's representative full access to facilities and appropriate documentation regarding coating application.

C. Observation by the Owner's representative or the waiver of observation of any particular portion of the Work shall not be construed to relieve the Contractor of his responsibility to perform the Work in accordance with the Contract Documents.

D. Materials shall be subject to testing for conformance with the Contract Documents as the Owner's representative may determine, prior to or during incorporation into the Work.

2.00 MATERIALS

2.01 GENERAL

A. Exterior and interior pipe and fitting surfaces shall be prepared and coated in accordance with referenced standards, written directions of the coating or lining manufacturer's, and this Section, whichever is more stringent.

B. Coatings and linings will be stored, handled, and applied per manufacturer's written directions.

C. Pipeline coating or lining shall be the product of a single manufacturer. Product substitutions during the Project will not be permitted.

2.02 EXTERIOR SHOP-APPLIED COATINGS

A. General:

1. Steel pipe shall be coated in accordance with AWWA C222, except as modified herein.

2. Concrete cylinder pipe shall be externally overcoated with polyurethane coating as specified herein and in accordance with the coating manufacturer's recommendations for concrete substrates.

3. Overcoating of concrete cylinder pipe with polyurethane shall be performed from joint to joint and shall include the minimum length as shown on the Drawings.

4. Pipe that is atmospherically exposed shall be shop primed as specified herein and in Section 09 96 00.01 "High-Performance Coatings."

5. Buried dielectrically coated pipe and fittings passing through a structure wall or floor shall be coated for a minimum of 2 inches beyond the interior wall or floor surface.

B. Plural Component Polyurethane:

1. General: Plural component, polyurethane coating system (referred to as a polyurethane system) shall be applied in accordance with AWWA C222, and as modified herein.

2. Shop Surface Preparation:

a. Steel pipe: SSPC-SP5, White Metal blast, 3.00 mil profile, minimum, or as required by the manufacturer, whichever is greater using standardized testing procedures.

b. Concrete Pipe:

1). Abrasive blast to remove all laitance and loose material and create a suitable anchor profile.

2). Cement mortar coating shall be allowed to cure 15 days or steam cured not less than 7 days prior to surface preparation of the mortar and coating application. Hand applied mortar lining shall be allowed to cure a minimum of 15 days or as required to meet the coating manufacturer's requirements for application on cement, whichever is greater.

3). Mortar coating shall be dry during coating application.

3. Shop Applied Coating Requirements:

a. Self-priming, plural component, 100 percent solids, non-extended polyurethane, suitable for burial or immersion.

b. One coat, 35 mils total dry film thickness, minimum, or as required to meet the holiday and coating defects limits specified in this Section.

c. Shall be one of the following products, subject to review and acceptance of submitted product performance reports:

1). Protec II, Futura Coatings, Hazelwood, Missouri.

2). Chemtane 2265, Chemline, Inc, St. Louis, Missouri.

3). Or Engineer approved equal.

d. Acceptance of submitted product is contingent upon:

1). Submission of an independent testing report conducted within 3 years prior to bid opening documenting conformance to the coating performance criteria specified herein.

2). Verification that no significant change in product formulation has occurred through comparison of current product Part A and B formulation with infrared spectrometry analysis of test product for the laboratory test report.

4. Laboratory Coating Testing and Report:

a. General: Coating manufacturer shall submit to the Engineer for approval, test reports indicating conformance to the specified performance criteria using prepared Samples as defined using coating materials conforming to the following general requirements:

1). Polyurethane coating material tested shall have been manufactured within 30 days of test Sample preparation.

2). Coating material to have a minimum of 3 years prior pipeline coating application history.

3). Extended polyurethane coatings will not be acceptable.

4). Submission of incomplete reports, use of test procedures or methods other than those specified, or preparation of Samples with a coating material other than those listed will result in rejection of the coating.

5). Reports shall be submitted for review and approval not less than 30 days prior to coating application along with current product data sheets and MSDS sheets for parts A and B.

6). New product formula tests shall be accompanied with Part A and B wet Samples for infrared spectrometry analysis. Wet Samples shall be from the lot and batch tested and shall be collected and sealed by the Engineer for laboratory analysis by the Engineer.

b. Test Sample Preparation:

1). Coating manufacturer to provide 10 days advanced notification of coating Sample preparation for Engineer observation.

2). Failure to fully conform to the preparation requirements will result in rejection of the submitted coating material.

3). Sample preparation completed by the coating manufacturer shall be fully documented and reported to the testing agency by the manufacturer.

4). All coating test Samples shall be prepared in conformance with the following general requirements.

c. Sample Surface Preparation:

1). Method: Abrasive Blast, Green Diamond or Steel Grit, SSPC-SP5, White Metal.

2). Profile: 3.25 mils (plus or minus 0.25 mils), Angular profile, 90 Peak Count per inch minimum, measured and recorded using surface profilometer.

d. Coating Application:

1). Method: Spray film, in accordance with manufacturer's written shop application requirements.

2). Thickness: 35 mils, minimum, 40 mils maximum.

3). Cure: Air cure only, oven or other accelerated cures will not be acceptable.

4). Form: Sheet, steel panel, or steel pipe as required for test procedure.

e. Sample Quantity: Three minimum for each test performed or as required by the ASTM Test Standard, whichever is more stringent.

f. Coating Tests:

1). Testing shall be performed by a certified independent laboratory testing agency with a minimum 5 years' experience in the performance of ASTM test procedures on coating systems.

2). All testing shall be at room temperature, unless specifically required otherwise by the ASTM test procedure.

3). Water Absorption (ASTM D570):

a). Criteria: 1.00 percent, maximum.

b). Method: Long-term Immersion.

c). Sample: Sheet, 1-mm maximum thickness.

4). Permeance (ASTM E96):

a). Criteria: 0.050 inch-pound.

b). Method: Water Procedure BW (App. X1).

c). Conditions: Supported in manner to provide full circulation of air around test container for duration of test procedure.

5). Impact Resistance (ASTM G14):

a). Criteria: 125 inch-pounds, minimum.

6). Cathodic Disbondment (ASTM G95):

a). Criteria: 8 mm, maximum.

b). Potential: -3.00 volts.

c). Duration: 30 days.

d). Radius: Measured from original holiday radius.

7). Adhesion to Steel, Dry (ASTM D4541):

a). Criteria: 3000 psi, minimum.

b). Equipment: Delfesko Positest.

c). Dollies: 20 mm, maximum, scored to metal substrate.

8). Abrasion (ASTM D4060):

a). Criteria: 85 mg loss, maximum.

b). Conditions: CS-17 wheel, 1000 grams weight, 1000 revolutions.

9). Tensile Strength (ASTM D412):

a). Criteria: 4000 psi, minimum.

10). Hardness, Shore D (ASTM D2240):

a). Criteria: 70, Shore D, minimum.

11). Flexibility (ASTM D522):

a). Criteria: Pass (no cracking).

b). Mandrel Diameter: 3 inches, 180 degrees.

g. Reporting:

1). As required by the ASTM test method, and the following additional information:

a). Sample panel preparation date and identification.

b). Surface preparation method and abrasive.

c). Surface Preparation profile and peak count.

d). Coating lot and date of manufacture.

e). Application spray gun and equipment used.

f). Application temperatures of coating materials and material temperature at the gun, ambient temperature, and panel surface temperature.

2). Include all periodic test data and/or observations for all tested Samples and show all multiple measurements in both table and graph.

3). Show all calculations as required by the ASTM test method.

4). Include digital photographic documentation of all visual assessments, test apparatus, and final panel condition using 4 mega pixels minimum resolution.

5). Submit reports in both PDF and color printed format with photographs in JEPG format on CD.

C. Exterior Coating for Exposed Steel Pipe: All atmospherically exposed or vault piping shall be shop primed with the coating system as specified in Section 09 96 00.01 “High-Performance Coatings.”

2.03 INTERIOR SHOP-APPLIED LININGS

A. Cement Mortar Lining:

1. Clean and cement mortar line steel pipe and fittings in accordance with AWWA C205.
2. Cement: Conform to ASTM C150, Type II.
3. Shop applied cement mortar lining shall be uniform in thickness over the full length of the pipe joint.
4. Aggregate shall be silica sand or other aggregate that is not subject to leaching. Conform to ASTM C33.
5. Water for cement mortar: Clean and free from organic matter, strong alkalis, vegetable matter, and other impurities.

B. Liquid Applied Epoxy Coating:

1. Provide liquid epoxy primer and lining in all cement mortar lined metallic pipe at insulating joints for a minimum of two pipe diameters on each side of the insulated joint.
2. Epoxy coatings shall be NSF approved coatings suitable for potable water contact in accordance with ANSI/NSF Standards 60 and 61.
3. Epoxy shall be applied over the cement mortar lining where specified for the pipeline lining material.
4. Prepare the cement mortar lining by abrasive blasting to remove all laitance and provide a surface profile.

5. Cement mortar shall be allowed to cure for a minimum of 15 days prior to surface preparation and coating application or 7 days with steam curing.

6. Mortar lining shall be dry when epoxy lining is applied.

2.04 SPECIALS, FITTINGS, AND CONNECTIONS

A. Coating and lining application for special sections, connections, and fittings for steel or ductile iron pipe shall conform to coating system and application requirements as specified in this Section.

B. Specials, fittings, and connections shall be defined as any pipe section with turnouts for blowoffs, interconnects, any valve, or other appurtenances; tees; crosses; wyes; laterals; manholes; mitered angles or elbows; and pipes which require special fabrication that prevents mechanical production application of the specified coating system from end to end of pipe joint.

C. In addition to the items listed as specials, the following items shall also be considered as specials:

1. Pipe joints with pass through holes.

D. Hand applied tape coatings will not be permitted on any specials, fittings, connections, and elbow fittings.

E. Specials, fittings, and connections shall be externally coated with polyurethane coating system applied from end to end of pipe joint on all specials, fittings, and connections.

2.05 EXTERIOR FIELD JOINT COATING

A. Pipe joints shall be field coated after pipe assembly in accordance with AWWA C216, or AWWA C217, whichever is applicable and as specified herein.

B. Field joint coating shall be compatible with the shop-applied coating system and provided by the same manufacturer or a manufacturer approved by the pipe coating manufacturer.

C. All joints on pipe 24 inches in diameter or greater shall be coated with a heat shrink coating material.

D. Field joint coating materials shall be as follows or an approved equal.

1. Heat Shrink Sleeves:

a. Filler Material:

1). Provide filler material for all push-on, flange, and coupling type joints and at all changes in outside diameter greater than 1/8 inch.

2). Filler material shall adhere to the pipe and heat shrink sleeve. Size and type shall be as recommended by the sleeve manufacturer for type of pipe and joint.

3). Filler mastic for joints subject to weld after backfill shall exceed 500 F melt point temperature.

4). Filler material shall be applied in a manner and of sufficient thickness that no tenting or voids remain under the heat shrink sleeve.

b. Joint Coating:

1). Heat shrink, cross-linked polyolefin wrap or sleeve with a mastic sealant, 85-mil nominal thickness, suitable for pipeline operating temperature, as recommended by the manufacturer.

2). Provide standard recovery sleeve for welded or bell and spigot steel pipe joints. High recovery sleeves shall be provided for flange joints and coupling style joints.

3). Width of heat shrink sleeves shall be sufficient to overlap existing coating 2 inches minimum.

4). Consideration sleeve shrinkage during installation and joint profile in determining sleeve width required. Overlapping of two or more heat shrink sleeves to achieve the necessary width on pipe joints will not be permitted without Engineer approval.

5). Sleeve shall meet requirements for "Weld After Backfill" when allowed and approved by Engineer.

c. Holdback Primer: As specified in this Section.

d. Manufacturer's: Canusa, Raychem-Covalence, or equal.

2. Wax Tape Coating:

a. Apply coating in accordance with AWWA C217, except as modified herein.

b. Wax tape coatings shall be field applied on all buried flexible joints, thrust restraint rods and brackets, and on joints, fittings, or irregular shapes or complex configurations that are not suited for the use of heat shrink coating system.

c. Do not use wax tape coating systems on vault piping, atmospherically exposed piping and appurtenances, or where subject to UV exposures.

d. Provide filler material to fill and smooth all irregular surfaces, such that no tenting or voids remain under the applied wax tape.

e. Use sand backfill to protect wax coating from damage.

f. Coating System:

1). Surface Preparation: SP11 Power Tool to Bare Metal.

2). Primer: Petroleum or petrolatum wax.

3). Filler Material: Filled Petroleum or petrolatum wax.

4). Inner Tape: Petroleum or petrolatum wax impregnated fabric, 6-inch width maximum, 40 mils thick.

5). Outer Wrap: PVC or tape suitable for application to inner tape.

g. Wax tape coating system shall be as manufactured by:

1). Denso North American.

2). Trenton.

3). Or approved equal.

2.06 INTERIOR FIELD JOINT COATING

A. Mortar Lining:

1. After the backfill has been completed to final grade, the interior joint recess shall be filled with grout. The grout shall be tightly packed into the joint recess and troweled flush with the interior surface. Excess shall be removed.

2. At no point shall there be an indentation or projection of the mortar exceeding 1/16 inch.

3. With pipe smaller than 24 inches in diameter, before the spigot is inserted into the bell, the bell shall be daubed with grout. The joint shall be completed and excess mortar on the inside of the joint shall be swabbed out.

2.07 REPAIR OF COATINGS AND LININGS

A. General:

1. Coating or lining repair materials shall be compatible with the shop-applied coating or lining system and shall be approved by the coating or lining manufacturer.

2. All major repairs on pipe greater than 24 inches in diameter or coated with polyurethane coating system shall be repaired using heat shrink sleeves as specified for field joint coating in accordance with AWWA C216, except as modified herein.

3. Minor coating repairs for polyurethane coated or exposed pipe shall be as specified herein.

B. Coating Repair Materials:

1. Heat Shrink Sleeves (Major Repair):

a. Filler Mastic: Provide mastic filler to fill tape void as required.

b. Full Wrap Coating: Cross-linked polyolefin wrap with a mastic sealant, 85-mil thickness nominal, suitable for pipeline operating temperature, sleeve material recovery as recommended by the manufacturer. Sleeve length shall provide a minimum of 3 inches overlap onto intact pipe coating.

c. Manufacturer's: Canusa, Raychem (Polyken), or equal.

2. Heat-Applied Patches (Minor Repair):

a. Heat applied adhesive, polyolefin backed, mastic coated tape, 12 inches maximum size.

b. Patch shall provide a minimum of 2 inches overlap onto intact pipe coating; except for "Pritec" coated pipe shall have a minimum overlap of 3 inches in the circumferential direction.

c. CRP patch as manufactured by Canusa, PERP patch as manufactured by Raychem (Polyken), or equal.

C. Polyurethane Coating:

1. Polyurethane coating system repair shall be in accordance with the coating manufacturer's recommended procedures.

2. Coating material for minor repairs shall be single use kits or other mix ratio controlled packages of slow set polyurethane coating material similar to the existing coating

3. Major repairs will be completed using the coating material specified for the coating or the lining. Coating shall be reapplied using plural component spray equipment by a manufacturer certified coating applicator.

D. Exposed Pipe Coating System: Touch-up repair all damage to the primer and/or intermediate coats with the specified coating system prior to final coating of the pipeline in accordance with Section 09 96 00.01 “High-Performance Coatings.”

3.00 EXECUTION

3.01 ENVIRONMENTAL LIMITATIONS

A. General:

1. Products shall comply with federal, state, and local requirements limiting the emission of volatile organic compounds and worker exposure.

2. Comply with applicable federal, state, and local, air pollution and environmental control regulations for surface preparation, blast cleaning, disposition of spent aggregate and debris, and coating application.

3. Do not perform abrasive blast cleaning whenever the relative humidity exceeds 85 percent, whenever surface temperature is less than 5 degrees above the dew point of the ambient air.

4. Do not apply coatings when:

   a. Surface and ambient temperatures exceeds the maximum or minimum temperatures recommended by the coating manufacturer or the Specifications.

   b. In dust or smoke-laden atmosphere, blowing dust or debris, damp or humid weather, or under conditions that could cause icing on the metal surface.

   c. For epoxy coatings or linings when it is expected that surface temperatures would drop below 5 degrees above dew point within 4 hours after application of coating.

   d. Whenever relative humidity exceeds 85 percent for polyurethane coating application.

5. Where weather conditions or Project requirements dictate, Contractor shall provide and operate heaters and/or dehumidification equipment to allow pipe surfaces to be abrasive blasted and coated as specified and in accordance with the manufacturer’s coating application recommendations.

6. Work activities can be restricted by the Engineer until adequate temperature and humidity controls are in place and functioning within the environmental limits specified.

7. Coating applicator shall provide a monitoring system approved by the coating manufacturer that constantly records pipe and coating conditions during coating application. Recorded monitoring parameters shall include pipe temperature, line speed, surface preparation, holiday test and other parameters applicable to the type of coating.

B. Temperature Control:

1. In cold weather or if moisture collects on the pipe, preheat pipe to a temperature between 45 and 90 degrees and 5 degrees above dew point, whichever is greater.
2. When temperatures are above or below the coating manufacturer's recommended application temperatures, the Contractor will provide temperature controls as necessary to permit Work to precede within the manufacturer's temperature limitations.
3. Provide tenting, insulating blankets, baffles, or bulkheads as required to zone and control heating or cooling effectiveness.
4. Heating shall be with indirect fired heaters that do not increase humidity levels within the work area. Heaters shall be sized for the area to be heated.

C. Dehumidification:

1. Contractor shall provide dehumidification equipment when necessary for shop or field environmental control during surface preparation and/or coating application. Dehumidification equipment shall be properly sized to maintain dew point temperature 5 degrees or more below surface temperature of metal surfaces to be cleaned and coated.
2. Cleaned metal surfaces shall be prevented from flash rusting throughout the Project duration, condensation or icing shall be prevented throughout surface preparation and coating application.
3. Equipment size and power requirements shall be designed by personnel trained in the operation and setup of dehumidification equipment based on Project requirements and anticipated weather conditions.
4. Dehumidification equipment shall operate 24 hours per day and continuously throughout surface preparation and coating application.
5. Contractor to provide personnel properly trained in the operation and maintenance of the dehumidification equipment or provided training by the dehumidification equipment Supplier.
6. Daily maintenance requirements of the equipment shall be documented in writing and posted near the equipment for review by the Engineer.
7. Reblasting of flash rusted metal surfaces or removal of damaged coatings, because of equipment malfunction, shutdown, or other events that result in the loss of environmental control, will be at the sole expense of the Contractor.

3.02 SURFACE PREPARATION

A. General:

1. Inspect and provide substrate surfaces prepared in accordance with the Contract Documents and the printed directions and recommendations of coating manufacturer whose product is to be applied.
2. Visible oil, grease, dirt, and contamination shall be removed in accordance with SSPC-SP1, solvent cleaning.

3. Surface imperfections such as metal slivers, burrs, weld splatter, gouges, or delaminations in the metal shall be removed by filing or grinding prior to abrasive surface preparation.

4. Protect prepared pipe from humidity, moisture, and rain. All flash rust, imperfections, or contamination on cleaned pipe surface shall be removed by reblasting.

5. Priming and coating of pipe shall be completed the same day as surface preparation.

B. Weld Surface Preparation:

1. Requirements: Spray applied coating systems do not require weld grinding.

C. Steel Surface Preparation:

1. Surface preparation of steel pipe shall be in accordance with SSPC surface preparation standards utilizing the degree of cleanliness specified for the coating system to be applied or as specified herein, whichever is more stringent.

2. Grit and/or shot abrasive mixture and gradation shall be as required to achieve the degree of cleanliness and coating adhesion specified.

3. Pipe cleaned by abrasive blasting with recyclable steel grit and/or shot or other abrasive shall be cleaned of debris and spent abrasive in an air wash separator.

4. Polyurethane coating system shall have a sharp angular surface profile of the minimum depth specified.

5. Work shall be performed in a manner that does not permit the cleaned metal surface to rust back or flash rust.

6. Rust back or flash rust shall be fully removed with the steel surface cleanliness equal to the metal surface cleanliness prior to rust back or flash rusting. Determination of the equivalent surface cleanliness shall be at the Engineer's sole discretion.

3.03 SHOP -APPLIED COATING SYSTEMS

A. Polyurethane Coating or Lining:

1. Applicator Qualifications:

a. Equipment will be certified by the coating manufacturer to meet the requirements for material mixing, temperature control, application rate, and ratio control for multi-part coatings.

b. Equipment not meeting the written requirements of the coating manufacturer shall be rejected for coating application until repairs or replacement of the equipment is made to the satisfaction of the Engineer.

c. Personnel responsible for the application of the coating system shall have certification of attendance at the coating manufacturer's training class within the last 3 years. The certified applicator shall be present during all coating application Work and shall have responsibility for controlling all aspects of the coating application.

2. Pipe surface temperature shall be between 50 and 100 F or 5 F above dew point, whichever is greater.

3. Coating application shall be performed in an environmentally controlled shop area that meets or exceeds the written environmental application requirements of the coating manufacturer. Application in outdoor conditions will not be acceptable without adequate environmental shelter, environmental controls, and/or dehumidification.
4. Coating adhesion and holiday testing shall be tested as specified in this Section.
5. Coating manufacturer shall provide to the Engineer a copy of the manufacturer's coating application quality assurance manual prior to beginning coating application. Strict conformance to the requirements of the manual will be required. Deviation from the requirements of the manual will be grounds for the Engineer to reject the applied coating.
6. Unacceptable Coating Application:
    a. Coating applied under improper environmental conditions will be rejected.
    b. Pipes that exceed the allowable quantity of coating defects, regardless of size or cause, shall be rejected.
    c. Coating which fails the adhesion or holiday testing as specified in this Section shall be rejected.
    d. Pipe coating that is subject to off ratio application, blistering, or is not applied in conformance with the coating manufacturer's written instructions or recommendations shall be rejected.
7. Rejected coating shall be removed from the full length of the pipe to bare metal and reapplied using proper application methods in accordance with the quality assurance manual and the requirements of the Contract Documents.
8. Perform coating and lining repairs as specified in this Section.

3.04 EXTERIOR COATING HOLDBACK

A. Coating holdbacks shall be straight and cut through the full thickness of the coating.

B. Cutbacks shall be completed in a manner that permits field coating of joints in accordance with the manufacturer's recommendations and as specified herein.

C. Holdbacks shall be as required for proper jointing of pipe, considering joint welding requirements, and be as follows:

Holdbacks	
Push-on joint, spigot	1 inch before centerline gasket
Push-on, bell	Flush with bell end
Welded, spigot	3 inches, minimum
Welded, Bell	4-inches, minimum

D. Holdback Corrosion Protection:

1. Holding primer for corrosion protection of cutbacks or holdbacks shall be compatible with the specified joint coating system and weld after backfill requirements, when applicable.

2. Approved holdback primers are:

    a. Tnemec Omnithane: Suitable for all joints, except joints subject to weld after backfill.

    b. Tnemec 90E-92 Ethyl Silicate Inorganic Zinc Primer: Suitable for all joints, including weld after backfill joints.

    c. ICI Devoe Cathacoat 304V Ethyl Silicate Inorganic Zinc Primer: Suitable for all joints including weld after backfill joints.

    d. Polyken or Other Tape Primers: Not allowed.

3. Primer shall not result in running or melting of the coating or cause toxic fumes when heated during weld after backfill operations.

4. Application and thickness of holding primer shall be in accordance with the coating manufacturer's recommendations, but shall not impair the clearances required for proper joint installation.

5. Primer application on spigot end of field welded pipe shall be held back 1 to 2 inches from the end of the spigot or as necessary to prevent toxic fumes during field welding.

6. Any corrosion within the holdback areas shall be abrasively blasted to near white metal in accordance with SSPC-SP10 or power tool cleaned to bare metal in accordance with SSPC-SP11 prior to applying joint coating.

3.05 PIPE LINING APPLICATION

A. Shop-applied Cement Mortar Lining:

1. Centrifugally line straight sections of pipe. Lining of special pieces or fittings shall be by mechanical, pneumatic, or hand placement. Provide cement mortar lining of uniform thickness. Finish to a smooth dense surface.

2. Steel plate specials larger than 16 inches in diameter shall have lining reinforced with 2-by-4-inch No. 13 gage welded steel wire mesh.

3. Centrifugally line straight sections of pipe. Lining of special pieces or fittings shall be by mechanical, pneumatic, or hand placement. Provide cement mortar lining of uniform thickness. Finish to a smooth dense surface.

4. Steel plate specials larger than 16 inches in diameter shall have lining reinforced with 2-by-4-inch No. 13 gage welded steel wire mesh.

5. Brace and support pipe during lining application to minimize pipe distortion or vibration. Bracing and supports shall not damage the pipe, coating, or lining.

6. Tightly close ends of pipe and fittings with plastic sheet caps. Plastic end caps shall be of sufficient thickness and strength to resist shipping, handling, and storage stresses.

7. Damage to the cement mortar lining, including disbondment, cracking, or blistering, caused by improper curing, shipping, handling, or installation shall be repaired in accordance with AWWA specifications and to the satisfaction of the Engineer.

8. Other requirements of mortar lining materials and processes: As specified in AWWA C205.

B. Liquid Epoxy Lining:

1. Clean and coat the interior of cement mortar lined pipe at insulating joints or where specified with two coats of epoxy coating.

2. Epoxy coating applied at insulating joints shall be applied to both sides of the insulating joint for a minimum of one pipe diameter. If only one side of the joint can be coated the coating shall be applied for a minimum of two pipe diameters.

3. Mortar lining shall be allowed to cure 15 days or steam cured not less than 7 days prior to surface preparation of the mortar and epoxy coating application. Hand applied mortar lining shall be allowed to cure a minimum of 15 days or as required to meet the coating manufacturer's requirements for application on cement or concrete, whichever is greater.

4. Prepared mortar lining by abrasive blasting to remove all laitance and create a suitable anchor profile.

5. Epoxy coating shall be applied in two coats minimum, at a total coating thickness of 16 mils dry film thickness. Coating applied over cement mortar lining shall be applied in a manner that will minimize gassing and pinholes in the completed lining.

6. Mortar lining shall be dry during epoxy lining application.

3.06 FIELD COATING JOINTS

A. General:

1. Remove all oil or grease contamination by solvent wiping the pipe and adjacent coating in accordance with SSPC-SP1, Solvent cleaning.

2. Clean pipe surface and adjacent coating of all mud, corrosion, and other foreign contaminates in accordance with SSPC-SP11, Power Tool Cleaning to Bare Metal or abrasive blast joints in accordance with SSPC-SP10, near white metal blast, that exhibit any surface corrosion or staining. When required, clean the full circumference of the pipe and a minimum of 6 inches onto the existing coating.

3. Remove all loose or damaged pipe coating at joint and either repair the coating as specified herein or increase the length of the joint coating, where reasonable and practical.

4. Complete joint bonding of pipe joints before application of joint coating. Joint bonds shall be installed as specified in Section 26 42 00 "Cathodic Protection." Joint bonds shall be low profile bonds and all gaps and crevices around the bonds shall be filled with mastic sealant.

5. Contractor to electrically test completed joint coating for holidays with high voltage spark tester.

B. Weld After Backfill Joint Requirements:

1. Post-welded or 'Weld after Backfill' joints are defined as welded pipe joints that have been coated and backfilled prior to completing interior welds.

2. Post welded joints shall be coated and protected as follows:

a. Joint coating shall be Canusa AquaWrap heat shrink joint sleeves only. Tape wrapped joints will not be acceptable.

b. Provide 6-inch wide Canusa AquaWrap protective layer centered over the interior weld location as recommended by the joint sleeve manufacturer. Heat resistant tape will not be acceptable.

c. Hold back primer shall be suitable for post weld conditions as specified in this Section and shall not exhibit any binder breakdown in the heat effect zone that causes loss of joint coating adhesion to the holdback primer.

d. Filler mastic materials shall be high temperature materials with 500 F melting point.

e. Joints shall be fully buried prior to welding, with not less than 36 inches cover of soil or flowable fill material on all sides. Sand or flowable fill backfill is preferred for weld after backfill joints.

3. Welding of the joints shall be in conformance with the Specification 33 11 13.13 "Steel Pipe and Fittings" and as modified herein:

   a. All welding shall be with stick electrodes and two or more weld passes as required to meet the specified AWS qualified welding procedures and maximum coating temperature limitations. 'Weld after Backfill' procedures on wall thicknesses of 1/4 inch or less must be approved by the Construction Manager based on field testing demonstrating the welding procedures can comply with the requirements of this Section.

   b. Welding speed, amperage, and voltage shall be as required to maintain a maximum heat input of 23,000 joules or a maximum surface temperature at the coating/steel interface of 800 F, whichever is least.

   c. Maximum weld temperature and duration shall not result in carbonization of the joint coating adhesive. Carbonization is defined as the loss of volatile organic compounds that result in loss of tackiness, adhesion to the steel, and corrosion protection properties.

   d. Finished joint coating shall not have any visual creases or folds in the joint coating backing material that extends through both the inner protective layer and outer joint sleeve.

4. If Contractor elects to post-weld any joints, Contractor shall demonstrate that the joint welding procedures will not significantly damage the coating by fully excavating the first two joints for evaluation of the joint coating condition. Engineer will randomly select up to three additional post-welded joints for excavation by Contractor for evaluation of joint coating condition. Joint coating will be destructively evaluated by the Engineer. Contractor will remove and replace joint heat shrink sleeve upon completion of the evaluation.

5. In the event that any excavated post welded joint exhibits any heat related damage as defined herein, Contractor shall modify and test a new post welding procedure prior to completing any additional post-welded joints. Contractor shall demonstrate that the revised joint welding procedure will not significantly damage the coating by repeating the weld after backfill evaluation requirements defined in this Section, including excavation of the three additional randomly selected joints for destructive evaluation.

C. Heat Shrink Sleeve Joint Coating:

1. Store, handle, and apply field heat shrink sleeve coatings in accordance with AWWA C216 and this Section.

2. Store sleeves in shipping box until use is required. Keep dry and sheltered from exposure to direct sunlight. Store off the ground or concrete floors and maintain at a temperature between 60 and 100 degrees as recommended by the sleeve manufacturer.

3. Metal surface shall be free of all dirt, dust, and surface corrosion prior to sleeve application. Surface preparation shall be in accordance with the joint coating manufacturer's recommendations.

4. Where corrosion in the holdback area is visible, surfaces shall be prepared in accordance with SSPC-SP10, near white metal blast, or SSPC-SP11, power tool cleaning to bare metal.

5. Preheat pipe uniformly as recommended by the sleeve manufacturer. Monitor pipe temperature using a surface temperature gauge, infrared thermometer, or color changing crayons. Protect preheated pipe from rain, snow, frost, or moisture with tenting or shields and do not permit the joint to cool.

6. Fill all cracks, crevices, gaps, and step-downs greater than 1/4 inch with filler mastic in accordance with the manufacturer's recommendations for the full circumference of the pipe.

7. Apply heat shrink sleeve when it is at a minimum temperature of 60 degrees and while maintaining the pipe temperature above the preheat temperature specified. Apply sleeve in accordance with the manufacturer's instructions and center the sleeve over the joint to provide a minimum 2-inch overlap onto the existing pipe coating.

8. Completed joint sleeve shall be fully bonded to the pipe and existing coating surface without voids. Mastic beading shall be visible along the full circumference of the sleeve. There shall be no wrinkling or excessive burns on the sleeves. Sleeves that do not meet these requirements shall be removed and the joint recoated as directed by the Engineer. Minor repairs may be repaired using heat applied patch material specified for minor coating repairs.

9. Allow the sleeve to cool before backfilling. In hot climates, provide shading from direct sunlight. Water quenching will be allowed only when permitted by the sleeve manufacturer.

10. Heat shrink joint coatings which have become wrinkled or disbonded because of prolonged exposure to UV light or thermal cycling shall be removed and replaced.

11. Double coating of defective or damaged heat shrink coatings will not be permitted. Any double coated heat shrink sleeves shall be immediately rejected and Contractor shall remove and recoat the joint.

3.07 REPAIR OF COATING AND LININGS

A. General:

1. All areas where holidays are detected or coating is visually damaged, such as blisters, tears, rips, bubbles, wrinkles, cuts, or other defects shall be repaired. Areas where no holidays are detected, but are visually damaged shall also be repaired.
2. Maximum allowable defects shall be as specified herein for the coating system.

B. Polyurethane Coating or Lining Repairs:

1. General:

a. Complete coating or lining repairs in accordance with the coating manufacturers written instructions and this Section, whichever is stricter.

b. Defect Size:

1). Minor repairs: Repairs that are less than 6 inches in the greatest dimension.

2). Major repairs: Repairs that exceed 6 inches in the greatest dimension.

c. Pipes exceeding the maximum number or size of coating defects shall be stripped of coating, reblasted, and recoated.

d. Pipe arriving in the field with defects or repairs exceeding the maximum number or size of coating defects will be returned to the shop for recoating at the Contractor's expense.

2. Minor Repairs:

a. Coating or lining repairs on any joint of pipe shall not exceed 1.5 per 100 square feet of surface area.

b. Two or more minor repairs within 6 inches diameter circle will be considered a single repair.

c. Repairs for adhesion testing will not be included in the total number of repairs.

d. Minor repairs:

1). Surface Preparation: Clean and feather the defect by power tool sanding with 80 grit or coarser sandpaper to roughen the existing coat and feather the edges of the defect for a minimum of 2 inches around the defect.

2). Shop Repair Materials:

a). Slow setting parent material polyurethane coating material in syringes or other single use packaging that controls mix ratio.

b). Coating manufacturer's polyurethane coating repair products subject to Engineer's approval.

3). Field Repair Materials:

a). Melt stick coating repair (not acceptable for repairs greater than 1-inch diameter); ScotchCoat P206, Canusa Melt Stick, or approved equal.

b). Heat applied coating materials; CRP Patch, Canusa; PERP Patch, Tyco Adhesives, or approved equal.

c). Coating manufacturer's polyurethane coating repair products subject to Engineer's approval.

4). Apply a single coat of the specified patch coating material at the specified coating thickness.

5). Repaired adhesion shall be 50 percent of the specified coating adhesion.

3. Major Repairs:

a. Major repairs shall not exceed two per pipe joint and the combined area shall not be greater than 50 percent of the pipe.

b. Major Repairs:

1). Surface Preparation:

a). The metal surface and surrounding coating shall be abrasively blasted in accordance with SSPC-SP10, near white metal, or to equal in cleanliness and profile as the original surface preparation.

b). Existing coating shall be feathered and roughened to the equivalent of 40 grit sandpaper.

2). Shop Repair Materials:

a). Same material as the pipeline coating or lining and shall be applied by using plural component spray equipment.

3). Field Repair Materials:

a). Same material as the pipeline coating or lining and shall be applied by using plural component spray equipment.

b). Heat shrink sleeves as specified for pipeline joints.

c. One coat of the specified original coating material shall be applied over the repaired surface at the specified thickness.

d. Repair adhesion shall be equal to the specified coating adhesion.

3.08 INSPECTION AND TESTING

A. General:

1. Applicator shall inspect and test the coating system in accordance with referenced standards and this Section, whichever is more stringent.

2. The frequency of the testing shall be determined by the applicator, but shall not be less than the requirements of this Section.

3. Owner or Owner's representative will conduct random independent inspections and tests for the final acceptance or rejection of pipe coating or lining.

B. Adhesion Testing:

1. General:

a. Adhesion testing shall be conducted at the shop prior to shipment. Pipe shipped without adhesion testing will be field-tested. Pipe rejected in the field will be returned to the shop for repair at the sole expense of the Contractor.

b. A minimum of two pipes will be tested for adhesion from each lot of pipe coated up to 3000 square feet of pipe. An additional adhesion test will be conducted on every increment up to 2000 square feet of pipe coated in excess of the first 3000 square feet of pipe. (i.e. if one workday of production is 6000 square feet of pipe, four adhesion tests will be conducted on the pipe lot.) Adhesion testing shall be conducted on not less than 50 percent of each pipe produced within a lot.

c. A pipe lot is defined as the quantity of pipe that is coated by a single crew within a work shift, but not to exceed 12 hours.

d. The pipe coating applicator shall repair all coating damage from shop adhesion testing. Contractor shall be responsible for coating repairs for all field adhesion testing.

e. Adhesion tests will be performed not less than 24 hours after coating application. Tests conducted prior to 24 hours will be acceptable only if the test meets or exceeds the adhesion criteria specified and the test was requested by the pipe fabricator.

f. Pipe will be randomly selected for adhesion testing.

g. Owner or the Owner's representative has the right to conduct additional adhesion testing as deemed necessary to assure the pipe meets or exceeds the requirements of this Section at any time and location.

2. Rejection of Coating:

3. If any pipe within a lot fails to meet the test criteria specified for the coating type, that pipe shall be rejected along with all other pipes within the lot. Each pipe within the rejected pipe lot will then be individually tested and rejected on a pipe-by-pipe basis in conformance with the test procedures and criteria specific for the coating type.

4. All rejected pipe shall have all coating removed from the full length pipe and the pipe abrasive blasted and recoated.

5. Polyurethane Adhesion Testing:

   a. Acceptance Criteria:

      1). Polyurethane coating or lining shall have an adhesion to steel of 1750 pounds per square inch, minimum. Acceptance will be based on one pull minimum, with no pulls less than the minimum criteria where multiple pulls are conducted on the same joint of pipe.

      2). The median value for all coating or lining adhesion pulls performed within a lot of pipe shall not be less than 2000 psi.

      3). Each pipe failing the minimum adhesion criteria shall be rejected. AWWA C222 rejection of pipe based on multiple adhesion pulls is specifically excluded from this Section.

      4). Pipe lots failing the median value for all adhesion pulls shall be rejected and each pipe within the lot tested for adhesion. Each pipe that fails the adhesion criteria shall be rejected.

5). Failure shall be by adhesive and cohesive failure only. Adhesive failure is defined as separation of the coating from the steel substrate. Cohesive failure is defined as failure within the coating, resulting in coating remaining both on the steel substrate and dolly.

b. Test Procedures:

1). Polyurethane coating adhesion to steel substrates shall be tested using self-aligning pneumatic pull off equipment, such as the Delfesko Positest, and test procedures in accordance with ASTM D4541 and AWWA C222, except as modified in this Section.

2). All adhesion test pull records shall be maintained in an electronic spreadsheet that includes pipe identification, pipe coating date, adhesion test date, surface tested (interior or exterior), surface temperature, coating thickness, tensile force applied, rate of pressure change per second, mode of failure, and percentage of substrate failure relative of dolly surface.

3). Dollies for adhesion testing shall be 20 millimeters in diameter, and glued to the coating surface and allowed to cure for a minimum of 12 hours before testing.

4). Polyurethane coatings shall be scored around the dolly prior to conducting the adhesion test. Scoring shall be completed manually, normal to the pipe surface, or in a manner that does not stress or over heat the coating.

5). Adhesion testing shall be performed at temperatures between 55 and 100 F. Tests may be performed at temperatures up to 115 F if no significant affect in the test results are statistically detectable.

6). Partial substrate and glue failures will be retested if the substrate failure is less than 50 percent relative of the dolly surface area and the applied tension was less than the specified adhesion. Pipes that have partial substrate failures greater than 50 percent and less than the specified adhesion will be rejected as a substrate adhesion failure.

7). Glue failures in excess of the minimum required tensile adhesion would be accepted as meeting the specified adhesion requirements.

8). If multiple adhesion pulls on the same pipe are performed, adhesion pulls shall be performed in a circumferential direction with all pulls in a straight line and within an area 1-1/2 inches in width and spacing between dollies between 1 and 2 inches.

9). Adhesion tests will be conducted on polyurethane pipe coating and lining independently and will be accepted or rejected independently of the other.

c. Adhesion Test Repairs:

1). Repair patches on the polyurethane coating shall be randomly selected for adhesion testing in a manner as described herein and at the discretion of the coating inspector conducting the adhesion tests. Adhesion of repairs shall be as specified for the type of repair.

C. Holiday Testing:

1. Holiday tests on polyurethane coatings or linings will be conducted on the completed coating or lining after cure or 24 hours, whichever is less, using a high voltage spark test in accordance with NACE Standard RP 0274 and the Specifications.
2. Coating thickness used for holiday testing shall be the minimum specified coating thickness.

D. Dry Film Thickness Testing:

1. Coatings shall be tested for dry film thickness using a properly calibrated magnetic pull off or eddy current equipment.
2. Coating thickness measurements shall be conducted as necessary and without limitation. Testing conformance to the requirements of SSPC PA-2 is specifically excluded from this Section.

3.09 HANDLING, TRANSPORTATION, AND STORAGE

A. Pipe shall be handled in such a manner as to protect the pipe and coating from damage.

B. Coated pipe shall not be shipped or installed until coating has developed full adhesion and cure.

C. During coating application, storage, loading, transportation, unloading, laying and installation, every precaution shall be taken to protect and prevent damage to pipe, lining, and coating. Forklift equipment shall have all bearing surfaces padded with suitable padding material. Lift pipe with web slings a minimum of 12 inches wide and of a type that will not damage the coating. Metal chains, cable, tongs, forklifts or other equipment likely to damage the coating will not be permitted. Dragging or skidding of pipe on grade or in the trench will not be permitted.

D. Provide transportation vehicles with padded bolsters between each layer of pipe and heavy padding under load ties. Bolsters shall be curved to fit the outside of the pipe and 12 inches wide, minimum. All pipe contact locations shall be heavily padded with carpet and strips of the outer tape wrap material (adhesive side against the carpet) during shipment to the Site and from the storage yard to the point of installation.

E. Pipe shall not be stored on rocks, gravel, or other hard materials that might damage the coating. Provide padded 12-inch wide skids and chucks, sand bags, select loamy or sand berms, or suspended from cutback ends, where possible, to minimize coating damage. Pipe shall not be laid on asphalt without suitable padding at all contact points.

F. Pipe shall be inspected by the Contractor at the Site for damage. Any damage to the pipe, lining, or coating shall be repaired as directed if, in the opinion of the Engineer, a satisfactory repair can be made; otherwise, the damaged section shall be replaced at the sole expense to the Contractor.

G. No metal tools or heavy objects shall be permitted to come into contact unnecessarily with the finished coating. Workmen shall not be permitted to walk on the coating except when absolutely necessary and approved by the Engineer. When permitted, shoes with rubber or composition soles and heels or other suitable footwear that will not damage coating shall be used.

H. Long-term Exposure: Pipe shall either be provided with UV inhibitor for lengthy above grade exposure or covered to prevent UV degradation of outer wrap. Amount of UV stabilizers required will depend on the Project location, laying schedule, anticipated length of exposure, and type of outer wrap. Manufacturer shall be consulted for recommended UV inhibitors requirements or pipe shall be stored under a protective cover. Protective covering can be colored plastic sheeting, canvas, or other UV blocking material. Clear plastic sheets are not acceptable. Areas of coating that display UV degradation shall be removed and repaired at sole cost of the Contractor.

I. End Caps: Pipe ends of mortar lined pipe and fittings shall be tightly closed with a plastic wrap to aid in curing and to minimize drying out of and contamination of the lining. Plastic end cap shall consist of a minimum of one 10-mil sheet of polyethylene or other suitable material. End caps shall be substantial enough to resist shipment, handling, and storage loads and firmly attached in place. The plastic end cap shall remain intact and in place until pipe installation. Damaged or missing plastic end caps shall be repaired or replaced.

J. Bracing:

1. The steel pipe manufacturer shall furnish and install adequate bracing or strutting to keep the pipe from becoming deformed or damage from occurring to the coating or linings. Strut-type bracing shall be installed as soon as possible after application of lining. Struts shall remain in place during handling, storage, transportation, and installation of pipe and fittings until after the pipe zone material is compacted.

2. The struts shall be installed with pads and wedges in such a manner that the pipe lining will not be damaged and the struts will not be dislodged during shipping and handling of the pipe. If struts are welded, they shall be installed and removed in such a manner to prevent damage to the steel cylinder, lining, or coatings. All damage shall be repaired to the satisfaction of the Engineer.

END OF SECTION

DIVISION 10

SPECIALTIES

10 14 16 PLAQUES

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes metal plaques.

1.03 DEFINITIONS

A. Accessible: In accordance with the accessibility standard.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Shop Drawings: For plaques.
   1. Include fabrication and installation details and attachments to other work.
   2. Show plaque mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
   3. Show message list, typestyles, graphic elements, and layout for each plaque at least half size.
C. Samples for Verification: For each type of plaque showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
   1. Plaques: Full-size Sample.
   2. Full-size Samples, if approved, will be returned to Contractor for use in the Project.
D. Product Schedule: For plaques. Use same designations indicated on Drawings or specified.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Sample Warranty: For special warranty.

1.06 CLOSEOUT SUBMITTALS

A. Maintenance Data: For plaques to include in maintenance manuals.

1.07 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.08 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of plaques that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Deterioration of finishes beyond normal weathering.
      b. Deterioration of embedded graphic image.
   2. Warranty Period: Five years from date of Substantial Completion.

2.00 PRODUCTS

2.01 PLAQUES

A. Cast Plaque: Cast-metal plaque with background texture, border, and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. A.R.K. Ramos.
      b. ACE Sign Systems, Inc.
      c. Erie Landmark Company; a division of Paul W. Zimmerman Foundries.
      d. Gemini Incorporated.
      e. Matthews International Corporation; Bronze Division.
      f. Metal Arts.
      g. Metallic Arts.
      h. Signs & Decal Corp.
   2. Plaque Material: Cast bronze.
   3. Plaque Thickness: 0.25 inch (6.35 mm).
   4. Finishes:
      a. Integral Metal Finish: Antique oxidized.
      b. Overcoat: Clear organic coating.
   5. Background Texture: Leatherette.
   6. Integrally Cast Border Style: Square single line, polished.
   7. Applied Frame Material, Style, and Finish: As indicated on Drawings.
   8. Mounting: Concealed studs.
   9. Text and Typeface: Typeface matching Architect's sample and variable content as scheduled. Finish raised characters to contrast with background color, and finish Braille to match background color.

2.02 MATERIALS

A. Bronze Castings: ASTM B584, Alloy UNS No. C86500 (No. 1 manganese bronze).

2.03 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of plaques, noncorrosive and compatible with each material joined, and complying with the following:
   1. Use concealed fasteners and anchors unless indicated to be exposed.
   2. For exterior exposure, furnish stainless-steel devices unless otherwise indicated.
   3. Plaque Mounting Fasteners:
      a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of plaque, screwed into back of plaque, or screwed into tapped lugs cast integrally into back of plaque unless otherwise indicated.

B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.04 FABRICATION

A. General: Provide manufacturer's standard plaques according to requirements indicated.
   1. Preassemble plaques in the shop to greatest extent possible. Disassemble plaques only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
   2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
   3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
   4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
   5. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match plaque finish.
   6. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.

2.05 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.

D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

3.00 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
B. Verify that plaque-support surfaces are within tolerances to accommodate plaques without gaps or irregularities between backs of plaques and support surfaces unless otherwise indicated.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General: Install plaques using mounting methods indicated and according to manufacturer's written instructions.
    1. Install plaques level, plumb, true to line, and at locations and heights indicated, with plaque surfaces free of distortion and other defects in appearance.
    2. Install plaques so they do not protrude or obstruct according to the accessibility standard.
    3. Before installation, verify that plaque surfaces are clean and free of materials or debris that would impair installation.
    4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
B. Mounting Methods:
    1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of plaque. Remove loose debris from hole and substrate surface.
        a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place plaque in position and push until flush to surface, embedding studs in holes. Temporarily support plaque in position until adhesive fully sets.
        b. Thin or Hollow Surfaces: Place plaque in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

3.03 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed plaques and plaques that do not comply with specified requirements. Replace plaques with damaged or deteriorated finishes or

components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as plaques are installed.

C. On completion of installation, clean exposed surfaces of plaques according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain plaques in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION

10 14 23 PANEL SIGNAGE

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Panel signs.
   2. Field-applied, vinyl-character signs.
B. Related Requirements:
   1. Section 015000 "Temporary Facilities and Controls" for temporary Project identification signs and for temporary informational and directional signs.

1.03 DEFINITIONS

A. Accessible: In accordance with the accessibility standard.

1.04 COORDINATION

A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Shop Drawings: For panel signs.
   1. Include fabrication and installation details and attachments to other work.
   2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
   3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
C. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
   1. Panel Signs: Full-size Sample.
   2. Field-Applied, Vinyl-Character Signs: Full-size Sample of characters on glass.
   3. Variable Component Materials: Full-size Sample of each base material, character (letter, number, and graphic element) in each exposed color and finish not included in Samples above.
   4. Full-size Samples, if approved, will be returned to Contractor for use in Project.

D. Product Schedule: For panel signs. Use same designations indicated on Drawings or specified.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.
B. Sample Warranty: For special warranty.

1.07 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.08 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.09 FIELD CONDITIONS

A. Field Measurements: Verify locations of anchorage devices embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Deterioration of finishes beyond normal weathering.
      b. Deterioration of embedded graphic image.
      c. Separation or delamination of sheet materials and components.
   2. Warranty Period: Five years from date of Substantial Completion.

2.00 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Thermal Movements: For exterior signs, allow for thermal movements from ambient and surface temperature changes.
   1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
B. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design".

2.02 PANEL SIGNS

A. Panel Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ACE Sign Systems, Inc.
      b. Advance Corporation.
      c. Allen Industries Architectural Signage.
      d. Allen Markings.
      e. APCO Graphics, Inc.
      f. ASE, Inc.
      g. ASI Sign Systems, Inc.
      h. Best Sign Systems, Inc.
      i. Bunting Graphics, Inc.
      j. Clarke Systems.
      k. Cosco.
      l. Diskey Architectural Signage Inc.
      m. Fossil Industries, Inc.
      n. Inpro Corporation.
      o. Mohawk Sign Systems.
      p. Nelson-Harkins Industries.
      q. Poblocki Sign Company, LLC.
      r. Seton Identification Products.
      s. Signs & Decal Corp.
      t. Stamprite Supersine; a division of Stamp Rite Inc.
      u. Vista System.
   2. Laminated Aluminum-Sheet Sign: Aluminum sheet laminated to both sides of acrylic core sheet.
      a. Composite-Sheet Thickness: 0.25 inch (6.35 mm).
      b. Engraved Graphics
      c. Surface-Applied, Raised Graphics: Applied Braille.
   3. Engraved Plastic-Laminate Sign: Plastic-laminate face laminated to contrasting phenolic core to produce composite sheet.
      a. Composite-Sheet Thickness: 0.125 inch (3.18 mm).
      b. Engraved Graphics: Characters engraved through plastic-laminate face sheet to expose contrasting phenolic core.
      c. Plastic-Laminate Color and Pattern: Metallic brushed aluminum
      d. Core Color: Manufacturer's standard black.
   4. Sign-Panel Perimeter: Finish edges smooth.
      a. Edge Condition: Square cut.
      b. Corner Condition in Elevation: As indicated on Drawings.
   5. Frame: Horizontal retainers to hold changeable sign panel.
      a. Material: Aluminum.

b. Profile: Square.
c. Corner Condition in Elevation: Square.
d. Finish and Color: Brushed Aluminum.

6. Mounting: Surface mounted to wall with two-face tape.
7. Surface Finish and Applied Graphics:
   a. Integral Aluminum Finish: Brushed.
8. Text and Typeface: typeface matching Architect's sample and variable content as scheduled. Finish raised characters to contrast with background color, and finish Braille to match background color.
9. Flatness Tolerance: Sign shall remain flat or uniformly curved under installed conditions as indicated on Drawings and within a tolerance of plus or minus 1/16 inch (1.5 mm) measured diagonally from corner to corner.

2.03 FIELD-APPLIED, VINYL-CHARACTER SIGNS

A. Field-Applied, Vinyl-Character Sign: Prespaced characters die cut from 3- to 3.5-mil (0.076- to 0.089-mm) thick, weather-resistant vinyl film with release liner on the back and carrier film on the front for on-site alignment and application.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Allen Markings.
      b. APCO Graphics, Inc.
      c. Mohawk Sign Systems.
   2. Size: As indicated on Drawings.
   3. Substrate: As indicated on Drawings.
   4. Text and Font: As indicated on Drawings.

2.04 PANEL-SIGN MATERIALS

A. Aluminum Sheet and Plate: ASTM B209 (ASTM B209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
B. Acrylic Sheet: ASTM D4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
C. Plastic-Laminate Sheet: NEMA LD 3, general-purpose HGS grade, 0.048-inch (1.2-mm) nominal thickness.
D. Vinyl Film: UV-resistant vinyl film of nominal thickness indicated, with pressure-sensitive, permanent adhesive on back; die cut to form characters or images as indicated on Drawings and suitable for exterior applications.
E. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.05 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following unless otherwise indicated:
   1. Use concealed fasteners and anchors unless indicated to be exposed.
   2. For exterior exposure, furnish stainless-steel devices unless otherwise indicated.
   3. Exposed Metal-Fastener Components, General:
      a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
      b. Fastener Heads: For nonstructural connections, use flathead or oval countersunk screws and bolts with tamper-resistant Allen-head slots unless otherwise indicated.
   4. Sign Mounting Fasteners:

a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly unless otherwise indicated.

5. Inserts: Furnish inserts to be set by other installers into concrete or masonry work.

B. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch (1.14 mm) thick, with adhesive on both sides.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.06 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Preassemble signs in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
5. Internally brace signs for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.
6. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

B. Surface-Engraved Graphics: Machine engrave characters and other graphic devices into indicated sign surface to produce precisely formed copy, incised to uniform depth.

1. Engraved Metal: Fill engraved graphics with manufacturer's standard baked enamel.

C. Shop- and Subsurface-Applied Vinyl: Align vinyl film in final position and apply to surface. Firmly press film from the middle outward to obtain good bond without blisters or fishmouths.

D. Signs with Changeable Message Capability: Fabricate signs to allow insertion of changeable messages as follows:

1. For slide-in changeable inserts, fabricate slot without burrs or constrictions that inhibit function. Furnish initial changeable insert. Subsequent changeable inserts are by Owner.
2. For frame to hold changeable sign panel, fabricate frame without burrs or constrictions that inhibit function. Furnish initial sign panel..

2.07 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.

D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.08 ALUMINUM FINISHES

A. Brushed aluminum.

3.00 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
C. Verify that anchorage devices embedded in permanent construction are correctly sized and located to accommodate signs.
D. Verify that electrical service is correctly sized and located to accommodate signs.
E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
    1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
    2. Install signs so they do not protrude or obstruct according to the accessibility standard.
    3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
    4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
B. Accessible Signage: Install in locations on walls as indicated on Drawings.
C. Mounting Methods:
    1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
        a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
        b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
    2. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to

support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

D. Field-Applied, Vinyl-Character Signs: Clean and dry substrate. Align sign characters in final position before removing release liner. Remove release liner in stages, and apply and firmly press characters into final position. Press from the middle outward to obtain good bond without blisters or fishmouths. Remove carrier film without disturbing applied vinyl film.

E. Signs Mounted on Glass: Provide opaque sheet matching sign material and finish onto opposite side of glass to conceal back of sign.

3.03 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION

10 28 00 TOILET, BATH, AND LAUNDRY ACCESSORIES

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Public-use washroom accessories.
   2. Public-use shower room accessories.
   3. Underlavatory guards.
   4. Custodial accessories.

B. Related Requirements:
   1. Section 093013 "Ceramic Tiling" for ceramic toilet and bath accessories.

1.03 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
   2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
   3. Include electrical characteristics.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
   1. Identify locations using room designations indicated.
   2. Identify accessories using designations indicated.

1.05 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's special warranty.

1.06 CLOSEOUT SUBMITTALS

A. Maintenance Data: For accessories to include in maintenance manuals.

1.07 WARRANTY

A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, visible silver spoilage defects.
   2. Warranty Period: 15 years from date of Substantial Completion.

2.00 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.02 PUBLIC-USE WASHROOM ACCESSORIES

A. Source Limitations: Obtain public-use washroom accessories from single source from single manufacturer.

B. Toilet Tissue (Roll) Dispenser TA-1:
   1. Manufacturers: Subject to compliance with requirements, provide Bobrick B-4288 Contura Series Surfact-mounted Multi-roll Toilet Tissue Dispenser, or comparable product by one of the following:
      a. AJW Architectural Products.
      b. American Specialties, Inc.
      c. Bradley Corporation.
      d. Brey-Krause Manufacturing Co.
      e. GAMCO Specialty Accessories; a division of Bobrick.
   2. Description: Roll-in-reserve dispenser with hinged front secured with tumbler lockset.
   3. Mounting: Surface mounted.
   4. Operation: Noncontrol delivery with standard spindle.
   5. Capacity: Designed for 5-inch- (127-mm-) diameter tissue rolls.
   6. Material and Finish: Stainless steel, No. 4 finish (satin).

C. Paper Towel (Folded) Dispenser <Insert drawing designation>:
   1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
   2. Mounting: [Recessed] [Semirecessed] [Deck mounted, recessed] [Surface mounted].
   3. Minimum Capacity: [400 C-fold or 525 multifold towels] [600 C-fold or 800 multifold towels] [400 single-fold towels] <Insert capacity>.
   4. Material and Finish: [Stainless steel, No. 4 finish (satin)] [ABS plastic, gray] <Insert material and finish>.
   5. Lockset: Tumbler type.
   6. Refill Indicator: Pierced slots at sides or front.

D. Combination Towel (Folded) Dispenser/Waste Receptacle TA-6:

1. Manufacturers: Subject to compliance with requirements, provide Bobrick B43944 Contura Series Recessed combination Towel and Waste Unit, or comparable product by one of the following:
    a. AJW Architectural Products.
    b. American Specialties, Inc.
    c. Bradley Corporation.
    d. Brey-Krause Manufacturing Co.
    e. GAMCO Specialty Accessories; a division of Bobrick.
    f. Seachrome Corporation.
2. Description: Combination unit for dispensing C-fold or multifold towels, with removable waste receptacle.
3. Mounting: Recessed with projecting receptacle.
    a. Designed for nominal 4-inch (100-mm) wall depth.
4. Minimum Towel-Dispenser Capacity: 600 C-fold or 800 multifold paper towels.
5. Minimum Waste-Receptacle Capacity: 12 gal. (45.4 L).
6. Material and Finish: Stainless steel, No. 4 finish (satin).
7. Liner: Reusable, vinyl waste-receptacle liner.
8. Lockset: Tumbler type for towel-dispenser compartment and waste receptacle.

E. Liquid-Soap Dispenser TA-4:

1. Manufacturers: Subject to compliance with requirements, provide Bobrick B-4112 Contrua Series Surface-mounted Soap Dispenser or comparable product by one of the following:
    a. AJW Architectural Products.
    b. American Specialties, Inc.
    c. Bradley Corporation.
    d. Brey-Krause Manufacturing Co.
    e. GAMCO Specialty Accessories; a division of Bobrick.
    f. Seachrome Corporation.
2. Description: Designed for dispensing antibacterial soap in liquid or lotion form.
3. Mounting: Vertically oriented, surface mounted.
4. Capacity: Insert 40 oz. (1,200 mL).
5. Materials: Corrosion-resistant valve with satin-finish stainless steel container.
6. Lockset: Tumbler type.
7. Refill Indicator: Window type.

F. Grab Bar TA-2, TA-3 & TA-9:

1. Manufacturers: Subject to compliance with requirements, provide Bobrick B-6806 Grab Bars for Toilets and B-6861 Grab Bars for Accessible Shower, or comparable products by one of the following:
    a. AJW Architectural Products.
    b. American Specialties, Inc.

c. Bradley Corporation.
d. Brey-Krause Manufacturing Co.
e. GAMCO Specialty Accessories; a division of Bobrick.
f. Oatey.

2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch (1.3 mm) thick.
   a. Finish: Smooth, No. 4 finish (satin).
4. Outside Diameter: 1-1/2 inches (38 mm).
5. Configuration and Length: As indicated on Drawings.

G. Mirror Unit TA-5:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AJW Architectural Products.
   b. American Specialties, Inc.
   c. Bradley Corporation.
   d. Brey-Krause Manufacturing Co.
   e. GAMCO Specialty Accessories; a division of Bobrick.
2. Frame: Stainless-steel channel.
   a. Corners: Manufacturer's standard.
3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
   a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
4. Size: As indicated on Drawings.

2.03 PUBLIC-USE SHOWER ROOM ACCESSORIES

A. Source Limitations: Obtain public-use shower room accessories from single source from single manufacturer.

B. Shower Curtain Rod TA-12:
1. Manufacturers: Subject to compliance with requirements, provide Bobrick B-207 or comparable product by one of the following:
   a. AJW Architectural Products.
   b. American Specialties, Inc.
   c. Bradley Corporation.
   d. Brey-Krause Manufacturing Co.
   e. GAMCO Specialty Accessories; a division of Bobrick.
2. Description: 1-inch (25.4-mm) OD; fabricated from nominal 0.0375-inch- (0.95-mm-) thick stainless steel.
3. Mounting Flanges: Stainless-steel flanges designed for exposed fasteners.
4. Finish: Stainless steel, No. 4 finish (satin).

C. Shower Curtain TA-13:

1. Manufacturers: Subject to compliance with requirements, provide Bobrick 204-2 or comparable product by one of the following:
    a. AJW Architectural Products.
    b. American Specialties, Inc.
    c. Bradley Corporation.
    d. Brey-Krause Manufacturing Co.
    e. GAMCO Specialty Accessories; a division of Bobrick.
2. Size: Minimum 6 inches (152 mm) wider than opening by 72 inches (1828 mm) high.
3. Material: Vinyl, minimum 0.006 inch (0.15 mm) thick, opaque, matte.
4. Color: White.
5. Grommets: Corrosion resistant at minimum 6 inches (152 mm) o.c. through top hem.
6. Shower Curtain Hooks: Chrome-plated or stainless-steel, spring wire curtain hooks with snap fasteners, sized to accommodate specified curtain rod. Provide one hook per curtain grommet.

D. Folding Shower Seat TA-10:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. AJW Architectural Products.
    b. American Specialties, Inc.
    c. Bradley Corporation.
    d. Brey-Krause Manufacturing Co.
    e. GAMCO Specialty Accessories; a division of Bobrick.
2. Configuration: Rectangular seat.
3. Seat: Phenolic or polymeric composite of slat-type or one-piece construction in color as selected by Architect.
4. Mounting Mechanism: Stainless steel, No. 4 finish (satin).
5. Dimensions: 18” x 15 13/16” Seat.

E. Robe Hook TA-7:

1. Manufacturers: Subject to compliance with requirements, provide Bobrick B-672 or comparable product by one of the following:
    a. AJW Architectural Products.
    b. American Specialties, Inc.
    c. Bradley Corporation.
    d. Brey-Krause Manufacturing Co.
    e. GAMCO Specialty Accessories; a division of Bobrick.
2. Description: Double-prong unit.
3. Material and Finish: Stainless steel, No. 7 finish (polished).

2.04 UNDERLAVATORY GUARDS

A. Underlavatory Guard:

1. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
2. Material and Finish: Antimicrobial, molded plastic, white.

2.05 CUSTODIAL ACCESSORIES

A. Source Limitations: Obtain custodial accessories from single source from single manufacturer.
B. Utility Shelf with Mop and Broom Holders and Hooks TA-14:
   1. Manufacturers: Subject to compliance with requirements, provide Bobrick B-239 x 34 or comparable product by one of the following:
      a. AJW Architectural Products.
      b. American Specialties, Inc.
      c. Bradley Corporation.
      d. Brey-Krause Manufacturing Co.
      e. GAMCO Specialty Accessories; a division of Bobrick.
   2. Description: With exposed edges turned down not less than 1/2 inch (13 mm) and supported by two triangular brackets welded to shelf underside.
   3. Size: 34 inches long.
   4. Material and Finish: Not less than nominal 0.05-inch- (1.3-mm-) thick stainless steel, No. 4 finish (satin).

2.06 MATERIALS

A. Stainless Steel: ASTM A666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.
B. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
C. Chrome Plating: ASTM B456, Service Condition Number SC 2 (moderate service).
D. Mirrors: ASTM C1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.07 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

3.00 EXECUTION

3.01 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F446.

3.02 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
B. Remove temporary labels and protective coatings.
C. Clean and polish exposed surfaces according to manufacturer's written instructions.

END OF SECTION

10 40 13 FALL PREVENTION AND SAFETY SYSTEMS

1.00 GENERAL

1.01 WORK INCLUDED

A. Furnish labor, materials, equipment, and incidentals to install the following complete systems:

1. Ladder safety system.
2. Horizontal fall restraint systems.
3. Guardrail safety gates.
4. Safety related signage.

1.02 REFERENCES

A. Occupational Safety and Health Administration (OSHA):

1. OSHA 1926.502, Subpart M - Fall Prevention Systems Criteria and Practices

B. American National Standard Institute (ANSI):

1. ANSI Z 359.1 - American National Standard Safety Requirements for Personal Fall Protection Systems and Components

1.03 SUBMITTALS

A. Submittals must be in accordance with Section 01 33 00 “Document Management” and must include:

1. Ladder Safety System:
    a. Manufacturer’s product data sheets.
    b. Material list of products to be installed on Project.
    c. O&M data for product.
2. Horizontal Fall Restraint System:
    a. Manufacturer’s product data sheets and fabrication drawings.
    b. Material list of products to be installed on Project.
    c. O&M data for product.
3. Safety Gates:
    a. Manufacturer’s product data sheets.
    b. Material list of products to be installed on Project.
    c. O&M data for product.
4. Manufacturer’s product data sheet for safety related signage.

2.00 PRODUCTS

2.01 HORIZONTAL FALL RESTRAINT SYSTEM

A. The Fall Restraint System shall allow the users to walk uninterrupted within the safe zone area while restricting travel beyond any un-protected boundary of fall hazard. Each restraint anchor shall be designed as a 304 stainless steel, clamp-on assembly to attach to a centrally located, circular vent or hatch without the need to penetrate or weld to the existing structure. Two cables are to be attached to center assembly to be used as a lifeline for operators on the roof. All components shall be included to provide a complete and fully operational system.

B. System layout, design analysis and calculations must be prepared and certified by a professional engineer licensed in the state where the Project is located.

C. Coordination of design and attachments to the tank must be coordinated with and approved by the tank manufacturer.

D. System must be designed to be used by two simultaneous users and be designed for simultaneous falls with a factor of safety of at least 2.0.

E. System components shall be of same material unless otherwise indicated. Exposed Work shall be true to line and level with accurate angles, surfaces and with straight square edges. Coordinate anchorage system with supporting structure. Fabricate anchoring devices as recommended by the manufacturer to provide adequate support for intended use. Fabricate Joints in a manner to discourage water accumulation. Provide weep holes to drain any water, which could accumulate in the exposed joints.

F. Lifelines are to be a minimum of 0.25-inch 304 stainless steel cable with loops or stainless-steel carabiners compatible with the center assembly as per the system Engineer's design. Cables must allow users to extend to within 42 inches of the roof's edge. Provide safety cable attachments on the roof of the tank at all areas protected by guardrail to secure the cables while user is within the guardrail.

G. All hardware, materials and components must be 304 stainless steel.

H. Approved Manufacturers:

1. Flexible Lifeline Systems.
2. CAI Safety Systems.
3. Approved Equal.

2.02 LADDER SAFETY SYSTEM

A. The complete system shall allow the worker to operate freely in a normal climbing position during ascent or descent. The device is to be installed in accordance with the manufacturer's instructions in such a manner to enable the worker to be attached to the device at all times while climbing ladders without having to remove his hands from the ladder to operate the system effectively and to be able to easily pivot onto and off of work platforms or landings while safely attached to the device. System must attach to ladders as specified and indicated on the Drawings.

B. Materials and Construction:

1. The rail, hardware and all system components shall be of Type 316 stainless steel.

2. All rails, components, brackets, etc. shall be on-site to complete installation.
3. The fall prevention system shall be installed in accordance with the manufacturer's installation instructions by a competent person.
4. Fall prevention system shall not be installed until all painting and/or construction has been completed on the tank.

C. Carrier Sleeve:

1. Provide Owner with three carrier sleeves.
2. The carrier sleeve shall be capable of being attached and detached to and from the rail. The carrier sleeve shall attach to the front of the user's harness with a twist lock carabiner supplied with each sleeve.
3. The carrier sleeve shall be constructed of corrosion resistant materials and be lightweight and easy to use.
4. Approved Manufacturers:
    a. FrenchCreek Production - TS Products Rigid Rail Climbing System.
    b. Approved Equal.

2.03 PERSONAL PROTECTIVE EQUIPMENT

A. Body Harnesses:

1. Provide Owner with two body harnesses, sizes are to be selected by the Owner during construction.
2. Harness must be full body type.
3. Sliding back D-ring on full body harness for fall arrest.
4. Hip positioning D-rings.
5. Harness must include lower back pad support.
6. Front D-rings on belt and sternum must be provided for climbing with the ladder safety system.
7. Provide one large canvas utility bag designed to attach to the harness belt for each harness provided.
8. Approved Manufacturers:
    a. North Safety Products – Model Saf-T-Climb Full Body Combo Harness Series 730-201-XXX.
    b. FrenchCreek Stratos 800 Series.
    c. Approved Equal.

B. Lanyards:

1. Provide two total, double (split) bungee cord type shock absorbing lanyards. Lanyard must be 4.5 feet long un-deployed, with 2-1/4-inch throat large rebar locking snap hooks on each lanyard.

2. Contractor must match lanyard manufacturer with the manufacturer of the harness.

2.04 SAFETY GATES

A. Gate must be yellow powder coated steel with at least two stainless steel hinges that are spring loaded to close automatically. Hinge spring tension must be field adjustable. Gate must be attached with a minimum of two u-bolt supports, incorporating a receiver plate for pipe guard rails.

B. Gates must be equipped with a kick plate and stop tab opposite of the hinge side to stop the gate at the guardrail post. Stop plate may be integral with the gate or fabricated on the adjacent handrail.

C. Mounting hardware must be 304 stainless steel.

D. Gate to be sized as required on the Drawings.

E. Approved Manufacturers:

1. FabEnCo – ZT Series.

2. Approved Equal.

2.05 SAFETY RELATED SIGNAGE

A. Provide “Danger Fall Hazard Follow Written Instructions for use of this Ladder. Report any Unsafe Conditions” or similar signage at the base of all ladders requiring cable safety climb systems. Self-adhesive vinyl with minimum dimensions 10 inches high by 14 inches wide.

B. Provide “Danger Follow Confined Space Entry Procedures Before Entering” or similar signage on all hatches. Provide 0.040-inch aluminum sign with 4.0-mil vinyl printing layer and 2.5-mil UV and moisture resistant laminate layer. Approximate Dimensions 10 inches high by 14 inches wide. Mount signs on or adjacent to all openings into confined spaces.

C. Use stainless steel hardware for mounting signage, as applicable.

3.00 EXECUTION

3.01 INSTALLATION

A. Install according to the approved Shop Drawings and manufacturer's instructions. Fall protection systems shall be installed by manufacturer's authorized, trained and certified personnel. Install anchorage and fasteners in accordance with manufacturer's recommendations to obtain the allowable working loads published in the product literature and in accordance with this Section.

B. The products must be installed in accordance with manufacturer’s installation instructions by a competent person.

C. Ladder fall prevention systems must not be installed until all painting operations are completed.

3.02 INSPECTION

A. All components, brackets, etc., shall be on-site to complete installation.

B. It must be verified that required products and components are stainless steel.

C. Determine products are new and undamaged.

3.03 SCHEDULES

A. Fall Prevention System Schedule: Refer to 33 16 13.18 “Precast Wire Wound Prestressed Concrete Tank”.

END OF SECTION

10 44 16 FIRE EXTINGUISHERS

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.
B. Product Schedule: For fire extinguishers. Coordinate final fire extinguisher schedule with fire protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.
C. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.
D. Warranty: Sample of special warranty.

1.04 QUALITY ASSURANCE

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
    1. Provide fire extinguishers approved, listed, and labeled by FMG.
C. Preinstallation Conference: Conduct conference at Project site.
    1. Review methods and procedures related to fire extinguishers including, but not limited to, the following:
        a. Schedules and coordination requirements.

1.05 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.06 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Failure of hydrostatic test according to NFPA 10.
      b. Faulty operation of valves or release levers.
   2. Warranty Period: Six years from date of Substantial Completion.

2.00 PRODUCTS

2.01 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet and mounting bracket indicated.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Cosmic 6E as manufactured by J.L. Industries, Inc. or comparable product by one of the following:
      a. Amerex Corporation.
      b. Ansul Incorporated; Tyco International Ltd.
      c. Badger Fire Protection; a Kidde company.
      d. Buckeye Fire Equipment Company.
      e. Fire End & Croker Corporation.
      f. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
      g. Larsen's Manufacturing Company.
      h. Moon-American.
      i. Pem All Fire Extinguisher Corp.; a division of PEM Systems, Inc.
      j. Potter Roemer LLC.
      k. Pyro-Chem; Tyco Safety Products.
   2. Valves: Manufacturer's standard.
   3. Handles and Levers: Manufacturer's standard.
   4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.
B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 3-A:40-B:C, 6-lb (2.7-kg) nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.02 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Amerex Corporation.

b. Ansul by Johnson Controls Company.
c. Babcock-Davis.
d. Badger Fire Protection.
e. Buckeye Fire Equipment Company.
f. Fire End & Croker Corporation.
g. Guardian Fire Equipment, Inc.
h. JL Industries, Inc.; a division of the Activar Construction Products Group.
i. Kidde Residential and Commercial Division.
j. Larsens Manufacturing Company.
k. Nystrom, Inc.
l. Potter Roemer LLC.
m. Pyro-Chem; Tyco Fire Suppression & Building Products.

2. Source Limitations: Obtain mounting brackets and fire extinguishers from single source from single manufacturer.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
a. Orientation: Vertical.

3.00 EXECUTION

3.01 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.
1. Remove and replace damaged, defective, or undercharged fire extinguishers.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General: Install fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction.

END OF SECTION

DIVISION 12

FURNISHINGS

12 21 13 HORIZONTAL LOUVER BLINDS

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Horizontal louver blinds with aluminum slats.

B. Related Sections include the following:

1. Division 06 Section "Miscellaneous Rough Carpentry" for wood blocking and grounds for mounting horizontal louver blinds and accessories.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication and installation details for horizontal louver blinds.

C. Samples for Initial Selection: For each type and color of horizontal louver blind indicated.

1. Include similar Samples of accessories involving color selection.

D. Samples for Verification: For each type and color of horizontal louver blind indicated.

1. Slat: Not less than 12 inches (300 mm) long.

2. Tapes: Full width, not less than 6 inches (150 mm) long.

3. Horizontal Louver Blind: Full-size unit, not less than 16 inches (400 mm) wide by 24 inches (600 mm) long.

4. Valance: Full-size unit, not less than 12 inches (300 mm) wide.

5. Cornice: Full-size unit, not less than 12 inches (300 mm) wide.

E. Product Certificates: For each type of horizontal louver blind, signed by product manufacturer.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for each type of horizontal louver blind.

G. Maintenance Data: For horizontal louver blinds to include in maintenance manuals.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain horizontal louver blinds through one source from a single manufacturer.

B. Fire-Test-Response Characteristics: Provide horizontal louver blinds with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1. Flame-Resistance Ratings: Passes NFPA 701.

C. Product Standard: Provide horizontal louver blinds complying with WCSC A 100.1.

D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver horizontal louver blinds in factory packages, marked with manufacturer and product name, fire-test-response characteristics, lead-free designation and location of installation using same designations indicated on Drawings and in a window treatment schedule.

1.06 PROJECT CONDITIONS

A. Environmental Limitations: Do not install horizontal louver blinds until construction and wet and dirty finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where horizontal louver blinds are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operable glazed units' operation

hardware throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

2.00 PRODUCTS

2.01 HORIZONTAL LOUVER BLINDS, ALUMINUM SLATS MB

A. Basis-of-Design Product: Subject to compliance with requirements, provide Mark 1 as manufactured by Levolor or a comparable product by one of the following:

1. Hunter Douglas.

2. Springs Window Fashions Division, Inc.

B. Slats: Aluminum; alloy and temper recommended by producer for type of use and finish indicated; with crowned profile and radiused corners.

1. Width: 1 inch (25 mm).

a. Spacing: Not less than every 0.71 inch (18 mm).

2. Thickness: Manufacturer's standard.

3. Finish: One color.

a. Ionized Coating: Antistatic, dust-repellent, baked polyester finish.

b. Reflective Coating: Manufacturer's special coating enhancing the reflection of solar energy on the outside-facing slat surface.

C. Headrail: Formed steel or extruded aluminum; long edges returned or rolled; fully enclosing operating mechanisms on three sides and end plugs and the following:

1. Capacity: One blind per headrail.

2. Integrated Headrail/Valance: Curved face.

3. Light-blocking lower back lip.

4. Tilt limiter with preselected degree settings.

D. Bottom Rail: Formed-steel or extruded-aluminum tube, with plastic or metal capped ends top contoured to match crowned shape of slat; with enclosed ladders and tapes to prevent contact with sill.

E. Maximum Light-Blocking Blinds: Designed for eliminating all visible light gaps if slats are tilted closed; with tight tape spacing indicated and slats with minimal-sized rout holes for ladders hidden and placed near back edge for maximum slat overlap; with headrail and bottom rail extended and formed for light-tight joints between rail and adjacent slats or construction.

1. Finish: Color texture, pattern, and gloss differing from slats as selected by Architect from manufacturer's full range.

F. Ladders: Evenly spaced to prevent long-term slat sag.

1. For Blinds with Nominal Slat Width 1 Inch (25 mm) or More: Manufacturer's standard.

a. Tape Color, Texture, and Pattern: Color, texture, and pattern as selected by Architect from manufacturer's full range.

G. Lift Cords: Manufacturer's standard.

H. Tilt Control: Enclosed worm-gear mechanism, slip clutch or detachable wand preventing overrotation and linkage rod, and the following:

1. Tilt Operation: Manual with clear plastic wand.

2. Length of Tilt Control: Manufacturer's standard.

3. Tilt: Full.

4. Tilt: Two-direction, positive stop or lock-out limited at an angle of 70 degrees from zero-degree horizontal, both directions.

I. Lift Operation: Manual, cord lock; locks pull cord to stop blind at any position in ascending or descending travel.

J. Tilt-Control and Cord-Lock Position: Right side of headrail, unless otherwise indicated.

K. Valance: Manufacturer's standard.

1. Finish Color Characteristics: Match color, texture, pattern, and gloss of slats.

L. Mounting: End mounting, permitting easy removal and replacement without damaging blind or adjacent surfaces and finishes; with spacers and shims required for blind placement and alignment indicated.

1. Provide intermediate support brackets if end support spacing exceeds spacing recommended by manufacturer for weight and size of blind.

M. Hold-Down Brackets and Hooks or Pins: Manufacturer's standard.

N. Side Channels and Perimeter Light Gap Seals: Manufacturer's standard.

O. Colors, Textures, Patterns, and Gloss: As selected by Architect from manufacturer's full range.

2.02 HORIZONTAL LOUVER BLIND FABRICATION

A. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.

1. Lift-and-Tilt Mechanisms: With permanently lubricated moving parts.

B. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):

1. Blind Units Installed between (inside) Jambs: Width equal to 1/4 inch (6 mm) per side or 1/2 inch (13 mm) total, plus or minus 1/8 inch (3.1 mm), less than jamb-to-jamb dimension of opening in which each blind is installed. Length equal to 1/4 inch (6 mm), plus or minus 1/8 inch (3.1 mm), less than head-to-sill dimension of opening in which each blind is installed.

2. Blind Units Installed outside Jambs: Width and length as indicated, with terminations between blinds of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

C. Installation Brackets: Designed for easy removal and reinstallation of blind, for supporting headrail, valance, and operating hardware, and for hardware position and blind mounting method indicated.

D. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to blind hardware and adjoining construction; type designed for securing to supporting substrate; and supporting blinds and accessories under conditions of normal use.

E. Color-Coated Finish:

1. Metal: For components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

F. Component Color: Provide rails, cords, ladders, and exposed-to-view metal and plastic matching or coordinating with slat color, unless otherwise indicated.

3.00 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install horizontal louver blinds level and plumb and aligned with adjacent units according to manufacturer's written instructions, and located so exterior slat edges in any position are not closer than 1 inch (25 mm) to interior face of glass. Install intermediate support as required to prevent deflection in headrail. Allow clearances between adjacent blinds and for operating glazed opening's operation hardware if any.

B. Flush Mounted: Install horizontal louver blinds with slat edges flush with finish face of opening if slats are tilted open.

C. Jamb Mounted: Install headrail flush with face of opening jamb and head.

D. Provide one horizontal louver blind for each exterior glazed opening (window).

3.03 ADJUSTING

A. Adjust horizontal louver blinds to operate smoothly, easily, safely, and free of binding or malfunction throughout entire operational range.

3.04 CLEANING AND PROTECTION

A. Clean horizontal louver blind surfaces after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that horizontal louver blinds are without damage or deterioration at time of Substantial Completion.

C. Replace damaged horizontal louver blinds that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION

DIVISION 13

SPECIAL CONSTRUCTION

13 47 13 CATHODIC PROTECTION SYSTEM

1.00 GENERAL

1.01 THIS SECTION INCLUDES

A. The WORK of this Section includes providing a complete cathodic protection (CP) system for the following structures as outlined in this Section and on the Drawings:

1. Yard Piping including 96-inch, 84-inch, 72-inch, 66-inc, 60-inch, 48-inch, 36-inch diameters for the Surface Water Supply Project Repump Station

B. Electrical isolation of the structures from adjacent metallic structures, steel reinforced concrete structures, casings, structures of dissimilar metal or dissimilar coatings, conduits, and all other metallic components that may impact the operation of the CP system.

C. Electrical bonding of all non-insulated, non-welded pipe joints and mechanical joints.

D. Installation of rectifiers, anode beds, insulating joints, test stations, other components associated with the CP system, and all other work described herein and on the Drawings.

E. Provision of electrical power for rectifiers, including any easements, permits, trenching, conduits, services meters, and other items as required. Not all required items are shown on the Drawings.

F. Testing of CP system during installation.

G. Cleanup and restoration of work site.

H. Final System Checkout: Testing of CP system after installation and backfill.

1.02 REQUIREMENTS

A. If the products installed as part of this Section are found to be defective or damaged or if the WORK of this Section is not in conformance with these Specifications, then the products and WORK shall be corrected at the CONTRACTOR’s expense.

B. Any retesting required due to inadequate installation or defective materials shall be paid for by the CONTRACTOR at no additional cost to the owner.

C. The WORK also requires that one Supplier or Subcontractor accept responsibility for the WORK, as indicated, but without altering or modifying the CONTRACTOR's responsibilities under the Contract Documents.

D. The WORK also requires coordination of assembly, installation, and testing between the pipeline contractor and any CP material supplier or subcontractor.

E. All electrical WORK shall be in accordance with NEC and local requirements.

1.03 RELATED SECTIONS

A. The WORK of the following Sections applies to the WORK of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this WORK.

1. Site Safety and Regulatory Requirements

2. Excavation, Trenching, Backfilling, and Compacting
3. Piping
4. Cast-In-Place Concrete
5. Protective Coatings

1.04 REFERENCED SPECIFICATIONS, CODES AND STANDARDS

A. The WORK of this Section shall comply with the current editions of the codes and standards referenced in this specification, including the following:

1. AASHTO American Association of State Highway and Transportation Officials
   a. H20 Specification for Highway Bridges
2. ASTM ASTM International
   a. A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
   b. A518 Standard Specification for Corrosion-Resistant High-Silicon Iron Castings
   c. A615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
   d. B3 Standard Specification for Soft or Annealed Copper Wire
   e. B8 Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
   f. B187 Standard Specification for Copper, Bus Bar, Rod, and Shapes and General Purpose Rod, Bar, and Shapes
   g. B338 Standard Specification for Seamless and Welded Titanium and Titanium Alloy Tubes for Condensers and Heat Exchangers
   h. C94 Standard Specification for Ready-Mixed Concrete
   i. D1000 Standard Test Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications
   j. D1248 Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
   k. D1785 Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
   l. D2220 Standard Specification for Poly(Vinyl Chloride) Insulation for Wire and Cable, 75°C Operation
   m. D3005 Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape
   n. D4388 Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes
   o. D6386 Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting

p. G97 Standard Test Method for Laboratory Evaluation of Magnesium Sacrificial Anode Test Specimens for Underground Applications

3. AWWA American Water Works Association

a. C217 Petrolatum and Petroleum Wax Tape Coatings for the Exterior of Connections and Fittings for Steel Water Pipelines

4. NACE International, the Corrosion Society

a. RP0375 Field-Applied Underground Wax Coating Systems for Underground Pipelines: Application, Performance, and Quality Control

b. SP0169 Control of External Corrosion on Underground or Submerged Metallic Piping Systems

c. SP0286 Electrical Insulation of Cathodically Protected Pipelines

d. SP0572 Design, Installation, Operation and Maintenance of Impressed Current Deep Anode Beds

e. TM0497 Measurement Techniques Related to Criteria for Cathodic Protection on Underground or Submerged Metallic Piping Systems

5. NFPA National Fire Protection Association

a. NFPA 70 National Electric Code (NEC)

6. NEMA National Electrical Manufacturers Association

a. 250 Enclosures for Electrical Equipment (1,000 Volts Maximum)

b. TC2 Electrical Polyvinyl Chloride (PVC) Tubing and Conduit

c. TC3 PVC Fittings for Use with Rigid PVC Conduit and Tubing

7. UL Underwriters Laboratories

a. 6 Rigid Metal Conduits

b. 467 Grounding and Bonding Equipment

c. 506 Standard for Specialty Transformers

d. 514B Fittings for Cable and Conduit

B. Whenever the Drawings or these Specifications require a higher degree of workmanship or better quality of material than indicated in the above codes and standards, these Drawings and Specifications shall prevail.

1.05 PERMITS AND JOB ACCESS

A. Prior to the start of construction, the CONTRACTOR shall apply to the required authorities for permits required for installation of the CP system.

B. The CONTRACTOR shall contact Underground Service Alert prior to commencing construction to locate existing utilities in the area of construction. Existing utilities include, but are not limited to, water lines, gas lines, telephone, street lights, sewer and storm drains and overhead and underground electric utilities.

C. If traffic control is necessary, it shall satisfy the requirements of the governing locality.

D. The CONTRACTOR shall be responsible for reviewing the rectifier locations to determine whether there are any conflicts with obtaining power at the indicated locations. The CONTRACTOR shall report any conflicts to the ENGINEER prior to proceeding with the Work.

E. The CONTRACTOR shall submit an application to the local power company for AC power to the new rectifiers. The CONTRACTOR shall be responsible for all fees and expenses (including easements) associated with providing power to the rectifiers.

1.06 QUALITY ASSURANCE

A. Installation of the CP equipment shall be performed by individuals having at least five years of experience in the installation of the CP equipment described herein.

B. All testing required to be performed by a “Corrosion Technician” shall be performed by a NACE certified Corrosion Technician under the supervision of a Corrosion Engineer. A Corrosion Technician is a NACE CP2 (CP Technician), CP3 (CP Technologist), or CP4 (CP Specialist). A Corrosion Engineer is a Registered Professional Corrosion Engineer or a NACE CP4 (CP Specialist).

C. All well drilling shall be performed by a Texas licensed Well Drilling CONTRACTOR.

D. All deep well installations shall be installed in accordance with the applicable sections on wells from local regulations.

1.07 SUBMITTALS

A. The following shall be submitted to the ENGINEER prior to any equipment installation.

1. Catalog cuts, bulletins, brochures, or data sheets for all materials specified herein.
2. Statement that the equipment and materials proposed meet the Specifications and the intent of the Specifications.
3. Statement of installation experience required.
4. Schedule, including the expected start date and planned completion date.
5. Copy of well drilling or surface disturbance permits, if permit(s) are required by local jurisdiction.
6. Description of power system to be provided for rectifiers, including cut sheets, meter sizing, power company requirements, and copy of permits.

B. The following shall be submitted to the ENGINEER after completion of the WORK.

1. Wire connection testing.
2. Insulating joint testing, before and after backfill.
3. Casing insulator testing, before and after backfill.
4. Joint bond testing, before and after backfill.
5. Well completion report.
6. Electrical log with anode-to-earth resistances.

7. Final System Checkout Report.

8. Record Drawings shall be submitted to and approved by the ENGINEER before the WORK is considered complete.

C. The following shall be included in the Owner's Manual:

1. Operations and maintenance (O&M) manual with instructions for CP system and components. O&M manual may include rectifier operations and instructions for adjustments, CP measurements at recommended frequencies, and testing documentation guidelines.

2. List of spare parts recommended for two years of successful operation.

1.08 INTERFERENCE AND EXACT LOCATIONS

A. The locations of CP equipment, test stations, devices, outlets, and appurtenances, as indicated are approximate only. Exact locations shall be determined by the CONTRACTOR in the field subject to the approval of the ENGINEER.

B. The CONTRACTOR shall field verify all data and final locations of work done under other Sections of the Specifications required for placing of the electrical work.

C. In case of interference with other work, foreign pipeline, or erroneous locations with respect to equipment or structures, the CONTRACTOR shall furnish all labor and materials necessary to complete the WORK in an acceptable manner to the OWNER. Deviations from the Drawings and Specifications shall be submitted to the OWNER for approval.

2.00 PRODUCTS

2.01 GENERAL

A. All materials installed must be new. All equipment and materials supplied shall be similar to that which has been in satisfactory service for at least 5 years.

2.02 RECTIFIERS

A. Rectifiers shall be air-cooled, single-phase, 115/230 VAC input, with DC Voltage and Current output ratings as indicated on the drawing rectifier schedule. Rectifiers shall be manufactured by Universal Rectifiers, Corrpro, JA Electronics, or an approved equivalent.

B. Rectifiers shall be designed to operate continuously at an ambient temperature of 50°C without damage to the rectifier components.

C. Transformer: Two-winding, insulating type that meets the requirements of NEMA and UL 506.

D. Rectifiers shall be capable of operating continuously at the rated output current at any voltage from zero to 100% without damaging any rectifier components. Full-rated DC output voltage shall be adjustable by not less than 25 equal steps from approximately 4% of rated voltage to full rated output voltage. This adjustment shall be accomplished with silver-plated or stainless steel connectors and adjustment link bars.

E. Rectifying element shall be a full-wave bridge, silicon diode stack with efficiency filter, metal oxide thyristors, and current-limiting devices for overvoltage and overcurrent protection of

stack. Silicon stacks shall be equipped with silicon diodes rated at a minimum of 1,000 peak inverse volts.

F. All rectifiers shall have overload and lightning protection for both AC and DC circuits.

G. A voltmeter and ammeter shall be provided. Voltmeter and ammeter shall be calibrated and adjusted at the factory.

H. Electrical tests shall be performed by the manufacturer and recorded as listed below:

1. AC Volts Input
2. DC Amperes Input
3. Apparent Watts Input
4. True Watts Input
5. Power Factor
6. DC Volts Output
7. DC Amperes Output
8. DC Watts Output
9. Conversion Efficiency
10. Dielectric Strength
11. Transformer Primary to Ground
12. Transformer Secondary to Ground
13. Transformer Primary to Secondary
14. Stack AC to Ground
15. Stack DC to Ground
16. Ripple Voltage at Full Output

I. The following shall be provided for each rectifier. Each item shall be provided in a waterproof bag or container.

1. Operations and Maintenance Manual
2. Circuit Diagram
3. Electrical Test Report

2.03 RECTIFIER CABINETS

A. Rectifier cabinets shall be NEMA 250 Type 3R and sized as shown on the Drawings.

B. Rectifier cabinets shall be made of steel that is either shop coated with a baked enamel finish, galvanized per ASTM A123, or pre-galvanized sheet finished with a powder coat.

C. Rectifier cabinets shall have a single door with a full-length hinge and a lockable latch. Hinge, latch, and other miscellaneous metallic components on the cabinet shall be 316 stainless steel.

D. Rectifier cabinets shall have sufficient venting provided for air cooled rectifiers.

E. Rectifiers shall be equipped with permanent identification tags affixed to the outside front door. The identification tag shall have white engraving for identification of the rectifier. Minimum height of lettering shall be 3/4 inch. The tags shall have the following legend:

WEST HARRIS COUNTY REGIONAL WATER AUTHORITY

SURFACE WATER SUPPLY PROJECT REPUMP STATION

STATION 5+30

CATHODIC PROTECTION RECTIFIER

2.04 HIGH-SILICON CAST IRON (HSCI) ANODES

A. HSCI anodes shall meet the requirements of ASTM A518 Grade 3. Anodes shall be manufactured by Anotec, Corrpro, or equivalent.

B. HSCI anodes shall be tubular type anodes with centered wire connection. Anodes shall have the following size, form, and shape.

Anode Type	Length (inch)	Diameter (inch)	Weight (lb)	Surface Area (ft2)
2684Z or TA3	84	2 to 2.7	63 to 70	4.9

C. Anode lead wire:

1. The wire attached to the anodes shall be of the size and type indicated on the Drawings. The anode lead wire shall conform to the specifications given for “Wires” in this specification.

2. The wire shall be connected to the interior of the anode and sealed by the manufacturer. The anode wire connection shall have a pulling strength exceeding the wire’s tensile strength. Any damage to the wire insulation or anode shall require complete replacement of the wire and anode.

3. Anode lead wires shall be of one continuous length, without splices, unless otherwise indicated on the Drawings, from the anode connection to the anode terminal board. Anode wires with the attached anodes shall be shipped to the job site with the wire wound on a reel. The minimum core diameter of the reel shall be 5 1/2 inches. The anode wire insulation shall be free of surface damage such as nicks, abrasions, scratches, etc., in all respects throughout the entire length of the wire. Precautions shall be taken during fabrication, transportation, and installation of the anodes to see that the wire is not kinked or sharply bent. Bends sharper than 2 1/2 inches in radius are not permissible.

D. The resistance of each anode wire connection shall not exceed 0.004 ohms. Each anode wire connection should be tested by the manufacturer for conformance with these Specifications. A record of tests shall be submitted to the ENGINEER. The records shall include a minimum of three copies of the following information:

1. Anode numbering system to identify anode under test

2. Anode wire length

3. Resistance value, as indicated by test
4. Test equipment
5. Test method

E. Anodes shall be individually labeled with the length of lead wire and anode number. Anodes shall be consecutively numbered with the deepest anode being Number 1.

2.05 CALCINED COKE BREEZE

A. Backfill material for impressed current anodes shall be calcined coke breeze.

B. Calcined coke breeze shall have a resistivity of 25 ohm-cm or less when tested with an applied pressure of 2 psi and a bulk density of 64 to 74 pounds per cubic foot. The particle size shall be between 200 mesh and 18 mesh and shall be dust free. The minimum calcination temperature of base materials shall be 1250 °C.

C. Calcined coke breeze shall have the following chemical properties:

1. Fixed carbon 98% minimum
2. Ash 0.6% maximum
3. Volatile matter 1.0% maximum
4. Moisture 1.0% maximum

D. Calcined coke breeze shall be Loresco SC-3, Asbury 251, or approved equivalent when installed by pumping down the hole. If installed via the freefall method, calcined coke breeze shall be Loresco RS-3, Ashbury 218-L, or equivalent.

2.06 ANODE VENT PIPING

A. Anode vent piping for the impressed current anode vent piping shall be 2-inch diameter PVC, Schedule 80, conforming to ASTM D1785 Type 1 Grade 1.

B. Slots and perforations shall be provided in the immediate vicinity of the anodes and throughout the coke breeze and sized such that coke breeze does not enter vent pipe. The vent pipe shall be capped at both ends during the backfilling operation to mitigate infiltration of backfill material or mud.

C. Above ground portions of anode vent piping shall be rated for sunlight resistance.

D. Above ground outlet for vent piping shall have a vent screen with an orientation preventing rainfall accumulation and bug intrusion.

2.07 ANODE CENTRALIZERS

A. Centering devices shall be designed and fabricated by the CONTRACTOR or Supplier and shall be submitted to the ENGINEER for acceptance prior to use. The device shall be constructed of metal.

2.08 READY-MIXED CONCRETE

A. Ready-mixed concrete shall be in accordance with ASTM C94, permit requirements, and the Specification section for cast-in-place concrete.

2.09 REINFORCING STEEL

A. Reinforcing steel shall be in accordance with ASTM A615, permit requirements, and the Specification section for reinforcing steel.

2.10 FLUSH-MOUNTED TEST STATION

A. Flush-mounted test station boxes shall be traffic boxes rated to withstand AASHTO H20 traffic loading.

B. The traffic boxes shall be G05 Utility Boxes, as manufactured by Christy Concrete Products, Inc.; No. 3RT Utility Box, as manufactured by Brooks Products; or an approved equivalent.

C. The traffic boxes shall be B1017, as manufactured by Christy Concrete Products, or an approved equivalent.

D. Traffic box covers for test stations shall be cast iron with welded bead legend and labeled “CP TEST” or “ANODE,” as required.

2.11 TERMINAL BOARDS

A. Terminal boards shall be made of 1/4-inch thick phenolic plastic and sized as indicated on the Drawings.

B. Connection hardware shall be brass or bronze. All connections shall be double nutted bolts with serrated lock washers.

C. Copper bus bar shall be 1/8-inch thick and sized to fit. The copper bus bar shall be per ASTM B187 with 98% conductivity.

2.12 MECHANICAL LUGS

A. Mechanical lugs shall be brass or copper with a brass, copper, or stainless steel set screw. Tin plating on the lugs is optional. Aluminum lugs shall not be permitted. Zinc-plated steel set screws shall not be permitted. The lug shall be listed per UL 467, suitable for direct burial, and appropriately sized for the incoming wires. The lug shall be ILSCO Type XT-6DB, Burndy GKA8C, or an approved equivalent.

2.13 SHUNTS

A. Shunts shall be the selected by the size indicated on the Drawings.

B. 0.001-ohm, 25-amp shunts shall be Type SS, as manufactured by Holloway, or equivalent.

2.14 CONDUIT AND FITTINGS

A. The minimum conduit size shall be 1 inch unless otherwise indicated. Refer to NFPA 70 (NEC) for additional conduit size requirements.

B. Conduit and fittings placed below grade shall be Schedule 80 PVC in accordance with NEMA TC2 and NEMA TC3.

C. Conduit and fittings placed above grade shall be rigid steel. Rigid Steel conduit shall be galvanized and conform to UL 6.

D. Conduit clamps shall be galvanized steel, 304 stainless steel, or 316 stainless steel.

E. Fittings for use with rigid steel conduit shall be galvanized cast ferrous metal, with gasketed covers, Crouse Hinds Condulets, Appleton Unilets, or equivalent. Rigid metallic conduit fittings shall be galvanized, conform to NEMA FB 1, and listed to UL 514B.

F. Union couplings for conduit shall be Erickson or Appleton Type EC, 0-Z Gedney 3-piece Series 4, or equivalent.

2.15 CAUTION TAPE

A. The caution tape shall be an inert plastic film designed for prolonged underground use. The caution tape shall be a minimum of 3 inches wide and a minimum of 4 mils thick.

B. The caution tape shall be continuously printed over the entire length with the wording "CAUTION: CATHODIC PROTECTION CABLE BURIED BELOW."

C. The wording shall be printed using bold black letters. The color of the tape shall be red.

2.16 WIRES

A. Conductors shall consist of stranded copper of the gauge indicated on the Drawings. Wire sizes shall be based on American Wire Gauge (AWG). Copper wire shall be in conformance with ASTM B3 and ASTM B8.

B. Insulation Type and Colors: As shown on the Drawings.

1. High molecular weight polyethylene (HMWPE) wires shall be rated for 600 volts and shall conform to ASTM D1248, Type 1, Class C, Grade 5.

2. Halar/HMWPE wires (CP wire) shall be rated for 600 volts and have dual insulation. The primary layer of insulation shall be a homogeneous 20 mil wall of ECTFE fluoropolymer (Halar), and the jacket shall be a 65 mil wall of HMWPE conforming to ASTM D1248, Type 1, Class C, Grade 5. Halar/HMWPE wire shall be UL listed as Cathodic Protection Wire.

2.17 WIRE IDENTIFICATION TAGS

A. Wire identification tags shall be the wrap-around type with a high resistance to oils, solvents, and mild acids. Wrap-around markers shall fully encircle the wire with imprinted alpha-numeric characters for pipe identification. The letters and numbers height shall be 3/16 inch at minimum.

2.18 EXOTHERMIC WELDS

A. Exothermic welds shall be in accordance with the manufacturer’s recommendations. Exothermic welds shall be Cadweld manufactured by Erico, Thermoweld manufactured by Burndy, or an approved equivalent.

B. Prevent molten weld metal from leaking out of the mold, where necessary, by using Duxseal packing manufactured by Johns-Manville, Thermoweld packing material manufactured by Burndy, Cadweld T403 Mold Sealer manufactured by Erico, or an approved equivalent.

C. The shape and charge of the exothermic weld shall be chosen based on the following parameters:

1. Pipe material
2. Pipe size
3. Wire size and requirement for sleeves
4. Number of wires to be welded
5. Orientation of weld (vertical or horizontal)

2.19 EXOTHERMIC WELD COATING

A. After exothermic welding, repair coatings and linings in accordance with the coating and lining manufacturer's recommendation.

B. For bare steel, dielectrically coated steel, or ductile iron pipe, weld caps with integrated primer shall be used to cover the exothermic weld connecting the wire to the pipe. The weld cap shall be a 10-mil thick durable plastic sheet that has a dome filled with a moldable compound to assure complete encapsulation of the exothermic weld and a layer of elastomeric adhesive with integrated primer. The adhesive and primer shall be compatible with the pipe material and pipe coating material. Adhesion to steel shall be at least 10 lb/in per ASTM D1000. Weld cap with integrated primer shall be Handy Cap IP manufactured by Royston or equivalent for wire size up to 8 AWG and Handy Cap XL IP manufactured by Royston or equivalent for wire size up to 2 AWG.

2.20 DIELECTRIC INSULATING FLANGE KITS

A. Insulating flange kits shall include full-faced gaskets, insulating sleeves and washers, and 316 stainless steel bolts, nuts, and washers. The complete assembly shall have a pressure rating equal to or greater than the flanges between which it is installed. Sleeves, gaskets, and insulating washers shall have a minimum dielectric constant of 300 volts per mil. Stainless steel washers shall fit well within the bolt facing on the flange. Insulating washers shall fit within the bolt facing the flange over the outside diameter of the sleeve.

1. Insulating gasket shall be full-faced, Type E, and 1/8-inch thick. Acceptable gasket materials include nitrile faced phenolic, G-10, or a material with equivalent or increased performance. Acceptable seal materials include EPDM, PTFE, or a material with equivalent or increased performance. When used in potable water systems, gasket and seal shall be NSF 61 approved.
2. Insulating sleeves shall be 1/32-inch thick and equal the number of bolts on the flange. Acceptable materials include Mylar, G-10, or a material with equivalent or increased performance.
3. Insulating washers shall be 1/8-inch thick and equal to twice the number of bolts on the flange. Acceptable materials include G-10 or a material with equivalent or increased performance.

B. Dielectric insulating flange kits shall be manufactured by Advance Products & Systems Inc., GPT Industries, or an approved equivalent.

2.21 PETROLATUM WAX TAPE

A. Petrolatum wax tape shall meet or exceed the requirements of AWWA C217 and shall consist of three parts: Surface primer, wax tape, and outer covering. All three parts shall be the product of a single manufacturer.

B. The primer shall be a blend of petrolatums, plasticizers, and corrosion inhibitors having a paste-like consistency. Primer shall be Wax-Tape Primer manufactured by Trenton, Denso Paste manufactured by Denso, or approved equivalent.

C. The wax tape shall be synthetic-fiber felt, 45 to 90 mils thick, saturated with a blend of micro- crystalline wax, petrolatums, plasticizers, and corrosion inhibitors that is capable of easy conformability over irregular surfaces. Wax tape shall be #1 Wax-Tape manufactured by Trenton, Denso Tape manufactured by Denso, or approved equivalent.

D. The outer covering shall be a plastic wrap consisting of one 150-gauge sheet or three 50-gauge sheets wound together as a single sheet, clear polyvinylidene chloride, shrink wrap that is flexible enough to conform to irregular surfaces. Outer wrapping shall be Poly-Ply by Trenton, Poly-Wrap by Denso, or approved equivalent.

3.00 EXECUTION

3.01 MATERIAL AND EQUIPMENT STORAGE

A. All materials and equipment to be used in construction shall be stored in such a manner to be protected from detrimental effects from the elements. If warehouse storage cannot be provided, materials and equipment shall be stacked well above ground level and protected from the elements with plastic sheeting or another method, as appropriate.

3.02 EXCAVATION AND BACKFILL

A. Buried wires shall have a minimum cover of 24 inches.

B. Caution tape shall be installed above buried wire. Caution tape shall be installed a minimum of 6 inches above underground wires and conduits.

C. Wire identification tags shall be placed on the wires prior to placing wire in conduit or backfilling.

3.03 RECTIFIER

A. Approximate rectifier locations are shown on the Drawings. The CONTRACTOR may propose an alternative rectifier location to the WHCRWA for review and approval.

B. Rectifier installation includes provision of AC power to the rectifier by the CONTRACTOR. CONTRACTOR shall furnish and install all required wiring, conduits, wires, meters, splice boxes, and equipment necessary for operation of the rectifier and as required by the local power agency.

C. The reinforced concrete pad shall be constructed such that water will not collect against the rectifier cabinet. The concrete pad shall extend a minimum of 2 inches above grade which should be higher than the 100 year flood plain. The finished grade shall be sloped away from the concrete pad to direct drainage water away from the rectifier cabinet. The vent pipe riser and conduits into the enclosure shall be cast into the concrete pad. After the concrete is set, the enclosure shall be securely anchored to the pad with expanding anchor bolts. Use leveling nuts below the cabinet flange to create space for the grout seal. Apply the non-shrink grout as shown on the Drawings.

3.04 DEEP ANODE WELL

A. Impressed current anode beds shall be installed in accordance with NACE SP0572, local well standards, and these Specifications.

B. Well Drilling

1. The CONTRACTOR shall obtain and pay for all fees and permits required for well drilling. CONTRACTOR shall log the well in accordance with local and state agency requirements.

2. The CONTRACTOR shall protect the well bore from the intrusion of contaminants into the hole at all times. The CONTRACTOR is responsible for the cost of all cleanup associated with contamination of the well and/or job site resulting from the CONTRACTOR's WORK.

3. Fresh water shall be circulated from the bottom of the hole to clear the well of drilling mud and cuttings after the well is drilled.

4. Loading of anodes and other equipment in the well shall be done in the presence of the ENGINEER. At minimum, 48-hour notice shall be given by the CONTRACTOR to the ENGINEER prior to loading anodes. Loading of the anodes into the well shall begin early enough in the day to ensure completion of all loading, including backfilling, during regular working hours.

5. The well shall be covered with a steel trench plate or other heavy device that blocks access and cannot be removed by hand whenever the well is left unattended.

C. Well Casing

1. The CONTRACTOR may elect to install the well with or without a casing. In the event that the well collapses for any reason, including the elimination of the casing, the well shall be relocated, re-drilled, and the original hole abandoned at the CONTRACTOR's expense. Only a metallic casing may be used in the coke breeze column.

D. Vent Pipe

1. The bottom of the vent pipe shall be securely capped with a PVC cap solvent-welded to the vent pipe.

2. The vent pipe shall be installed along with the first anode placed in the hole by attaching it to one of the centralizer straps with a stainless steel clamp. The vent pipe shall not be attached to the anode itself. Obtain the ENGINEER's acceptance of the attachment before the vent pipe is lowered into the hole. Sections of vent pipe shall be joined to one another as the first anode, with the vent pipe attached, is lowered into the hole. Joints shall be solvent-welded.

3. The top of the vent pipe shall be temporarily sealed during the coke breeze loading process. Any foreign material entering the vent pipe shall be removed.

E. Anodes

1. Loading of anodes and other equipment in the well shall be done in the presence of the ENGINEER. A minimum of 48 hours' notice shall be given prior to loading anodes. Loading of the anodes into the well shall begin early enough in the day to ensure completion of all loading, including backfilling, during regular working hours. Loading shall not be commenced later than 1:00 p.m. unless the CONTRACTOR has obtained prior written acceptance from the ENGINEER.
2. The ENGINEER shall visually inspect the insulation on the anode lead wire for abrasion or other damage to the insulation and wire before and as the anode is lowered into place. Anodes with damaged insulation or wire are not acceptable and shall not be installed. Splices are not allowed on the anode wire.
3. Attach the centering devices to the anodes before lowering them in the well. All sharp edges on the centering device assembly shall be taped with vinyl electrical tape to preclude damaging any wires while lowering anodes into place.
4. The terminal end of the anode wires shall be identified with permanent wire markers.
5. Anode No. 1 shall be lowered into the well supported by the attached lead wire. The CONTRACTOR shall fabricate an apparatus that allows the anodes to be lowered by the lead wire, but does not bend the wire into a radius less than 2.5 inches. The vent pipe shall be secured to the centering device on Anode No. 1, not the anode itself, and lowered alongside Anode No. 1. A soil resistance meter, furnished and operated by the ENGINEER, shall be connected between the anode lead wire for Anode No. 1 and the pipeline drain wire. The drain wire should be installed and be accessible to the ENGINEER during the time of testing. The CONTRACTOR shall stop lowering the anode at 10-foot intervals to tape the anode lead wire to the vent pipe and to allow the ENGINEER to measure the resistance profile of the anode well. This shall continue to the bottom of the hole and the vent pipe shall be secured in place.
6. Continuing with Anode No. 2, the anodes shall be lowered into the well by the attached lead wires. The vent pipe shall not be attached to the centralizers or lead wires for Anodes No. 2 to No. 4. The ENGINEER may adjust the depths of the individual anodes to avoid high resistance soil layers. When an anode has been placed at the final depth, it shall be securely fixed in that position prior to coke breeze backfill.
7. Anodes shall not be backfilled until the ENGINEER has inspected the placement of the anodes and given permission to backfill.

F. Coke Breeze Backfill

1. Coke breeze shall be placed using a slurry pump that pumps the coke into the bottom of the hole using a tremie pipe, allowing the hole to be filled from the bottom up. Coke breeze shall not be pumped through the vent pipe.
2. Coke breeze shall be mixed with water when introduced into the hole to prevent bridging or the creation of voids. Minimize the risk of bridging by ensuring the hole has sufficient water and the backfilling rate is controlled. In the event that voids or bridging

does occur, the CONTRACTOR shall correct the deficiency to the satisfaction of the ENGINEER.

3. Coke breeze shall be placed in the hole at a steady rate to ensure the coke breeze does not bridge or block the hole. The hole shall be kept completely full of water during placement of backfill.
4. Backfill settling and anode coverage will be determined by measuring the anode-to-earth resistance from the digital resistance meter. During coke breeze backfilling, the ENGINEER will measure the resistance between the lowermost uncovered anode and the pipeline drain wire. Coverage of the anode will be indicated by a rapid decrease in resistance, normally by at least 50%. As soon as coverage of a lower anode is indicated, the circuit shall be attached to the next highest anode in the hole. Testing will continue until coverage of all anodes has been verified. The ENGINEER shall record the resistance of each backfilled anode. At least 20 feet of coke breeze shall be added above the top anode. The CONTRACTOR shall sound the anode hole with a weighted tape measure and determine the final height of the coke breeze column.
5. Coke shall be allowed 24 hours to settle. After 24 hours, the coke column shall be topped off, as required, to achieve the specified coke column length.
6. Incomplete coverage of each anode with coke breeze shall be cause for rejection of the anode well.
7. The CONTRACTOR shall record the total weight of coke breeze placed in each anode well.

G. Well Seal

1. Backfilling operations above the coke breeze column shall begin no sooner than 24 hours after installation of the coke breeze to allow for settling. Backfilling shall be done continuously and without interruption until the hole is sealed.
2. Collapse of the hole prior to the introduction of the seal material shall be cause for abandonment of the well at the CONTRACTOR's expense.
3. Sealing materials shall not be allowed to drop from the top of the hole. All materials shall be pumped into the hole from the top of the coke breeze column to the top of the hole.
4. If well casing materials are used in the construction of the well, then the annular space between the well bore and the casing shall also be sealed with a conductive grout.
5. Sealing material shall not enter the vent pipe.
6. The CONTRACTOR shall record the volume of sealing material installed in the hole.

H. Well Head

1. The well head shall be a concrete traffic box set at the top of the anode hole and shall contain slack for the anode lead wires, as indicated on the Drawings.
2. The concrete traffic box lid shall be cast iron and marked "ANODE."

I. Storage and Disposal of Drilling Fluids, Cuttings, and Mud

1. During the drilling and loading process, drilling fluids, cuttings, and mud shall be stored onsite in uncontaminated, watertight, lockable debris boxes. Alternative storage methods may be used only with prior approval of the ENGINEER.
2. Drilling mud and cuttings shall be disposed of by the CONTRACTOR at a suitable disposal site.

3.05 TEST STATIONS

A. Test stations shall be installed at the approximate locations shown on the Drawings. The CONTRACTOR shall field verify all final locations, subject to acceptance by the ENGINEER. Test stations shall be located within the pipeline easement. Test stations shall be located in areas not subject to vehicular traffic, such as sidewalks, unless otherwise approved by the ENGINEER.

B. For flush-mounted test stations, place the bottom of the test box on native soil. Do not place rock, gravel, sand, or debris in the box. Install 4,000 psi concrete collar with reinforcement after placement of the test box to finished grade. Provide sufficient sloping in the concrete pad or surrounding pavement to provide drainage away from the test box.

C. Connect wires to the terminal board as shown on the Drawings. Each wire shall be identified with a permanent wire identifier within 4 inches of the termination. After installation, all wire connections in the test station shall be tested by the Contractor to ensure they meet the requirements herein.

D. The CONTRACTOR shall provide global positioning system (GPS) coordinates for each test station location with a minimum accuracy of 1 meter or 3 feet. The CONTRACTOR shall submit the GPS coordinates of the test stations to the ENGINEER after installation.

3.06 WIRES

A. Buried wires shall be laid straight without kinks. Each wire run shall be continuous in length and free of joints or splices, unless otherwise indicated. Care shall be taken during installation to avoid punctures, cuts, or other damage to the wire insulation. Damage to insulation shall require replacement of the entire length of wire at the CONTRACTOR's expense.

B. At least 12 inches of slack (coiled) shall be left for each wire at each flush-to-grade test station. Wire slack shall be sufficient to allow removal of wire extension for testing.

C. Wire shall not be bent into a radius of less than eight times the overall wire diameter.

D. The wire conduits must be of sufficient diameter to accommodate the wires. This shall be determined by the number and size of wires in accordance with the applicable codes and standards.

E. Conduit shall be installed to a minimum depth of 30 inches below grade.

F. Install caution tape a minimum of 6 inches above buried wire and conduits at a minimum depth of 24 inches below grade. Every 3 feet, double over the tape for a distance of 8 inches to increase the apparent flexibility of the tape.

3.07 WIRE IDENTIFICATION TAGS

A. All wires shall be coded with wire identification tags within 4 inches of the wire end indicating diameter and type of pipe.

B. Wire identification tags shall be placed on all wires prior to backfill and installation of test stations.

3.08 EXOTHERMIC WELD CONNECTIONS

A. Exothermic weld connections shall be installed in the manner and at the locations indicated. Exothermic welds shall be spaced at least 6 inches apart from other exothermic welds, fittings, and circumferential welds.

B. Coating materials shall be removed from the surface over an area of sufficient size to make the connection and as indicated on the Drawings. The surface shall be cleaned to bare metal per SSPC SP11 prior to welding the conductor. The use of resin impregnated grinding wheels will not be allowed.

C. Only enough insulation shall be removed such that the copper conductor can be placed in the welding mold. If the wire conductor diameter is not the same as the opening in the mold, then a copper adapter sleeve shall be fitted over the conductor.

D. The CONTRACTOR shall be responsible for testing all test lead and bond wire welds. The ENGINEER, at his or her discretion, shall witness these tests. After the weld has cooled, all slag shall be removed and the metallurgical bond shall be tested for adherence by the CONTRACTOR. A 22-ounce hammer shall be used for adherence testing by striking a blow to the weld. Care shall be taken to avoid hitting the wires. All defective welds shall be removed and replaced in a new location at least 6 inches away from the original weld location.

E. All exposed surfaces of the copper and steel shall be covered with insulating materials.

   1. For dielectrically coated or polyethylene encased pipes, a plastic weld cap with integrated primer shall cover the exothermic weld and surrounding area. All surfaces must be clean, dry, and free of oil, dirt, loose particles, and all other foreign materials prior to application of the weld cap.

F. The CONTRACTOR shall inspect both the interior and exterior of the pipe to confirm that all coatings and linings removed or damaged as a result of the welding have been repaired. The CONTRACTOR shall furnish all materials, clean surfaces, and repair protective coatings and linings damaged as a result of the welding. Repair of any coating or lining damaged during welding shall be performed in accordance with coating or lining manufacturer's recommendations.

G. After backfilling pipe, all test lead pairs shall be tested for broken welds using a standard ohmmeter. The resistance shall not exceed 150% of the theoretical wire resistance, as determined from published wire data.

3.09 JOINT BONDS

A. Joint bonding shall be provided across flexible couplings and all non-welded joints to ensure electrical continuity, except where insulating joints have been installed to provide electrical isolation. Joint bonds shall be of the type, size, length, and number shown on the Drawings and installed as indicated.

B. Bonding wires shall allow at least 2 inches of movement in the pipe joint. The wire shall be attached by exothermic welding. At least 2 bond wires shall be provided between all discontinuous joints.

3.10 DIELECTRIC INSULATING FLANGE KITS

A. All insulating components of the insulating flanged gasket set shall be cleaned of dirt, grease, oil, and other foreign materials immediately prior to assembly. If moisture, soil, or other foreign matter contacts any portion of these surfaces, disassemble the entire joint and clean with a suitable solvent. Dry the entire joint. Once completely dry, reassemble the joint.

B. Care shall be taken to prevent any excessive bending or flexing of the gasket. Creased or damaged gaskets shall be rejected and removed from the job site.

C. Bolt holes in mating flanges shall be properly aligned at the time bolts and insulating sleeves are inserted to prevent damage to the insulation. Follow the manufacturer's recommended bolt tightening sequence. Center the bolt insulating sleeves within the insulation washers so that the insulating sleeve is not compressed and damaged.

D. After flanged bolts have been tightened, each insulating washer shall be inspected for cracks or other damage. All damaged washers shall be replaced.

E. When the flange is determined to be properly functioning to the full satisfaction of the OWNER, approval will be granted to proceed with installation. Do not proceed with coating, lining, or backfilling the insulating joint prior to gaining approval to proceed. If the coating or lining is applied prior to gaining approval to proceed, the coating or lining shall be completely removed to the satisfaction of the OWNER at the CONTRACTOR’s expense. If the insulating joint is backfilled prior to gaining approval from the OWNER, the CONTRACTOR shall completely excavate the insulating joint at the CONTRACTOR’s expense.

F. After testing and acceptance by the OWNER, coat the interior insulating flange a minimum of two pipe diameters beyond the gasket with high-solids epoxy to a 10 mil (minimum) dry film thickness. Follow the manufacturer’s surface preparation and application procedures.

G. After testing and acceptance by the OWNER, coat the exterior insulating flange and a minimum of two pipe diameters beyond the gasket with the wax tape system specified herein.

3.11 PETROLATUM WAX TAPE

A. Petrolatum wax tape systems shall be applied on insulating joints and non-cathodically protected metallic appurtenances and fittings, regardless of whether they are bare or factory coated, as indicated in the Drawings. Extend the petrolatum wax tape coating system over any adjacent pipe coating by a minimum of two pipe diameters. Petrolatum wax tape systems shall be applied in accordance with NACE RP0375, AWWA C217, these Specifications, and the Manufacturer’s recommendations.

B. Surfaces shall be cleaned of all dirt, grease, oil and other foreign materials immediately prior to coating. Loose rust, loose paint and other foreign matter shall be removed in accordance with SSPC SP2 or SP3.

C. A prime coating shall be applied in a uniform coating over the entire surface to be wrapped. A liberal coating shall be applied to threads, cavities, shoulders, pits, and other irregularities.

D. Petrolatum wax tape shall be applied immediately after applying the primer using a 1-inch overlap. A spiral wrap shall be used and slight tension shall be applied to ensure that there are no air pockets or voids. For bolts, nuts, and other irregular shapes, cut strips of wax tape and apply them by gloved hand so that there are no voids or spaces under the tape. Apply a sufficient amount of tape to completely encapsulate all exposed steel surfaces. After applying the tape, the applicator shall firmly press and smooth out all lap seams and crevice areas. The tape shall be in tight intimate contact with all surfaces. The minimum wax tape thickness shall be 70 mils over smooth surfaces and 140 mils over sharp and irregular surfaces, or more as required to fill all voids.

E. Apply two layers of outer covering over the wax tape coating by tightly wrapping it around the pipe such that it adheres and conforms to the wax tape. Secure the outer covering to the pipe with adhesive tape.

3.12 WIRE CONNECTIONS

A. After installation, all wire connections shall be tested to ensure electrical continuity at the test station locations by the CONTRACTOR to ensure that they meet the requirements and intent of the Contract Documents.

3.13 RESTORATION SERVICES

A. Compaction of backfill for anodes and trenches shall match the existing conditions and shall be in conformance with the EARTH MOVING Section (31 20 00).

B. RESTORATION OF SOD: Restore unpaved surfaces disturbed during the installation of anodes and wires to their original elevation and condition. Preserve sod and topsoil carefully and replace after the backfilling is completed. Replace sod that is damaged using sod of quality equal to that removed. Where the surface is disturbed in a newly seeded area, re-seed the area with the same quality and formula of seed as that used in the original seeding.

C. RESTORATION OF PAVEMENT: Patch pavement, sidewalks, curbs, and gutters where existing surfaces are removed for construction in conformance with the ASPHALT PAVING Section (32 12 16) and the CAST-IN-PLACE CONCRETE Section (03 30 00).

3.14 ISOLATION TESTING ON INSULATING JOINTS

A. Insulating joints shall be installed to effectively isolate metallic piping from foreign metallic structures. The CONTRACTOR shall test the performance of these insulating joints before and after backfill.

B. Before backfill, the CONTRACTOR shall test the insulating joint using a Gas Electronics Model No. 601 Insulation Checker or an approved equivalent. If the testing results indicate less than 100% insulation, then the insulating joints shall be repaired and retested at the CONTRACTOR's expense.

C. After backfill, testing shall be performed by measurement of native pipe-to-soil potentials at both sides of the insulating joint. If the difference in native pipe-to-soil potentials on both sides of the insulating joint is within ±100 mV, then additional testing shall be performed, as follows. Temporary CP current shall be circulated on one side of the insulating joint. "On"

and “Instant Off” pipe-to-soil potentials shall be measured on the other side of the insulating joint. If the “Instant Off” potential is more negative than the native potential, the insulating joint shall be considered deficient and shall be repaired and retested at the CONTRACTOR’s expense.

3.15 CONTINUITY TESTING

A. Continuity testing of joint bonds shall be performed by the CONTRACTOR’s qualified corrosion technician as defined in this section after backfilling. The electrical continuity test may additionally be performed before backfilling at the CONTRACTOR’s option.

B. The pipe shall be tested for electrical continuity. Continuity shall be verified using the linear resistance method. The pipe should be tested in spans that are no less than 250 feet, unless the pipe is shorter than 250 feet, and no more than 1,000 feet, if test station locations are available. Each test span shall have two test leads connected to the pipe at each end. Existing test stations can be used. A direct current shall be applied through the pipe using two of four test leads. The potential across the test span shall be measured using the other two test leads. The current applied and voltage drop shall be recorded for a minimum of three different current levels.

C. The theoretical resistance of the pipe shall be calculated. It shall take into account the pipe wall thickness, material, and joint bonds.

D. The average measured resistance shall be compared to the theoretical resistance of the pipe and bond wires. If the measured resistance is greater than 125% of the theoretical resistance, then the joint bonds shall be considered deficient and shall be repaired and retested at the CONTRACTOR’s expense. If the measured resistance is less than 100% of the theoretical resistance, then the test and/or calculated theoretical resistance shall be considered deficient and the test span shall be retested and/or recalculated at the CONTRACTOR’s expense. If the piping forms a loop which allows current to flow both in and out of the test span, then consideration shall be made for current circulating through both the loop and the test span.

E. Alternative continuity testing methods can be submitted to the ENGINEER for consideration and approval.

3.16 FINAL SYSTEM CHECKOUT

A. Upon completion of the installation, the CONTRACTOR shall provide testing of the completed system by a Corrosion Technician, and the data shall be reviewed by a Corrosion Engineer to ensure conformance with the Contract Documents, NACE SP0169, and NACE SP0286.

B. The testing described herein shall be in addition to and not substitution for any required testing of individual items at the manufacturer's plant and during installation.

C. Testing shall be performed at all test leads of all test stations, junction boxes, and locations of exposed pipe as soon as possible after installation of the CP system.

D. Testing shall include the following and shall be conducted in accordance with NACE TM0497:

1. Measure and record native pipe-to-soil, casing-to-soil, and anode-to-soil potentials at all test locations. CONTRACTOR shall submit data to ENGINEER a minimum of 48 hours before energizing the cathodic protection system.
2. Verify electrical isolation at all insulating joints and casing insulators per NACE SP0286. CONTRACTOR shall submit data to ENGINEER a minimum of 48 hours before energizing the cathodic protection system.
3. Confirm electrical continuity of the cathodically protected pipeline or structure in accordance with this Section. CONTRACTOR shall submit data to ENGINEER a minimum of 48 hours before energizing the cathodic protection system.
4. Measure and record the “On” and “Instant Off” structure-to-soil or structure-to-water potentials at each location after the structure has been given adequate time to polarize.
5. Measure and record the current output of each anode when the CP system is initially turned on and again after it has been given adequate time to polarize.

E. Test results shall be analyzed to determine compliance with NACE SP0169.

F. Test results shall be analyzed to determine if stray current interference is present. Stray current interference is defined as a ±50 mV shift in a pipeline’s pipe-to-soil potential that is caused by a foreign current source. Stray current interference shall be tested on the project pipeline and foreign pipelines that have a reasonable chance of being affected by stray currents.

G. The CONTRACTOR shall provide a written report, prepared by the Corrosion Engineer, documenting the results of the testing and recommending corrective work, as required to comply with the Contract Documents. Any deficiencies of systems tested shall be repaired and re-tested by the CONTRACTOR at no additional cost to the OWNER.

END OF SECTION

DIVISION 22

PLUMBING SYSTEMS

22 00 01 PLUMBING SYSTEMS

1.00 GENERAL

1.01 WORK INCLUDED

A. Provide labor, materials, equipment and incidentals for complete, operable plumbing systems. Provide appurtenances for every pipe, valve, and fixture or equipment item for a complete operable system.

1.02 QUALITY ASSURANCE

A. Verify location, size, depth and pressure of each utility prior to beginning Work. If conditions are found that will adversely affect the installation, notify the Owner's Representative in writing before proceeding with Work.

B. Plumbing fixtures and trim of like kind shall be of the same manufacturer throughout the Project, in the following categories:

1. Water closets, lavatories, urinals, bathtubs.
2. Showers, and shower-tub combinations.
3. Countertop sinks.
4. Drinking Fountains and Electric water coolers.
5. Emergency shower, eye and face washes.
6. Faucets, mixing valves (other than thermostatic mixing valves).
7. Tailpiece, fixture traps, escutcheons, arm extensions, strainers.
8. Fixture carriers.

1.03 WATER USAGE REQUIREMENTS

A. Water saving performance standards of the Texas Commission on Environmental Quality (TCEQ) adopted April 26, 2012, shall apply to every fixture included for this Project.

1. The maximum flow from a sink or lavatory faucet shall not exceed 2.20 gallons of water per minute at 60 psig.
2. The maximum flow from a shower head shall not exceed 2.5 gallons of water per minute at 80 psig.
3. The maximum volume of water per flush from a urinal and associated flush valve shall not exceed 0.5 gallons of water per flush.

4. The maximum volume of water per flush from a toilet (water closet) shall not exceed 1.60 gallons (1.6 gpf)

1.04 SUBMITTALS

A. Provide Submittals in accordance with Section 01 33 00 “Submittal Procedures” and include manufacturer’s Product Data sheets for the following:

1. Plumbing fixtures and trim.

2. Piping materials and valves.

3. Equipment and accessories.

B. Operation and Maintenance Data: Submit operation and maintenance data in accordance with Division 01.

1.05 STANDARDS

A. Authority Having Jurisdiction: Perform all Work in accordance with the regulations and ordinances of federal, state, and local agencies, who have lawful jurisdiction over the Place of Record. Notify proper authorities for inspections as Work progresses.

B. Codes and Ordinances: The design and installation shall be in accordance with the applicable provisions of the latest edition of the following codes and ordinances. These codes and ordinances shall apply as if written here in their entirety:

1. International Energy Conservation Code (IECC), with any local city amendments.

2. Americans with Disabilities Act (ADA).

3. Texas Accessibility Standards (TAS).

4. Occupational Safety and Health Standards (OSHA).

5. Texas Water Commission; Water Conservation Standards.

C. Standards:

1. The design and installation shall be in accordance with the applicable provisions of the following standards. These standards shall apply as if written here in their entirety:

a. American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME).

b. American National Standards Institute (ANSI)/ American Society for Testing Materials (ASTM).

c. American National Standards Institute (ANSI)/ American Welding Society (AWS).

d. American National Standards Institute (ANSI)/ American Water Works Association (AWWA).

e. American National Standards Institute (ANSI)/ National Fire Protection Association (NFPA).

f. American Society of Testing and Materials (ASTM) Publications.

g. American Welding Society (AWS) Specifications.

h. American Water Works Administration (AWWA) Publications.

i. American Society of Sanitary Engineering (ASSE).

j. Cast Iron Soil Pipe Institute (CIPE) Standards.

1.06 DELIVERY AND STORAGE

A. Deliver and store equipment and materials in accordance with Division 01. Handle pipe in a manner which prevents damage. Store on raised platforms or wood runners in neat piles. Prevent debris or dirt from entering open ends of pipe.

1.07 JOB CONDITIONS

A. Drawings are schematic and intended to show the general arrangement and extent of the Work. Follow dimensions without regard to scale. Determine the exact location and arrangement of piping with regard to the actual equipment furnished, the surrounding conditions and the Work installed by other trades.

B. Review the Drawings and each Section of the Specifications. Install Work indicated, regardless of which Drawing or Section of the Specifications it occurs. No allowances shall be made for the Contractor's failure to review complete Contract Documents.

C. Locate by field measurement the exact rough-in and final connection location of all fixtures, drains and plumbing. Center pipe between walls and chases.

D. Conform to the manufacturer's rough-in and installation requirements for each fixture equipment and appliance.

E. Perform cutting and patching required to install the Work under the requirements of the individual trade. Patching shall restore the area to the original condition. No structural member shall be cut without the written approval of the Engineer.

F. Schedule Work to avoid conflicts with other trades.

G. For pipe penetrations through metal roofs, conform to the metal roofing manufacturer's installation requirements.

1.08 GUARANTEES

A. In addition to the Contractor's standard 1 year guarantee, provide the manufacturer's warranty for all equipment installed. Include warranties in the O & M Manual, in accordance with Division 01.

2.00 PRODUCTS

2.01 PIPE AND FITTINGS

A. Water Piping Buried Within 5 Feet of Building:

1. Copper Tubing: For 2-inch diameter and less, (ASTM B88), Type L or K or annealed. Fittings: ANSI/ASME B16.18, cast copper or ANSI/ASME B16.22, wrought copper. Joints: AWS A5.8 BCuP silver braze.

2. Copper Tube for 2-1/2-inch Diameter and Greater: (ASTM B88) Type L or K hard drawn. Fittings ANSI/ASME B16.8 cast copper or ANSI/ASME B16.22 wrought copper. Joints: AWS A5.8 BCuP silver braze.

3. Ductile Iron Piping for 3-inch Diameter and Greater: Pipe: ANSI/AWWA C151, Class 50. Fittings: ANSI/AWWA C110, ductile iron, standard thickness. Joints: ANSI/AWWA C111, rubber gasket, mechanical joint. Pipe and fittings shall have tar coated outside and cement mortar lined inside in accordance with ANSI A21.4.

B. Water Piping Above Grade:

1. Copper Tubing: For 4-inch diameter and less, (ASTM B88), Type L, hard drawn. Fittings: ANSI/ASME B16.18, cast brass, or ANSI/ASME B16.22, wrought copper. Joints: (ANSI/ASTM B32), solder, (Grade 95TA) or Copper Pipe 2 through 6 inches may be installed using mechanical type couplings on roll-grooved pipe; coupling housing, ductile iron (ASTM A536) grade 65-45-12, with factory coat copper alkyd enamel paint. Gaskets, flanges, shall be rated for the system by the manufacturer.

2. PEX Tubing: PEX tubing (ASTM F877) 175 psig pipe, SDR 9 tubing. Fittings: (ASTM F1807) metal insert type with copper crimp rings and matching PEX tube dimensions. Manifold system: Multiple outlet, plastic corrosion-resistant metal assembly complying with ASTM F877 and with plastic or corrosion resistant metal valve for each outlet. PEX tubing installed in plenums and above ceilings shall be wrapped or coated with an approved fire retardant to comply with the local code.

C. Sanitary Drain, Sanitary Waste and Vent Piping (DWV) Buried:

1. Cast Iron Pipe: (ASTM A74) service weight. Fittings: Cast iron. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and be listed by NSF International. Joints: Hub-and-spigot, CISPI HSN compression type with (ASTM C564) neoprene gaskets.

2. PVC DWV Pipe: Polyvinyl Chloride, Schedule 40 (ASTM D2665) pipe, and fittings (ASTM D2466).

3. PVC Sewer Pipe (beyond 5 feet of building): Polyvinyl Chloride Gravity Sewer Pipe (ASTM 3034) SDR 35, or (ASTM F789) PS 46 and Fittings, with elastomeric Joints. (Uni-Bell B-4-82, ASTM D3212).

4. Reinforced Concrete Pipe (RCP): Pipe shall be RCP class III, and shall conform to ASTM C76 for Circular Pipe.

D. Sanitary Drain, Sanitary Waste and Vent Piping (DWV) Above Grade:

1. Cast Iron Pipe: (ASTM A74), service weight. Fittings: Cast iron. Joints: Hub-and-spigot, CISPI HSN compression type with (ASTM C564) neoprene gaskets.

2. Cast Iron Pipe: (CISPI 301), hubless, service weight. Fittings: Cast iron. All cast iron pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and shall be listed by NSF International. Joints: Cast-iron couplings (ASTM A48, Class 30-A) with neoprene gaskets (ASTM C1277, ASTM D412 18-8 and CISPI 310) stainless steel bolts and nuts; manufactured by MG Piping Products Co. or equal.

3. Copper Pipe: (ASTM B306), DWV. Fittings; (ANSI/ASME B16.3), cast bronze, or (ANSI/ASME B16.29), wrought copper. Joints: (ANSI/ASTM B32), solder, Grade 50B.

4. PVC Pipe: (ASTM D2665), Schedule 40. Fittings: PVC DWV Type, Schedule 40, (ASTM D2665). Joints: (ASTM D2855) and (D2564), solvent weld. PVC pipe installed in plenums and above ceilings shall be wrapped or coated with an approved fire retardant to comply with the local code.

E. Condensate Drain Piping, Above Grade:

1. Copper Tubing: For 4-inch diameter and less, (ASTM B88), Type L, hard drawn. Fittings: ANSI/ASME B16.18, cast brass, or ANSI/ASME B16.22, wrought copper. Joints: (ANSI/ASTM B32), solder, (Grade 95TA) or Copper Pipe 2 through 6 inches may be installed using mechanical type couplings on roll-grooved pipe; coupling housing, ductile iron (ASTM A536) grade 65-45-12, with factory coat copper alkyd enamel paint. Gaskets, flanges, shall be rated for the system by the manufacturer.

2.02 FLANGES, UNIONS, AND COUPLINGS

A. Pipe size 2 inches and under: 150 psig malleable iron unions for threaded ferrous piping; bronze unions for copper pipe, solder joints.

B. Pipe size over 2 inches: 150 psig forged steel slip-on flanges for ferrous piping; bronze flanges for copper piping.

C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.03 VALVES (WITHIN 5 FEET OF BUILDING)

A. Gate Valves (For Water Shut-Off and Pumped Waste Drain Shut-Off):

1. Gate Valves 3 inches and Less: MSS-SP-80, rated 175-lb. minimum water pressure, brass or bronze construction screw-in bonnet, rising stem, solid wedge disc, threaded or soldered connections. Acceptable manufacturers and models: Nibco, T-111, S-111 ITT; Grinnell, 3010, 3010SJ; Watts, B-3100 & B-3101 and Milwaukee, 148, 149.

B. Ball Valves (For Water Shut-Off and Throttling):

1. Ball Valves 2 inches and Less: Full-port, rated 175-lb. minimum water, oil, air and gas pressure, brass or bronze construction, seat material as recommended by manufacturer for material conveying, lever handle, threaded or soldered connections. Throttling valves shall be provided with memory stops. Acceptable manufacturers and models: ITT Grinnell, 3500, 3500SJ; Milwaukee, BA-200, BA-250; Watts, B-6000, B-6001 and Nibco, T-580, S-580.

C. Water Pressure Reducing Valve: Automatic, pressure-reducing control valve, ductile iron main valve body, pressure reducing control, fixed orifice, and adjustable opening speed, globe type, 400 psi max. working pressure, threaded connections. Provide 300-lb. pilot with bronze and stainless steel trim. Acceptable manufacturer and model: Cla-Val Co., 90-01-AS, Watts 115 or approved equal.

2.04 SPECIAL PIPE FITTINGS

A. Flexible Ball Joints for Sanitary Waste Piping: Double Ball Flexible Expansion Joint: Ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include gasketed double ball-joint section and ductile-iron gland, rubber gasket, polyethylene wrap (for underground installation), and steel bolts. Acceptable manufacturer and model: EBAA Iron Sales, Flex-Tend Series.

2.05 DOMESTIC WATER HEATERS AND ACCESSORIES

1. Domestic Water Heater (WH1): Point-of-use instantaneous electric, UL listed, for wall mounted installation near or under fixture. Factory set water heater at 105 F or provide a high temperature shut-off, set at 105 F. Provide a flow restrictor, installed in the hot water outlet of the heater, compatible with the manufacturer's recommendations and with the fixture selection.

    a. Acceptable Manufacturers and Models:

        1). EEMAX: "EX" Thermostatic Series.

        2). CEC: Power Stream RP Series.

        3). Rheem.

2.06 PLUMBING FIXTURES AND TRIM

A. Water Closets:

1. Water Closet (WC1): Accessible wall-mounted, flush-valve type, white vitreous china, siphon-jet action, elongated bowl, 1-1/2-inch top inlet spud, and designed to operate on 1.28 gallons per flush maximum. Mounting height to be 17 to 19 inches from finished floor to top of seat. Provide floor mounted carrier to support heavy fixture weight. Acceptable manufacturers and models: American Standard, 2257.001; Briggs 7781; Toto, CT708E; Kohler, K-4325; Zurn, Z5610-BWL.

B. Flush-Valves for Water Closets:

1. Flush-Valve for Water Closets: Exposed type, chrome-plated, 1-inch supply inlet, screw driver back-check angle stop, vacuum breaker, lever activating handle, solid ring pipe support 1-1/2-inch top outlet spud with wall and spud flanges. Inlet of flush-valve shall be 11-1/2 inches maximum, above rim of water closet, coordinate flush valve location with grab bars for accessible installations. Acceptable manufacturers and models: Sloan, Royal III-1.6 or -1.28; Delany, U402-1.28 and Zurn, Z-6000-AV-HET.WS-1 (typical note: flush valves need to indicate 1.6 or 1.28 gpf and model numbers need to match.

C. Seats for Water Closets:

1. Seat for Water Closets: White, posture molded, elongated type, open front, extra heavy construction, concealed check stainless steel hinges, and rubber bumpers. Provide with antimicrobial agent option. Acceptable manufacturers and models: Olsonite, 10CC; Church/Bemis, 1955C; Beneke, 527 or 533 and Kohler, K-4680-CA series.

D. Water Closet Carriers:

1. Carriers for Water Closets: Heavy duty, wall-mounted, floor supported type, adjustable height, compatible with specified water closet, complete with chrome-plated finished trim, foot support, through wall frame, and required accessories of the appropriate type for the pipe materials specified. Assembly shall also include an adjustable horizontal cast iron closet fitting of the inlet type compatible with the piping type and arrangement as shown on the Drawings. Acceptable manufacturers: Josam, Jay R. Smith, Tyler/Wade, Mifab, Watts Drainage, and Zurn.

E. Lavatories:

1. Lavatory (L1): Wall-mounted, white vitreous china, size 20 by 18 inches, holes for concealed arms, front overflow, integral back, soap depression, and 4-inch center holes. Acceptable manufacturers and models: American Standard, 0355.012; Eljer, 051-1644; Briggs, 6620; Zurn, Z5344; Kohler, K-2005.

F. Faucets for Lavatories:

1. Faucet for Lavatories: Chrome-plated brass, 4-inch centers, soft flow vandal proof spout, with chrome-plated brass wrist-blade handles. Maximum flow is 2.20 gpm. Acceptable manufacturers and models: Chicago Faucet, 802; T & S Brass, B-871; Royal Brass, 905-A-BH.3; Speakman, SC-3063; American Standard, 5400.142 H lever, Cambridge/Delta 21T143, Symmons, S-240-LWG Moen 8215 and Zurn, Z-81104.

G. Supplies and Stops for Lavatories:

1. Supply and Stop for Lavatories: Supplied through the wall, chrome-plated cast brass stop, 1/2-inch female standard pipe thread inlet by 3/8-inch O.D. compression type outlet angle stop, wheel or four armed handle, 3/8-inch O.D. chrome-plated copper flexible riser, and wall escutcheon. Acceptable manufacturers and models: McGuire, 2165LK; Eljer, American Standard, Cambridge/Delta, Zurn and Engineered Brass (Just), Specified trim.

H. Strainer and Tailpiece for Lavatories:

1. Offset Strainer for Lavatories: Heavy Duty 17-gauge chrome plated wheelchair strainer and tailpiece, cast grid drain plug with strainer. Acceptable manufacturers and models:

McGuire, 155WC; Eljer, American Standard, Cambridge/Delta, Specified Trim ST155WC, Zurn and Engineered Brass (Just).

I. P-Trap for Lavatories:

1. P-Trap for Lavatories: 17-gauge chrome-plated brass size 1-1/4 inches, integral cleanout, and wall escutcheon. Acceptable manufacturers: McGuire, B8872**;** Eljer, American Standard, Cambridge/Delta, Zurn and Engineered Brass (Just) Specified Trim.

J. Lavatory Insulation Kits: Fully molded closed cell vinyl insulation 3/16-inch thick with nylon fasteners. K factor of 1.17 (ASTM C177) self-extinguishing burn characteristics (ASTM D635). Insulation kit for p-trap, tailpiece, trap arm, hot and cold water supplies, white. Acceptable manufacturers and models**;** Truebro Inc., #102 with accessory #105**;** Brocar Products Inc., Plumberex, and TCI Products.

K. Lavatory Carriers:

1. Carrier for wall-mounted Lavatories mounted on walls other than concrete block: Wall and floor supported type, compatible with specified lavatory, complete with adjustable through the wall frame including steel uprights, block foot supports, concealed arms, and accessories. Verify that base plate for carrier specified will fit within wall space provided. Acceptable manufacturers and models: Zurn, Z-1231 or Z-1231-D Series (3-inch deep base plates); Jay R. Smith, 700 Series (4-inch deep base plates); Tyler/Wade, W520 (4-1/4-inch deep base plates) and Josam, 17100 & 17105 Series (4-inch deep base plates); Josam, 17570 (For corner lavatory); Mifab, MC-31-C, Watts Drainage CA-411 or CA-411D.

2. Carrier for Lavatories mounted on concrete block walls only: Wall supported type, compatible with specified lavatory, complete with adjustable hanger wall plate, through the wall concealed arms, and accessories. Acceptable manufacturers and models: Josam, 17110; Jay R. Smith, 0720 series; Tyler/Wade, W-573; Watts Drainage CA-461; and Zurn, Z-1253 or 1254.

2.07 PLUMBING SPECIALTIES

A. Floor Drains:

1. Floor Drain (FD1) (for use in Finished Floors without square tile): ANSI A112.21.1; cast iron body, double drainage flange, weepholes, bottom outlet, vandal proof secured 6-inch diameter nickel bronze adjustable flat strainer, and non-puncturing flashing collar. Provide with trap primer connection adapter if trap primers are used for the floor drain.

a. Acceptable Manufacturers and Models:

1). Josam: Series 30000-6A.

2). Jay R. Smith: Series 2005 or 2010.

3). Wade: Series W-1100.

4). Zurn: Series Z-415.

5). Mifab: Series F-1100.

B. Cleanouts:

1. Floor Cleanout (FCO) (for Use in Finished Floors): Cast iron body, adjustable type, inside caulk connection, vandal proof secured, standard round nickel bronze top, threaded brass plug.

   a. Acceptable Manufacturers and Models:

      1). Josam: Series 56000.

      2). Jay R. Smith: Series 4128-NB.

      3). Wade: Series W-6000.

      4). Zurn: Series Z-1405-2.

      5). Mifab: Series C-1100.

      6). Watts Drainage: Series CO-200.

2. Wall Cleanout (WCO): Recessed wall type, cast iron body with threaded brass plug, flush mounted stainless steel access cover with countersunk center screw and vandal proof secured.

   a. Acceptable Manufacturers and Models:

      1). Josam: Series 58710.

      2). Jay R. Smith: Series 4402.

      3). Wade: Series W-8450-R.

      4). Zurn: Series ZN-1440-1.

      5). Mifab: Series C-1400.

      6). Watts Drainage: Series CO-380.

3. Grade Cleanout (GCO & DGCO): Cast iron body, with straight body for caulking into soil pipe hub with countersunk tapered threaded bronze plug. Provide “T” handle wrench.

Double Grade Cleanouts (DGCO) will require two GCO's as described above, along with the proper two-way cleanout pipe fitting.

a. Acceptable Manufacturers and Models:

1). Josam: Series 58850-22.

2). Jay R. Smith: Series 4338.

3). Wade: Series W-8530.

4). Zurn: Series Z-1450.

5). Mifab: Series C-1300.

6). Watts Drainage: Series CO-260.

C. Backflow Preventers:

1. Reduced Pressure Backflow Preventers (RPBFP):

a. Reduced Pressure Backflow Preventer (2 inches and smaller): ANSI/ASSE 1013; complete unit of two independently acting check valves together with an automatically operating pressure relief valve, two ball valves, strainer, and four test cocks, bronze or iron body with bronze internal parts, 150 psi working pressure, and shall comply with AWWA Standard C506.

1). Acceptable Manufacturers and Models:

a). Cla-Val Co.: RP-2 (1-1/2 inches and smaller).

b). Watts: 009QT.

c). Hersey: FRP-II.

d). Febco: 825Y.

e). Wilkins: 975XL.

D. Water Hammer Arrestors:

1. Water Hammer Arrestors (WHA): ANSI A112.26.1, ASSE 1010, and PDI WH-201; permanently sealed bellows or expanding chamber. Sizing designations indicated on the Drawings are standard classifications established by Plumbing and Drainage Institute "Standard PDI-WH201." Verify that system pressure meets minimum required for water hammer arrestor provided.

a. Acceptable Manufacturers and Models:

1). Josam: 75000.

2). Jay R. Smith: 5000.

3). Wade: "SHOKSTOP" Series.

4). Zurn: Z-1700.

5). Sioux Chief: "Hydra-Rester" Series.

6). Watts: No. 15M2 Series.

7). PPP: SC & SWA Series.

8). Mifab: WHB Series.

E. Trap Seals:

1. Trap Seals (TS): Flexible elastomeric or neoprene trap seal device utilizes a normally closed seal to prevent evaporation of the liquid trap seal and also protects against sewer gases from backing up into the building or surrounding areas. The device opens when liquid enters to allow drainage to flow through into the building drainage piping, and closes when there is no drainage flow entering the drain. Provide in all floor drains, floor sinks, area drains and hub drains connected to the sanitary sewer system or to other systems that may have sewer gases present in the drainage system.

a. Acceptable Manufacturers and Models:

1). ProVent Systems, Inc.: ProSet Trap Guard Series, 800.262.5355 or www.trapguard.com.

2). Mifab: Mi-Gard Series.

3). SureSeal.

4). Jay R. Smith Mfg. Co.: Quad Close Series.

F. Hose Bibbs:

1. Hose Bibb (HB): Chrome plated brass, provided with wall flange, 1/2-inch female NPT inlet by 3/4-inch male N.H.T. outlet, with chrome plated vacuum breaker in conformance with ANSI/ASSE 1011.

a. Acceptable Manufacturers and Models:

1). Chicago Faucet: 15-E27 or 7-E27.

2). T&S Brass: B-702-B-972.

3). Royal Brass: 5115-136-G.

4). Woodford: 24P.

5). Watts: SC8-1.

G. Wall Hydrants:

1. Non-Freeze Wall Hydrant (NFWH1): ANSI/ASSE 1019; exposed wall hydrant type, with chrome plated brass or nickel bronze finish on brass castings, freezeless, 3/4-inch hose thread nozzle, integral vacuum breaker, and loose key handle.

   a. Acceptable Manufacturers and Models:

      1). Woodford: 65.

      2). Josam: 71050.

      3). Jay R. Smith: 5609.

      4). Wade: W-8620.

      5). Zurn: Z-1310.

      6). Watts: HY-420.

2. Non-Freeze Wall Hydrant (NFWH2): ANSI/ASSE 1019; recessed box wall hydrant type, with chrome plated brass or nickel bronze finish on brass castings, freezeless, 3/4-inch hose thread nozzle, integral vacuum breaker, with loose key handle for box and valve.

   a. Acceptable Manufacturers and Models:

      1). Woodford: B65.

      2). Josam: 71150.

      3). Jay R. Smith: 5509.

      4). Wade: W-8625.

      5). Zurn: Z-1300.

      6). Watts HY-725.

H. Pipe Hangers and Supports:

1. Hangers for pipe sizes 1/2 to 1-1/2 inches: Malleable iron, adjustable swivel, split ring.

2. Hangers for pipe sizes 2 to 4 inches and cold pipe sizes 6 inches and over: Carbon steel, adjustable, clevis.

3. Hangers for hot pipe sizes 6 inches and over: Adjustable steel yoke, cast iron roll, double hanger.

4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods; cast iron roll and stand for hot pipe sizes 6 inches and over.

5. Vertical Support: Steel riser clamp.

6. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

7. Shields for insulated piping 2 inches and smaller: 18 gage galvanized steel shield over insulation in 180 degree segments, minimum 12-foot long at pipe support.

8. Shields for Vertical Copper Pipe Risers: Sheet lead.

9. Support horizontal piping as follows:

Pipe Size	Max. Hanger Spacing	Hanger Diameter
1/2" to 1-1/4"	6'-6"	3/8"
1-1/2" to 2"	10'-0"	3/8"
2-1/2" to 3"	10'-0"	1/2"
PVC (All Sizes)	6'-0"	3/8"
C.I. Bell and Spigot (or No-Hub)	5'-0" and at Joints	

10. Hanger Notes:

    a. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent Work.

    b. Place a hanger within 12 inches of each horizontal elbow.

    c. Use hangers with 1-1/2-inch maximum vertical adjustment.

    d. Support horizontal cast iron pipe adjacent to each hub, with 5-inch maximum spacing between hangers.

    e. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers. Consult with project structural engineer for approval.

    f. Support riser piping independently of connected horizontal piping.

    g. For below floor hanger installations, place one hanger at each pipe penetration thru a concrete grade beam, at either side, a minimum of 12 inches from the face of the grade beam.

I. Hanger Rods:

1. Steel Hanger Rods: Threaded both ends.

J. Inserts:

1. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

K. Insulation:

1. Pipe insulation for domestic hot and cold water pipe, roof drains and horizontal roof drain pipe.

   a. Heavy duty preformed fiberglass (ASTM C547, type 1, 2 or 3). Schuller, Knauf or Certainteed.

   b. Preformed flexible elastomeric insulation (ASTM C534) Armstrong "Armaflex", or Schuller "Rubatex."

   c. Preformed unicellular polyolefin foam (ASTM C534) tubular preslit with adhesive. IMCOA.

Insulation Schedule	
Cold Water	1" thick up to 2" pipe size 1-1/2" thick over 2" pipe size
Hot Water	1" thick up to 2" pipe size 1-1/2" thick over 2" pipe size

   d. Provide all purpose jacket, high density white kraft bonded to aluminum foil, reinforced with fiberglass yarn lap and butt, self-sealing, pressure sensitive. Schuller "Micro-Lok", Certainteed "Snap-On."

   e. PVC fitting covers, one piece pre molded high impact PVC white gloss insulating fitting covers and jackets. Schuller "Zeston 2000PVC."

2. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.

   a. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.

b. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

L. Piping Identification:

1. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.

a. Pipes with OD, Including Insulation, Less than 6 inches: Pre-tensioned pipe markers. Use size to match pipe and ensure a tight fit.

b. Pipes with OD, Including Insulation, 6 inches and Larger: Shaped pipe markers. Use size to match pipe and secure with fasteners.

c. Locate pipe markers and color bands on piping as follows: Near each valve and control device; Near each branch connection, excluding short takeoffs; Where flow pattern is not obvious, mark each pipe at branch; At other points of origination and termination; Spaced at maximum intervals of 50 feet along each run; Reduce intervals to 25 feet in areas of congested piping and equipment.

3.00 EXECUTION

3.01 PREPARATION

A. Establish invert elevations for drainage piping within 5 feet of building. Minimum slopes for drainage pipe is 1/4 inch per foot for 2 1/2-inch diameter and less and 1/8 inch per foot for 3-inch diameter pipe and greater.

3.02 INSTALLATION

A. Pipe, Valves and Fittings:

1. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

2. Provide clearance for installation of insulation, and access to valves and fittings.

3. Provide access doors where valves and equipment are not accessible. Coordinate size and location of access doors with applicable Section.

4. Install sanitary drainage piping true to line with proper grading. Connect horizontal branches to one another with 45 degrees “Y” fittings, combination “Y” and 1/8 bend fittings. Connect horizontal lines to vertical stacks using 45 degrees “Y” branches, 60 degree “Y” branches, or combination “Y” and 1/8 bend fittings. Horizontal branches turning down to vertical stacks may use a short sweep or 1/2 bend. Branches connecting to mains or to other branches shall enter the branch line at a 45 degree angle, tilted 45 degrees upward, so that the entry is from the side and top.

5. Materials exposed within ducts or plenums (ceiling spaces used as supply or return air plenums) shall have a flame-spread index of not more than 25 and a smoke-developed rating of not more than 50 when tested in accordance with the test for Surface Burning Characteristics of Materials, UBC Standard. Wrap or enclose with rated materials, any CPVC, PVC or PEX piping installed in rated spaces, including return air plenums.

6. Piping hangers shall be sized large enough to allow insulation to pass through. Hangers for piping 2 inches and less shall be provided with pipe covering shields. On cold water piping provide vapor barrier through hanger.

7. Anchor piping with regard to the transmission of vibration and noise. Securely anchor copper piping to studs or wood blocking with "C" clamp of proper size for piping. At each fixture location where the piping penetrates the partition, back the elbow inside the partition, or chase, with wood blocking. Anchor with "C" clamps or cast brass drop ear elbows to prevent movement. Do not use wire as an anchoring device.

8. Piping shall not come into direct contact with metal studs, beams, or other construction elements. Provide a non-metallic separation between dissimilar metals when copper piping is installed in direct contact with steel.

9. Install unions in piping 2 inches and smaller and flanges in piping 2-1/2 inches and larger, adjacent to each valve and at final connection to each piece of equipment having threaded pipe connection.

10. Install piping adjacent to equipment and specialties to allow service and maintenance.

11. Install piping free of sags and bends.

B. Plumbing Specialties and Equipment:

1. Pipe relief valves and drains to nearest floor drain. Minimum slope 1/16 inch per foot. Provide 1-inch air gap.

2. Install equipment plumb and square to wall on a 4-inch thick (minimum) reinforced concrete housekeeping pad.

3. Provide all interconnecting electrical power and control wiring from control panels to equipment and accessories for a complete operable systems. All exposed wiring shall be in conduit. Comply with Division 26.

4. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

5. Encase grade cleanouts in concrete flush with grade when not located in concrete, pavement, sidewalk, etc.

6. Grade cleanouts located in pavement or sidewalks shall have a brass or cast iron cover that extends to grade and a brass cap shall be installed.

7. Trap all drains connected to the sanitary sewer.

8. Install floor and area drains with top depressed 1/2 inch below finished floor elevation.

9. In addition to cleanouts, as shown on the Drawings, Contractor shall provide any additional cleanouts required by local codes and ordinances at no additional cost to the Owner.

10. Outlet of plumbing vents and flues shall be located a minimum of 25 feet from fresh air intakes. Provide offset as required.

11. Relief valve discharge drain from reduced pressure backflow preventers shall be piped full outlet size down to nearest floor drain. Drain line shall terminate above floor drain with air gap unless otherwise indicated on the Drawings.

12. Prior to ordering and installing water hammer arrestors, verify that the pressure at the point of installation does not drop to below 30 psig at any time. If the pressure drops below 30 psig, do not install piston type water hammer arrestors. Install bellows type arrestors under low pressure circumstances. Provide access panel directly in front of each water hammer arrestor.

13. Inlet of overflow drain shall be 2 inches above inlet of adjacent roof drain (or as required by local code). Overflow drain installation may be similar to vent through roof installation.

C. Plumbing Fixtures and Connections:

1. Furnish and install plumbing fixtures, as noted on the Drawings. Each fixture shall be complete with trim and fittings, including traps and supply fittings. Set fixture with close tolerance to wall and floor surfaces.

2. Provide all wall mounted fixtures with floor carriers. Install and secure fixtures in place with wall supports carriers and bolts. Exposed bolts, nuts, etc. shall be stainless steel or chrome-plated brass.

3. Seal fixtures to wall and floor surfaces with white mildew resistant sealant.

4. Mount fixtures to Architectural Drawings interior wall elevations, manufacturers recommended elevations or the requirements of the ADA or TAS, whichever is applicable.

5. Provide removable insulation covering on stops and supplies and drains and P-traps on all handicapped lavatories. All lavatories in rooms with handicapped water closets are considered handicapped lavatories.

6. Provide accessible stops on all water supplies to fixtures and equipment.

7. Provide accessible water hammer arresters on hot and cold water supplies to plumbing fixtures and/or fixture groups in accordance with Standard PDI-WH-201. Water hammer arresters shall be as shown on diagrams and if not shown, provide for plumbing fixtures and/or fixture groups in accordance with Standard PDI-WH-201.

8. Provide drainage and vent piping run-outs to plumbing fixtures and drains, with approved trap, of sizes indicated, but in no case smaller than required by the governing Plumbing Code.

9. Provide drainage piping run-outs to urinals of cast iron material. Copper or brass material is prohibited.

D. Trenching, Excavation and Backfill:

1. Perform excavating and backfilling necessary for the installation of Work. Shore, bail, pump and maintain all trenches dry until the Work is completed. Keep trenches open until piping has been inspected, tested and approved. Take necessary precautions to protect the public from open trenches. Erect and maintain barricades and warning devices in accordance with OSHA requirements.

2. Backfill trenches after piping has been tested and approved. Material for backfilling shall be a clean, sandy loam up to 4 inches above the top of pipe. Above that point, use overburden removed in the excavation process. Overburden shall be free of trash, debris, rocks or boulders. Deposit backfill material in 12-inch layers and compact to the density of the adjacent, undisturbed soil. Remove all excess material from the Site.

3.03 TESTING

A. Piping Systems:

1. General: Furnish pumps, compressors,-gauges, equipment and personnel required, and test as necessary to demonstrate the integrity of the finished installation.

2. Soil, Sanitary Waste and Vent: Unless otherwise directed by the authority having jurisdiction, plug all openings except for the highest opening and fill with water to the point of overflow. Perform a water test consisting of no less than 10 feet of head shall be applied to the system. Allow to stand 1 hour or longer as required. The system should be water tight and leak free. If leaks exist, repair and retest.

3. Water: Unless otherwise directed by the authority having jurisdiction, hydrostatically test and make tight the entire system at 120 psi. Retain for 4 hours. The system should be water tight and leak free. If leaks exist, repair and retest.

3.04 DEMONSTRATION OF EQUIPMENT

A. Prior to final acceptance, Contractor and Manufacturer's Representative of Domestic Water Heaters and associated accessories and controls, each shall provide a minimum of 4 hours (or as long as required by the Owner) to demonstrate to the Owner the proper operation of the equipment.

B. Prior to final acceptance, Contractor shall provide a minimum of 4 hours (or as long as required by the Owner) to demonstrate to the Owner the proper operation of all the plumbing equipment and associated accessories and controls.

3.05 FLUSHING

A. General: After piping systems have been tested and approved, systems shall be flushed. Furnished compressors, pumps, equipment, personnel, etc. required to flush piping systems.

B. Soil, Sanitary Waste and Vent, Storm Drainage: Unless otherwise directed by the authority having jurisdiction, thoroughly flush piping systems with water until free of debris, or detrimental materials that may cause partial or full blockage. As a minimum comply with the International Plumbing Code, Section 302, of the latest edition.

C. Water Piping: Unless otherwise directed by the authority having jurisdiction, flush piping with water until water flows clear for a minimum of 60 seconds per 100 linear feet of piping being flushed at a velocity of 9 feet per second.

D. All strainers and filters shall be cleaned and replaced prior to start-up.

3.06 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Prior to starting Work, verify system is complete, flushed and clean.

B. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.

C. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum five remote outlets.

D. Maintain disinfectant in system for 24 hours.

E. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

F. Take Samples no sooner than 24 hours after flushing, from five remote outlets and from water entry, and analyze in accordance with AWWA C601.

G. Disinfection and disinfection procedures shall be witnessed and approved by the Owners Representative.

H. After disinfection is completed, submit “Disinfection Certificate of Approval” for domestic water piping systems to the Owners Representative stating that all test results are satisfactory. Certificate of Approval must be signed by Contractor, Testing Laboratory. Certificate shall show the date, time and residual of each of the following tests:

1. Initial disinfection residual (50 ppm minimum) - five Samples.

2. Final disinfection residual (25 ppm minimum) - five Samples.

3. After flushing residual (5 ppm maximum) - five Samples.

4. Analyze in accordance AWWA C601 - five Samples.

3.07 CLOSING IN UNINSPECTED WORK

A. Do not cover up or enclose Work until it has been properly and completely inspected and approved. Should any of the Work be covered up or enclosed prior to all required inspections and approvals, uncover the Work as required. After it has been completely inspected and approved, make all repairs and replacements as necessary to the satisfaction of the Owner’s representative. Repairs and replacements shall be at no additional cost to the Owner.

END OF SECTION

DIVISION 23

HEATING, VENTILATING, & AIR CONDITIONING

23 00 00 HEATING, VENTILATING, AND AIR CONDITIONING

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Grout.
8. Equipment installation requirements common to equipment sections.
9. Painting and finishing.
10. Concrete bases.
11. Supports and anchorages.

1.03 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.

3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:
1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.04 SUBMITTALS

A. Welding Certificates.

1.05 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing; connecting electrical services, circuit breakers, and conduit sizes are appropriately modified; and all is provided at no additional cost. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.07 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08.

2.00 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.03 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, non-metallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.

b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for Joining Plastic Piping:

1. ABS Piping: ASTM D2235.

2. CPVC Piping: ASTM F493.

3. PVC Piping: ASTM D2564. Include primer according to ASTM F656.

4. PVC to ABS Piping Transition: ASTM D3138.

I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.04 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 F (82 C).

1. Manufacturers:

a. Capitol Manufacturing Co.

b. Central Plastics Company.

c. Epco Sales, Inc.

d. Hart Industries, International, Inc.

e. Watts Industries, Inc.; Water Products Div.

f. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Couplings: Galvanized-steel coupling with inert and non-corrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 F (107 C).

1. Manufacturers:

a. Calpico, Inc.

b. Lochinvar Corp.

E. Dielectric Nipples: Electroplated steel nipple with inert and non-corrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 F (107 C).

1. Manufacturers:

a. Perfection Corp.

b. Precision Plumbing Products, Inc.

c. Sioux Chief Manufacturing Co., Inc.

d. Victaulic Co. of America.

2.05 SLEEVES

A. Steel Pipe: ASTM A53/A53M, Type E, Grade B, Schedule 40, galvanized, plain ends.

B. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.06 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated.

E. One-Piece, Stamped-Steel Type: With spring clips and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With concealed hinge, spring clips, and chrome-plated finish.

2.07 GROUT

A. Description: ASTM C1107, Grade B, non-shrink and non-metallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, non-staining, non-corrosive, non-gaseous, and recommended for interior and exterior applications.

2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

3. Packaging: Premixed and factory packaged.

3.00 EXECUTION

3.01 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping, pipe hangers and supports to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Wrap or enclose with rated materials PVC piping installed in rated spaces, including return air plenums.

M. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.

b. Insulated Piping: One-piece, stamped-steel type with spring clips and chrome plated finish.

c. Bare Piping at Wall Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.

d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.

e. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.

f. Bare Piping in Equipment Rooms: One-piece, cast-brass type with chrome-plated finish.

N. Install sleeves for pipes passing through concrete and masonry walls, and gypsum-board partitions.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls as new walls are constructed.

3. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

a. Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 for materials and installation.

O. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.

2. Install cast-iron “wall pipes” for sleeves 6 inches (150 mm) and larger in diameter.

3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 for materials.

Q. Verify final equipment locations for roughing-in.

R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.02 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.

2. ABS Piping: Join according to ASTM D2235 and ASTM D2661 Appendixes.

3. CPVC Piping: Join according to ASTM D2846/D2846M Appendix.

4. PVC Pressure Piping: Join schedule number ASTM D1785, PVC pipe and PVC socket fittings according to ASTM D2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D2855.
5. PVC Non-pressure Piping: Join according to ASTM D2855.
6. PVC to ABS Non-pressure Transition Fittings: Join according to ASTM D3138 Appendix.

I. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D3139.

J. Plastic Non-pressure Piping Gasketed Joints: Join according to ASTM D3212.

K. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D2657.
1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

L. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.03 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping Materials of dissimilar metals.

3.04 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.05 PAINTING

A. Painting of mechanical systems, equipment, and components is specified in Division 09.

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.06 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit and not less than top level at 4 inches (100 mm) above grade or finished floor.

2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.

3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.

4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

5. Install anchor bolts to elevations required for proper attachment to supported equipment.

6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

7. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 03.

3.07 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Sections for miscellaneous metal fabrications and structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.08 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.09 GROUTING

A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION

23 05 13 COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes basic requirements for factory-installed motors.

1.03 DEFINITIONS

A. Factory-Installed Motor: A motor installed by motorized-equipment manufacturer as a component of equipment.

1.04 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.05 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices and features that comply with the following:

1. Compatible with the following:

a. Magnetic controllers.

b. Multispeed controllers.

c. Reduced-voltage controllers.

2. Designed and labeled for use with variable frequency controllers, and suitable for use throughout speed range without overheating.

3. Matched to torque and horsepower requirements of the load.

4. Matched to ratings and characteristics of supply circuit and required control sequence.

2.00 PRODUCTS

2.01 MOTOR REQUIREMENTS

A. Motor requirements apply to factory-installed motors except as follows:

1. Different ratings, performance, or characteristics for a motor are specified in another Section.

2. Manufacturer for a factory-installed motor requires ratings, performance, or characteristics, other than those specified in this Section, to meet performance specified.

2.02 MOTOR CHARACTERISTICS

A. Motors 3/4 HP and Larger: Three phase.

B. Motors Smaller Than 3/4 HP: Single phase.

C. Frequency Rating: 60 Hz.

D. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.

E. Minimum Service Factor: 1.15 for open drip-proof motors; 1.10 for totally enclosed motors.

F. Duty: Continuous duty at ambient temperature of 105 F (40 C) and at altitude of 3300 feet (1005 m) above sea level.

G. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

H. Enclosure: Unless indicated otherwise, provide the following enclosure type:

1. Open drip-proof (ODP): In indoor, moderately clean and dry environments.

2. Totally enclosed, non-ventilated (TENV): In damp, dirty, corrosive or contaminated environments.

3. Totally enclosed, fan cooled (TEFC): Outdoors.

4. Hazardous location motors:

a. In Class I environments which involve potentially explosive liquids, vapors and gases; with motor approved for specific hazard category as defined by Article 500 of the National Electric Code.

b. Dust ignition resistant: In Class II environments that contain combustible dusts such as coal, grain, flour, etc.

2.03 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Premium as defined in NEMA MG 1.

C. Stator: Copper windings, unless otherwise indicated.

1. Multispeed motors shall have separate winding for each speed.

D. Rotor: Squirrel cage, unless otherwise indicated.

E. Bearings: Double-shielded, pre-lubricated ball bearings suitable for radial and thrust loading.

F. Temperature Rise: Match insulation rating, unless otherwise indicated.

G. Insulation: Class F, unless otherwise indicated.

H. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.

2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.

I. Enclosure: Cast iron for motors 7.5 HP and larger; rolled steel for motors smaller than 7.5 HP.

1. Finish: Gray enamel.

2.04 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Inverter – duty rated. Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Designed with critical vibration frequencies outside operating range of controller output.

2. Temperature Rise: Matched to rating for Class B insulation.

3. Insulation: Class H.

4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Rugged-Duty Motors: Totally enclosed, with 1.25 minimum service factor, greased bearings, integral condensate drains, and capped relief vents. Windings insulated with non-hygroscopic material.

1. Finish: Chemical-resistant paint over corrosion-resistant primer.

D. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.05 SINGLE-PHASE MOTORS

A. Type: Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.

2. Split-phase start.

3. Capacitor start, inductor run.

4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Shaded-Pole Motors: For motors 1/20 HP and smaller only.

D. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

E. Bearings: Ball type for belt-connected motors and other motors with high radial forces on motor shaft; sealed, pre-lubricated-sleeve type for other single-phase motors.

3.00 EXECUTION (NOT USED)

END OF SECTION

23 05 29 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes hangers and supports for mechanical system piping and equipment.

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Equipment supports.

1.03 DEFINITIONS

A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry.

B. Terminology: As defined in MSS SP-90, “Guidelines on Terminology for Pipe Hangers and Supports.”

1.04 PERFORMANCE REQUIREMENTS

A. Design channel support systems for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

B. Design heavy-duty steel trapezes for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

1.05 SUBMITTALS

A. Welding Certificates: Copies of certificates for welding procedures and operators.

1.06 QUALITY ASSURANCE

A. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, “Welding and Brazing Qualifications.”

B. Engineering Responsibility: Design and preparation of Shop Drawings and calculations for each multiple pipe support, trapeze, and seismic restraint by a qualified professional engineer.

1. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing

engineering services of the kind indicated. Engineering services are defined as those performed for installations of hangers and supports that are similar to those indicated for this Project in material, design, and extent.

2.00 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:

1. Pipe Hangers:
    a. AAA Technology and Specialties Co., Inc.
    b. B-Line Systems, Inc.
    c. Carpenter & Patterson, Inc.
    d. Empire Tool & Manufacturing Co., Inc.
    e. Globe Pipe Hanger Products, Inc.
    f. Grinnell Corp.
    g. GS Metals Corp.
    h. Michigan Hanger Co., Inc.
    i. National Pipe Hanger Corp.
    j. PHD Manufacturing, Inc.
    k. PHS Industries, Inc.
    l. Piping Technology & Products, Inc.
2. Channel Support Systems:
    a. B-Line Systems, Inc.
    b. Grinnell Corp.; Power-Strut Unit.
    c. GS Metals Corp.
    d. Michigan Hanger Co., Inc.; O-Strut Div.
    e. National Pipe Hanger Corp.
    f. Thomas & Betts Corp.
    g. Unistrut Corp.
    h. Wesanco, Inc.
3. Thermal-Hanger Shield Inserts:
    a. Carpenter & Patterson, Inc.
    b. Michigan Hanger Co., Inc.
    c. PHS Industries, Inc.
    d. Pipe Shields, Inc.

e. Rilco Manufacturing Co., Inc.

f. Value Engineered Products, Inc.

4. Powder-Actuated Fastener Systems:

a. Gunnebo Fastening Corp.

b. Hilti, Inc.

c. ITW Ramset/Red Head.

d. Masterset Fastening Systems, Inc.

2.02 MANUFACTURED UNITS

A. Pipe Hangers, Supports, and Components: MSS SP-58, factory-fabricated components. Refer to "Hanger and Support Applications" Article in Part 3 for where to use specific hanger and support types.

1. Galvanized, Metallic Coatings: For piping and equipment that will not have field-applied finish.

2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

B. Channel Support Systems: MFMA-2, factory-fabricated components for field assembly. Calculation and detail of each support is required.

1. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

C. Thermal-Hanger Shield Inserts: 100-psi (690-kPa) minimum compressive-strength insulation, encased in sheet metal shield.

1. Material for Cold Piping: ASTM C552, Type I cellular glass or water-repellent-treated, ASTM C533, Type I calcium silicate with vapor barrier.

2. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.

3. For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.

4. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.03 MISCELLANEOUS MATERIALS

A. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Do not use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick.

B. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Do not use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick.

C. Structural Steel: ASTM A36/A 36M, steel plates, shapes, and bars, black and galvanized.

D. Grout: ASTM C1107, Grade B, factory-mixed and -packaged, non-shrink and nonmetallic, dry, hydraulic-cement grout.

1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
2. Properties: Non-staining, noncorrosive, and nongaseous.
3. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

3.00 EXECUTION

3.01 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger requirements are specified in Sections specifying equipment and systems.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification Sections.

C. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Adjustable Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated stationary pipes, NPS 1/2 to NPS 30 (DN15 to DN750).
2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24 (DN20 to DN600), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24 (DN15 to DN600), if little or no insulation is required.
4. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4 (DN15 to DN100), to allow off-center closure for hanger installation before pipe erection.
5. Adjustable Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of non-insulated stationary pipes, NPS 3/4 to NPS 8 (DN20 to DN200).
6. Adjustable Steel Band Hangers (MSS Type 7): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8 (DN15 to DN200).
7. Adjustable Band Hangers (MSS Type 9): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8 (DN15 to DN200).
8. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 2 (DN15 to DN50).
9. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of non-insulated stationary pipes, NPS 3/8 to NPS 8 (DN10 to DN200).
10. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of non-insulated stationary pipes, NPS 3/8 to NPS 3 (DN10 to DN80).
11. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.

D. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20 (DN20 to DN500).
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20 (DN20 to DN500), if longer ends are required for riser clamps.

E. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 F (49 to 232 C) piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 F (49 to 232 C) piping installations.

F. Building Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    a. Light (MSS Type 31): 750 lb. (340 kg).
    b. Medium (MSS Type 32): 1500 lb. (675 kg).
    c. Heavy (MSS Type 33): 3000 lb. (1350 kg).
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where head room is limited.

G. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
    1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
    2. Protection Shields (MSS Type 40): Of length recommended by manufacturer to prevent crushing insulation.
    3. Thermal-Hanger Shield Inserts: For supporting insulated pipe, 360-degree insert of high-density, 100-psi (690-kPa) minimum compressive-strength, water-repellent-treated calcium silicate or cellular-glass pipe insulation, same thickness as adjoining insulation with vapor barrier and encased in 360-degree sheet metal shield.

3.02 HANGER AND SUPPORT INSTALLATION

A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.
    1. Field assemble and install according to manufacturer's written instructions.

C. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated, heavy-duty trapezes.
    1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
    2. Field fabricate from ASTM A36/A36M, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.

D. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

E. Install powder-actuated drive-pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.

F. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

I. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

J. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.

K. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.
    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits according to ASME B31.9.
2. Install MSS SP-58, Type 39 protection saddles, if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span arc of 180 degrees.
4. Shield Dimensions for Pipe: Not less than the following:
    a. NPS 1/4 to NPS 3-1/2 (DN8 to DN90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
5. Insert Material: Length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.03 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

3.04 METAL FABRICATION

A. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.

B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.05 ADJUSTING

A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.06 PAINTING

A. Touching Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION

23 05 53 IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following mechanical identification materials and their installation:

1. Equipment nameplates.
2. Equipment markers.
3. Equipment signs.
4. Access panel and door markers.
5. Pipe markers.
6. Duct markers.
7. Warning tags.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

1.04 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME A13.1, “Scheme for the Identification of Piping Systems,” for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.05 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with location of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

2.00 PRODUCTS

2.01 EQUIPMENT IDENTIFICATION DEVICES

A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.

1. Data:

a. Manufacturer, product name, model number, and serial number.

b. Capacity, operating and power characteristics, and essential data.

c. Labels of tested compliances.

2. Location: Accessible and visible.

3. Fasteners: As required to mount on equipment.

B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.

1. Terminology: Match schedules as closely as possible.

2. Data:

a. Name and plan number.

b. Equipment service.

c. Design capacity.

d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.

3. Size: 2-1/2 by 4 inches (64 by 100 mm) for control devices, dampers, and valves; 4-1/2 by 6 inches (115 by 150 mm) for equipment.

C. Equipment Signs: ASTM D709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine sub-core, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.

1. Data: Instructions for operation of equipment and for safety procedures.

2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.

3. Thickness: 1/16 inch (1.6 mm) for units up to 20 sq. in. (130 sq. cm) or 8 inches (200 mm) in length, and 1/8 inch (3.2 mm) for larger units.

4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

D. Access Panel and Door Markers: 1/16-inch (1.6-mm) thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch (3.2-mm) center hole for attachment.

1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.02 PIPING IDENTIFICATION DEVICES

A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.

1. Colors: Comply with ASME A13.1, unless otherwise indicated.

2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.

3. Pipes with OD, Including Insulation, Less than 6 inches (150 mm): Full-band pipe markers extending 360 degrees around pipe at each location.

4. Pipes with OD, Including Insulation, 6 inches (150 mm) and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.

B. Pretensioned Pipe Markers: Pre-coiled semi-rigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.

2.03 DUCT IDENTIFICATION DEVICES

A. Duct Markers: Engraved, color-coded laminated plastic. Include direction and quantity of airflow and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive.

2.04 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.
1. Size: Approximately 4 by 7 inches (100 by 178 mm).
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
4. Color: Yellow background with black lettering.

3.00 EXECUTION

3.01 APPLICATIONS, GENERAL

A. Products specified are for applications referenced in other Division 23 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.02 EQUIPMENT IDENTIFICATION

A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible.

B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
1. Letter Size: Minimum 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering 2/3 to 3/4 the size of principal lettering.

2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
    a. Fans, blowers, primary balancing dampers, and mixing boxes.
    b. Packaged HVAC central-station and zone-type units.

C. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.
1. Identify mechanical equipment with equipment markers in the following color codes:
    a. Green: For cooling equipment and components.
    b. Yellow: For heating equipment and components.
    c. Green and Yellow: For combination cooling and heating equipment and components.
2. Letter Size: Minimum 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering 2/3 to 3/4 the size of principal lettering.
3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.

D. Install access panel markers with screws on equipment access panels.

3.03 PIPING IDENTIFICATION

A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
1. Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): Pretensioned pipe markers. Use size to ensure a tight fit.

B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior non-concealed locations as follows:
1. Near each branch connection. Where flow pattern is not obvious, mark each pipe at branch.
2. Near penetrations through walls, floors, ceilings, and non-accessible enclosures.
3. At access doors, manholes, and similar access points that permit view of concealed piping.
4. Near major equipment items and other points of origination and termination.
5. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.

6. On piping above removable acoustical ceilings. Omit intermediately spaced markers.

3.04 DUCT IDENTIFICATION

A. Install duct markers with permanent adhesive on air ducts in the following color codes:

1. Green: For cold-air supply ducts.
2. Blue: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
3. ASME A13.1 Colors and Designs: For hazardous material exhaust.
4. Letter Size: Minimum 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering 2/3 to 3/4 the size of principal lettering.

B. Locate markers near points where ducts enter into concealed spaces and at maximum intervals of 50 feet (15 m) in each space where ducts are exposed or concealed by removable ceiling system.

3.05 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

3.06 ADJUSTING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.07 CLEANING

A. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION

23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC

1.00 GENERAL

1.01 SUMMARY

A. This Section includes TAB to produce design objectives for the following:

1. Air Systems:

a. Constant-volume air systems.

b. Variable-air-volume systems.

2. HVAC equipment quantitative-performance settings.

3. Verifying that automatic control devices are functioning properly.

4. Reporting results of activities and procedures specified in this Section.

1.02 SUBMITTALS

A. Strategies and Procedures Plan: Within 30 days from Contractor's Notice to Proceed, submit four copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.

B. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

C. Warranties specified in this Section.

1.03 QUALITY ASSURANCE

A. TAB Firm Qualifications: Engage a TAB firm certified by AABC, NEBB, or TABB.

B. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.

2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

C. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," as applicable.

1.04 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.05 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Perform TAB after leakage and pressure tests on air distribution systems have been satisfactorily completed.

1.06 WARRANTY

A. National Project Performance Guarantee: If AABC, provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:

1. The certified TAB firm has tested and balanced systems according to the Contract Documents.

2. Systems are balanced to optimum performance capabilities within design and installation limits.

B. Special Guarantee: If NEBB, provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:

1. The certified TAB firm has tested and balanced systems according to the Contract Documents.

2. Systems are balanced to optimum performance capabilities within design and installation limits.

2.00 PRODUCTS (NOT APPLICABLE)

3.00 EXECUTION

3.01 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

1. Verify that balancing devices, such as manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine approved submittal data of HVAC systems and equipment.

C. Examine Project Record Documents described in Division 01.

D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data including fan curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.

G. Examine system and equipment test reports.

H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

K. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

L. Examine equipment for installation and for properly operating safety interlocks and controls.

M. Examine automatic temperature system components to verify the following:

    1. Dampers are operated by the intended controller.

    2. Dampers are in the position indicated by the controller.

    3. Integrity of dampers for free and full operation and for tightness of fully closed and fully open positions.

    4. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.

    5. Sensors are located to sense only the intended conditions.

    6. Sequence of operation for control modes is according to the Contract Documents.

    7. Controller set points are set at indicated values.

    8. Interlocked systems are operating.

9. Changeover from heating to cooling mode occurs according to indicated values.

N. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.02 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system readiness checks and prepare system readiness reports. Verify the following:

1. Permanent electrical power wiring is complete.
2. Automatic temperature-control systems are operational.
3. Equipment and duct access doors are securely closed.
4. Balance, smoke, and fire dampers are open.
5. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
6. Windows and doors can be closed so indicated conditions for system operations can be met.

3.03 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," as applicable, and this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, fan-speed-control levers, and similar controls and devices, to show final settings.

3.04 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

D. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.

E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

F. Verify that motor starters are equipped with properly sized thermal protection.

G. Check dampers for proper position to achieve desired airflow path.

H. Check for airflow blockages.

I. Check condensate drains for proper connections and functioning.

J. Check for proper sealing of air-handling unit components.

K. Check for proper sealing of air duct system.

3.05 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure fan static pressures to determine actual static pressure as follows:

a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.

b. Measure static pressure directly at the fan outlet or through the flexible connection.

c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.

d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.

3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.

4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.

5. Obtain approval from Owners Representative for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes at no additional cost.

6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.

a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure terminal outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.

2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.06 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outside-air dampers at minimum and return- and exhaust-air dampers at a position that simulates full-cooling load.

2. Measure total system airflow. Adjust to within indicated airflow.

3. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.

4. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.

5. Record the final fan performance data.

3.07 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer, model, and serial numbers.

2. Motor horsepower rating.

3. Motor rpm.

4. Efficiency rating.

5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.08 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.09 PROCEDURES FOR HEAT-TRANSFER COILS

A. Electric-Heating Coils: Measure the following data for each coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

B. Refrigerant Coils: Measure the following data for each coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.10 PROCEDURES FOR TEMPERATURE MEASUREMENTS

A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.

B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive 8-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.

C. Measure outside-air, wet- and dry-bulb temperatures.

3.11 TEMPERATURE-CONTROL VERIFICATION

A. Verify that controllers are calibrated and commissioned.

B. Check transmitter and controller locations and note conditions that would adversely affect control functions.

C. Record controller settings and note variances between set points and actual measurements.

D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).

E. Check free travel and proper operation of control devices such as damper operators.

F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow measurements. Note the speed of response to input changes.

G. Check the interaction of electrically operated switch transducers.

H. Check the interaction of interlock and lockout systems.

I. Check main control supply-air pressure and observe compressor and dryer operations.

J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or non-grounded power supply.

K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.12 TOLERANCES

A. Set HVAC system airflow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.

2. Air Outlets and Inlets: 0 to minus 10 percent.

3.13 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.

1. Include a list of instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to certified field report data, include the following:

1. Fan curves.

2. Manufacturers' test data.

3. Field test reports prepared by system and equipment installers.

4. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.

D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:

1. Title page.

2. Name and address of TAB firm.
3. Project name.
4. Project location.
5. Architect/Engineer's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB firm who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:
    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Notes to explain why certain final data in the body of reports varies from indicated values.
14. Test conditions for fan performance forms including the following:
    a. Settings for outside-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Fan drive settings including settings and percentage of maximum pitch diameter.
    e. Inlet vane settings for variable-air-volume systems.
    f. Settings for supply-air, static-pressure controller.
    g. Other system operating conditions that affect performance.

E. System Diagrams: Include schematic layouts of air distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outside, supply, return, and exhaust airflows.
2. Duct, outlet, and inlet sizes.
3. Balancing stations.
4. Position of balancing devices.

3.14 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION

23 07 13 DUCT INSULATION

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes semi-rigid and flexible duct, and plenum insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

1.03 SUBMITTALS

A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets with requirements indicated. Include dates of tests.

C. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the U.S. Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.

2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

1.06 COORDINATION

A. Coordinate clearance requirements with duct Installer for insulation application.

1.07 SCHEDULING

A. Schedule insulation application after testing duct systems. Insulation application may begin on segments of ducts that have satisfactory test results.

2.00 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Mineral-Fiber Insulation:

a. CertainTeed Manson.

b. Knauf FiberGlass GmbH.

c. Owens-Corning Fiberglas Corp.

d. Schuller International, Inc.

2. Flexible Elastomeric Thermal Insulation:

a. Armstrong World Industries, Inc.

b. Rubatex Corp.

2.02 INSULATION MATERIALS

A. Mineral-Fiber Board Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C612, Type IB, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film. (ASTM C612, Type III for operating temperatures higher than 850 F (454 C)).

B. Mineral-Fiber Blanket Thermal Insulation: 0.75 lb./ft^3, glass fibers bonded with a thermosetting resin. Comply with ASTM C553, Type II, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film. (ASTM C553, Type V for operating temperatures higher than 850 F (454 C)).

2.03 FIELD-APPLIED JACKETS

A. General: ASTM C921, Type 1, unless otherwise indicated.

B. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.

C. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils (0.5 mm) thick; roll stock ready for shop or field cutting and forming.

1. Adhesive: As recommended by insulation material manufacturer.

2. PVC Jacket Color: White.

D. Aluminum Jacket: Deep corrugated sheets manufactured from aluminum alloy complying with ASTM B209 (ASTM B209M), and having an integrally bonded moisture barrier over entire surface in contact with insulation. Metal thickness and corrugation dimensions are scheduled at the end of this Section.

1. Finish: Smooth finish.

2. Moisture Barrier: 1-mil (0.025-mm) thick, heat-bonded polyethylene and kraft paper.

2.04 ACCESSORIES AND ATTACHMENTS

A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, pre-sized a minimum of 8 oz./sq. yd. (270 g/sq. m).

1. Tape Width: 4 inches (100 mm).

B. Bands: 3/4 inch (19 mm) wide, in one of the following materials compatible with jacket:

1. Stainless Steel: ASTM A66, Type 304; 0.020 inch (0.5 mm) thick.

2. Galvanized Steel: 0.005 inch (0.13 mm) thick.

3. Aluminum: 0.007 inch (0.18 mm) thick.

4. Brass: 0.010 inch (0.25 mm) thick.

5. Nickel-Copper Alloy: 0.005 inch (0.13 mm) thick.

C. Wire: 0.080-inch (2.0-mm), nickel-copper alloy; 0.062-inch (1.6-mm), soft-annealed, stainless steel; or 0.062-inch (1.6-mm), soft-annealed, galvanized steel.

D. Self-Adhesive Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated.

2.05 VAPOR RETARDERS

A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

3.00 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.03 GENERAL APPLICATION REQUIREMENTS

A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of ducts and fittings.

B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each duct system.

C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Apply multiple layers of insulation with longitudinal and end seams staggered.

E. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.

F. Keep insulation materials dry during application and finishing.

G. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

H. Apply insulation with the least number of joints practical.

I. Apply insulation over fittings and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

J. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic. Apply insulation continuously through hangers and around anchor attachments.

K. Insulation Terminations: For insulation application where vapor retarders are indicated, seal ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

L. Apply insulation with integral jackets as follows:

1. Pull jacket tight and smooth.

2. Joints and Seams: Cover with tape and vapor retarder as recommended by insulation material manufacturer to maintain vapor seal.

3. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to duct flanges and fittings.

M. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.

N. Install vapor-retarder mastic on ducts and plenums scheduled to receive vapor retarders.

1. Ducts with Vapor Retarders: Overlap insulation facing at seams and seal with vapor-retarder mastic and pressure-sensitive tape having same facing as insulation. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-retarder seal.

2. Ducts without Vapor Retarders: Overlap insulation facing at seams and secure with outward clinching staples and pressure-sensitive tape having same facing as insulation.

O. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.

P. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire/smoke damper sleeves for fire-rated wall and partition penetrations.

Q. Floor Penetrations: Terminate insulation at underside of floor assembly and at floor support at top of floor.

1. For insulation indicated to have vapor retarders, taper termination and seal insulation ends with vapor-retarder mastic.

3.04 MINERAL-FIBER INSULATION APPLICATION

A. Blanket Applications for Ducts and Plenums: Secure blanket insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of duct and plenum surfaces.

2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

3. Install anchor pins and speed washers on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

a. On duct sides with dimensions 18 inches (450 mm) and smaller, along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.

b. On duct sides with dimensions larger than 18 inches (450 mm). Space 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.

c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.

d. Do not over-compress insulation during installation.

4. Impale insulation over anchors and attach speed washers.

5. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

6. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch (13-mm) staples, 1 inch (25 mm) o.c., and cover with pressure-sensitive tape having same facing as insulation.

7. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. Secure with steel band at end joints and spaced a maximum of 18 inches (450 mm) o.c.

8. Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Apply insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
9. Insulate duct stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6-inch (150-mm) wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches (150 mm) o.c.
10. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

B. Board Applications for Ducts and Plenums: Secure board insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Space anchor pins as follows:
    a. On duct sides with dimensions 18 inches (450 mm) and smaller, along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
    b. On duct sides with dimensions larger than 18 inches (450 mm). Space 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.
    c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not over-compress insulation during installation.
4. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
5. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch (13-mm) staples, 1 inch (25 mm) o.c., and cover with pressure-sensitive tape having same facing as insulation.
6. Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Apply insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6-inch (150-mm) wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches (150 mm) o.c.

8. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

3.05 FIELD-APPLIED JACKET APPLICATION

A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.

1. Apply jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.

2. Embed glass cloth between two 0.062-inch (1.6-mm) thick coats of jacket manufacturer's recommended adhesive.

3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.

3.06 FINISHES

A. Glass-Cloth Jacketed Insulation: Paint insulation finished with glass-cloth jacket as specified in Division 09.

B. Color: Final color as selected by Architect/Engineer. Vary first and second coats to allow visual inspection of the completed Work.

3.07 DUCT SYSTEM APPLICATIONS

A. Insulation materials and thicknesses are specified in schedules at the end of this Section.

B. Materials and thicknesses for systems listed below are specified in schedules at the end of this Section.

C. Insulate the following plenums and duct systems:

1. Indoor concealed supply-, return-, and outside-air ductwork.

2. Indoor exposed supply-, return-, and outside-air ductwork.

3. Outdoor exposed supply and return ductwork.

D. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:

1. Factory-insulated flexible ducts.

2. Factory-insulated plenums, casings, and filter boxes and sections.

3. Flexible connectors.

4. Vibration-control devices.

5. Testing agency labels and stamps.

6. Nameplates and data plates.

7. Access panels and doors in air-distribution systems.

3.08 INDOOR DUCT AND PLENUM APPLICATION SCHEDULE

A. Service: Round and Rectangular, supply-, return-, and outside- air ducts, concealed.
   1. Material: Mineral-fiber blanket.
   2. Thickness: 2 inches (50 mm).
   3. Number of Layers: One.
   4. Field-Applied Jacket: None.
   5. Vapor Retarder Required: Yes.

B. Service: Double-wall round and rectangular, supply-air ducts, exposed.
   1. Material: Mineral-fiber board.
   2. Thickness: 1-1/2 inch (38 mm).
   3. Number of Layers: One.
   4. Field-Applied Jacket: None.
   5. Vapor Retarder Required: Yes.

3.09 OUTDOOR DUCT APPLICATION SCHEDULE

A. Service: Double-wall round, supply- and return-air ducts.
   1. Material: Mineral-fiber board.
   2. Thickness: 1-1/2 inches (38 mm).
   3. Number of Layers: One.
   4. Field-Applied Jacket: None.
   5. Vapor Retarder Required: Yes.

END OF SECTION

23 07 19 HVAC PIPING INSULATION

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes preformed, rigid and flexible pipe insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

1.03 SUBMITTALS

A. Product Data: Identify thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets with requirements indicated. Include dates of tests.

C. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the U.S. Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.

2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

1.06 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Section 23 05 29 “Hangers and Supports for HVAC Piping and Equipment.”

B. Coordinate clearance requirements with piping Installer for insulation application.

C. Coordinate installation and testing of heat tracing.

1.07 SCHEDULING

A. Schedule insulation application after testing piping systems and, where required, after installing and testing heat-trace tape. Insulation application may begin on segments of piping that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

2.00 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flexible Elastomeric Thermal Insulation:

a. Armstrong World Industries, Inc.

b. Rubatex Corp.

2.02 INSULATION MATERIALS

A. General: Insulation materials shall have a thermal conductivity, k, not exceeding 0.27 BTU per inch/h · ft^2 · degrees F.

B. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534, Type I for tubular materials and Type II for sheet materials.

1. Adhesive: As recommended by insulation material manufacturer.

2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.

2.03 FIELD-APPLIED JACKETS

A. General: ASTM C921, Type 1, unless otherwise indicated.

B. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.

C. Aluminum Jacket: Factory cut and rolled to indicated sizes. Comply with ASTM B209 (ASTM B209M), 3003 alloy, H-14 temper.

1. Finish and Thickness: Stucco-embossed finish, 0.016 inch (0.40 mm) thick.

2. Moisture Barrier: 1-mil (0.025-mm) thick, heat-bonded polyethylene and kraft paper.

3. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish, and thickness as jacket.

2.04 ACCESSORIES AND ATTACHMENTS

A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, pre-sized a minimum of 8 oz./sq. yd. (270 g/sq. m).

1. Tape Width: 4 inches (100 mm).

B. Bands: 3/4 inch (19 mm) wide, in one of the following materials compatible with jacket:

1. Galvanized Steel: 0.005 inch (0.13 mm) thick.

C. Wire: 0.062-inch (1.6-mm), soft-annealed, galvanized steel.

2.05 VAPOR RETARDERS

A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates. Comply with MIL-PRF-19565C, Type II.

3.00 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

3.03 GENERAL APPLICATION REQUIREMENTS

A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.

C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.

E. Apply multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.

H. Keep insulation materials dry during application and finishing.

I. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

J. Apply insulation with the least number of joints practical.

K. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.

L. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.

1. Apply insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches (300 mm) from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.

M. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

N. Apply adhesives and mastics at the manufacturer's recommended coverage rate.

O. Apply insulation with integral jackets as follows:

1. Pull jacket tight and smooth.

2. Circumferential Joints: Cover with 3-inch (75-mm) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches (100 mm) o.c.

3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches (40 mm). Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches (100 mm) o.c.

a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.

4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.

5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.

P. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.

Q. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.

R. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.

1. Firestopping and fire-resistive joint sealers are specified in Division 07.

3.04 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Follow manufacturer's written instructions for applying insulation.

2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

B. Apply insulation to fittings and elbows as follows:

1. Apply mitered sections of pipe insulation.

2. Secure insulation materials and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

C. Apply insulation to valves and specialties as follows:

1. Apply preformed valve covers manufactured of the same material as pipe insulation and attached according to the manufacturer's written instructions.

2. Apply cut segments of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, fabricate removable sections of insulation arranged to allow access to strainer basket.

3. Apply insulation to flanges as specified for flange insulation application.

4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

3.05 FIELD-APPLIED JACKET APPLICATION

A. Foil and Paper Jackets: Apply foil and paper jackets where indicated.

1. Draw jacket material smooth and tight.

2. Apply lap or joint strips with the same material as jacket.

3. Secure jacket to insulation with manufacturer's recommended adhesive.

4. Apply jackets with 1-1/2-inch (40-mm) laps at longitudinal seams and 3-inch (75-mm) wide joint strips at end joints.

5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-retarder mastic.

B. Apply metal jacket where indicated, with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with

weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.06 FINISHES

A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of the insulation manufacturer's recommended protective coating.

B. Color: Final color as selected by Architect/Engineer. Vary first and second coats to allow visual inspection of the completed Work.

3.07 PIPING SYSTEM APPLICATIONS

A. Insulation materials and thicknesses are specified in schedules at the end of this Section.

B. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:

1. Flexible connectors.

2. Vibration-control devices.

3. Air chambers, unions, strainers, check valves, plug valves, and flow regulators.

3.08 FIELD QUALITY CONTROL

A. Inspection: Perform the following field quality-control inspections, after installing insulation materials, jackets, and finishes, to determine compliance with requirements:

1. Inspect fittings and valves randomly selected by Architect/Engineer.

2. Remove fitting covers from 20 elbows or 1 percent of elbows, whichever is less, for various pipe sizes.

3. Remove fitting covers from 20 valves or 1 percent of valves, whichever is less, for various pipe sizes.

B. Insulation applications will be considered defective if sample inspection reveals noncompliance with requirements. Remove defective Work and replace with new materials according to these Specifications.

C. Reinstall insulation and covers on fittings and valves uncovered for inspection according to these Specifications.

3.09 INSULATION APPLICATION SCHEDULE, GENERAL

A. Refer to insulation application schedules for required insulation materials, vapor retarders, and field-applied jackets.

B. Application schedules identify piping system and indicate pipe size ranges and material, thickness, and jacket requirements.

3.10 INTERIOR INSULATION APPLICATION SCHEDULE

A. Service: A/C condensate drain piping.

1. Insulation Material: Flexible elastomeric.

2. Insulation Thickness: 1/2-inch (13-mm) thickness for all pipe sizes.
3. Field-Applied Jacket: None.
4. Vapor Retarder Required: Yes.

B. Service: Refrigerant piping.
1. Insulation Material: Flexible elastomeric.
2. Insulation Thickness:
a. Liquid Pipe:
1). Pipe size less than 1.5 inches: 1 inch insulation thickness
2). Pipe size greater than 1.5 inches: 1.5 inches insulation thickness
b. Suction Pipe:
1). Pipe size less than 1.5 inches: 1.5 inches insulation thickness
2). Pipe size greater than 1.5 inches: 2 inches insulation thickness
3. Field-Applied Jacket: None.
4. Vapor Retarder Required: Yes.

3.11 EXTERIOR INSULATION APPLICATION SCHEDULE

A. This application schedule is for aboveground insulation outside the building. Piping below ground requiring insulation will be provided as part of a pre-insulated double wall piping system specified elsewhere.

B. Service: Refrigerant piping.
1. Insulation Material: Flexible elastomeric.
2. Insulation Thickness:
a. Liquid Pipe:
1). Pipe size less than 1.5 inches: 1 inch insulation thickness
2). Pipe size greater than 1.5 inches: 1.5 inches insulation thickness
b. Suction Pipe:
1). Pipe size less than 1.5 inches: 1.5 inches insulation thickness
2). Pipe size greater than 1.5 inches: 2 inches insulation thickness
3. Field-Applied Jacket: Aluminum.
4. Vapor Retarder Required: Yes.

END OF SECTION

23 23 00 REFRIGERANT PIPING

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes refrigerant piping used for air-conditioning applications.

1.03 SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for thermostatic expansion valves.

B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall penetrations, and equipment connection details. Show interface and spatial relationship between piping and equipment.

1. Refrigerant piping indicated is schematic only. Size piping and design the actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes, to ensure proper operation and compliance with warranties of connected equipment.

C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

D. Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals specified in Division 01.

1.04 QUALITY ASSURANCE

A. ASHRAE Standard: Comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."

B. ASME Standard: Comply with ASME B31.5, "Refrigeration Piping."

C. UL Standard: Provide products complying with UL 207, "Refrigerant-Containing Components and Accessories, Nonelectrical"; or UL 429, "Electrically Operated Valves."

1.05 COORDINATION

A. Coordinate layout and installation of refrigerant piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

B. Coordinate pipe sleeve installations for foundation wall penetrations.

C. Coordinate pipe sleeve installations for penetrations in exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 07 for materials and methods for sealing pipe penetrations through fire and smoke barriers.

D. Coordinate pipe fitting pressure classes with products specified in related Sections.

1.06 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Refrigeration Oil Test Kits: Two each, containing everything required to conduct one test.

2. Refrigerant: Two containers each, with 20 lb. (9 kg) of refrigerant.

3. Filter-Dryer Cartridges: Three of each type.

2.00 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Refrigerants:

a. Allied Signal, Inc./Fluorine Products; Genetron Refrigerants.

b. DuPont Company; Fluorochemicals Div.

c. Elf Atochem North America, Inc.; Fluorocarbon Div.

d. ICI Americas Inc./ICI KLEA; Fluorochemicals Bus.

2. Refrigerant Valves and Specialties:

a. Climate & Industrial Controls Group; Parker-Hannifin Corp.; Refrigeration & Air Conditioning Division.

b. Danfoss Electronics, Inc.

c. Emerson Electric Company; Alco Controls Div.

d. Henry Valve Company.

e. Sporlan Valve Company.

2.02 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tube: ASTM B280, Type ACR.

B. Annealed-Temper Copper Tube: Type K (ASTM B88M, Type A).

C. Wrought-Copper Fittings: ASME B16.22.

D. Wrought-Copper Unions: ASME B16.22.

E. Bronze Filler Metals: AWS A5.8, Classification BAg-1 (silver).

2.03 VALVES

A. Diaphragm Packless Valves: 500-psig (3450-kPa) working pressure and 275 F (135 C) working temperature; globe design with straight-through or angle pattern; forged-brass or

bronze body and bonnet, phosphor bronze and stainless-steel diaphragms, rising stem and handwheel, stainless-steel spring, nylon seat disc, and with solder-end connections.

B. Packed-Angle Valves: 500-psig (3450-kPa) working pressure and 275 F (135 C) working temperature; forged-brass or bronze body, forged-brass seal caps with copper gasket, back seating, rising stem and seat, molded stem packing, and with solder-end connections.

C. Service Valves: 500-psig (3450-kPa) pressure rating; forged-brass body with copper stubs, brass caps, removable valve core, integral ball check valve, and with solder-end connections.

D. Pressure Relief Valves: Straight-through or angle pattern, brass body and disc, neoprene seat, and factory sealed and ASME labeled for standard pressure setting.

E. Thermostatic Expansion Valves: Comply with ARI 750; brass body with stainless-steel parts; thermostatic-adjustable, modulating type; size and operating characteristics as recommended by manufacturer of evaporator, and factory set for superheat requirements; solder-end connections; with sensing bulb, distributor having side connection for hot-gas bypass line, and external equalizer line.

2.04 REFRIGERANT PIPING SPECIALITIES

A. Straight- or Angle-Type Strainers: 500-psig (3450-kPa) working pressure; forged-brass or steel body with stainless-steel wire or brass-reinforced Monel screen of 80 to 100 mesh in liquid lines up to 1-1/8 inches (30 mm), 60 mesh in larger liquid lines, and 40 mesh in suction lines; with screwed cleanout plug and solder-end connections.

B. Moisture/Liquid Indicators: 500-psig (3450-kPa) maximum working pressure and 200 F (93 C) operating temperature; all-brass body with replaceable, polished, optical viewing window with color-coded moisture indicator; with solder-end connections.

C. Permanent Filter-Dryer: 350-psig (2410-kPa) maximum operating pressure and 225 F (107 C) maximum operating temperature; steel shell and wrought-copper fittings for solder-end connections; molded-felt core surrounded by desiccant.

2.05 REFRIGERANTS

A. ASHRAE 34, R-410A.

3.00 EXECUTION

3.01 PIPING APPLICATIONS

A. Aboveground, within Building: Type ACR drawn-copper tubing.

3.02 VALVE APPLICATIONS

A. Install diaphragm packless or packed-angle valves in suction and discharge lines of compressor.

B. Install packed-angle valve in liquid line between receiver shutoff valve and thermostatic expansion valve for system charging.

C. Install diaphragm packless or packed-angle valves on each side of strainers and dryers, in liquid and suction lines at evaporators, and elsewhere as indicated.

D. Install a full-sized, three-valve bypass around each dryer.

E. Install thermostatic expansion valves as close as possible to evaporator.

1. If refrigerant distributors are used, install them directly on expansion-valve outlet.

2. Install valve so diaphragm case is warmer than bulb.

3. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line. Verify proper location for bulb with valve manufacturer.

4. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

F. Install pressure relief valves as required by ASHRAE 15. Pipe pressure relief valve discharge to outside.

3.03 SPECIALTY APPLICATIONS

A. Install liquid indicators in liquid line leaving condenser.

B. Install strainers immediately upstream from each automatic valve, including expansion valves.

C. Install moisture-liquid indicators in liquid lines between filter-dryers and thermostatic expansion valves and in liquid line to receiver.

D. Install pressure relief valves on ASME receivers; pipe discharge to outdoors.

E. Install permanent filter-dryers in low-temperature systems, in systems using hermetic compressors.

F. Install flexible connectors at or near compressors where piping configuration does not absorb vibration.

3.04 PIPING INSTALLATION

A. Install refrigerant piping according to ASHRAE 15.

B. Basic piping installation requirements are specified in Division 23 Section “Basic Mechanical Materials and Methods.”

C. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

D. Arrange piping to allow inspection and service of compressor and other equipment. Install valves and specialties in accessible locations to allow for service and inspection.

E. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation. Use sleeves through walls, or ceilings, sized to permit installation of full-thickness insulation.

F. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.

G. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

H. Install unions to allow removal expansion valves and at connections to compressors and evaporators.

I. When brazing, remove sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion valve bulb.

J. Hanger, support, and anchor products are specified in Section 23 05 29 “Hangers and Supports for HVAC Piping and Equipment.”

K. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet (6.0 m) long.

L. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 1/2 (DN 15): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).
2. NPS 5/8 (DN 18): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).
3. NPS 1 (DN 25): Maximum span, 72 inches (1800 mm); minimum rod size, 1/4 inch (6.4 mm).
4. NPS 1-1/4 (DN 32): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
5. NPS 1-1/2 (DN 40): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).

3.05 PIPE JOINT CONSTRUCTION

A. Braze joints according to Division 23 Section “Basic Mechanical Materials and Methods.”

B. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide) during brazing to prevent scale formation.

3.06 FIELD QUALITY CONTROL

A. Test and inspect refrigerant piping according to ASME B31.5, Chapter VI.

1. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure.

2. Test high- and low-pressure side piping of each system at not less than the lower of the design pressure or the setting of pressure relief device protecting high and low side of system.
    a. System shall maintain test pressure at the manifold gage throughout duration of test.
    b. Test joints and fittings by brushing a small amount of soap and glycerine solution over joint.
    c. Fill system with nitrogen to raise a test pressure of 150 psig (1035 kPa) or higher as required by authorities having jurisdiction.
    d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.07 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat requirements.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of the conditioned air or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
    1. Check compressor oil level above center of sight glass.
    2. Open refrigerant valves, except bypass valves that are used for other purposes.
    3. Check compressor-motor alignment, and lubricate motors and bearings.

3.08 CLEANING

A. Before installing copper tubing other than Type ACR, clean tubing and fittings with trichloroethylene.

3.09 SYSTEM CHARGING

A. Charge system using the following procedures:
    1. Evacuate entire refrigerant system with a vacuum pump to a vacuum of 500 micrometers (67 Pa). If vacuum holds for 12 hours, system is ready for charging.
    2. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig (14 kPa).

END OF SECTION

23 31 13 METAL DUCTS

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes metal ducts for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 2- to plus 10-inch wg (minus 500- to plus 2500-Pa). Metal ducts include the following:

1. Rectangular ducts and fittings.
2. Single-wall, round spiral-seam ducts and formed fittings.
3. Double-wall, round spiral-seam and formed fittings and double-wall rectangular ducts.

1.03 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, “Structural Welding Code--Steel,” for hangers and supports, AWS D1.2, “Structural Welding Code--Aluminum,” for aluminum supporting members and AWS D9.1, “Sheet Metal Welding Code,” for duct joint and seam welding.

B. NFPA Compliance:

1. NFPA 90A, “Installation of Air Conditioning and Ventilating Systems.”

2.00 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 SHEET METAL MATERIALS

A. Comply with SMACNA’s “HVAC Duct Construction Standards--Metal and Flexible” for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A653/A653M and having G90 (Z275) coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.

D. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.03 SEALANT MATERIALS

A. Joint and Seam Sealants, General: The term “sealant” is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.

B. Joint and Seam Tape: 2 inches (50 mm) wide; glass-fiber-reinforced fabric.

C. Tape Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.

D. Solvent-Based Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant formulated with a minimum of 75 percent solids.

E. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use O.

F. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

2.04 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.

2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.

B. Hanger Materials: Galvanized sheet steel or threaded steel rod.

1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

2. Strap and Rod Sizes: Comply with SMACNA’s “HVAC Duct Construction Standards--Metal and Flexible” for steel sheet width and thickness and for steel rod diameters.

3. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

D. Trapeze and Riser Supports: Steel shapes complying with ASTM A36/A36M.

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

2.05 RECTANGULAR DUCT FABRICATION

A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA’s “HVAC Duct Construction Standards--Metal and Flexible” and

complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.

1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.

1. Manufacturers:
   a. Ductmate Industries, Inc.
   b. Nexus Inc.
   c. Ward Industries, Inc.

C. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.

1. Manufacturers:
   a. Ductmate Industries, Inc.
   b. Lockformer.
2. Duct Size: Maximum 30 inches (750 mm) wide and up to 2-inch wg (500-Pa) pressure class.
3. Longitudinal Seams: Pittsburgh lock sealed with non-curing polymer sealant.

D. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches (480 mm) and larger and 0.0359 inch (0.9 mm) thick or less, with more than 10 sq. ft. (0.93 sq. m) of non-braced panel area unless ducts are lined.

3.00 EXECUTION

3.01 DUCT APPLICATIONS

A. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following:

1. Supply Ducts: 2-inch wg (500-Pa).
2. Return and Outside-air Ducts (Negative Pressure): 1-inch wg (250-Pa).
3. Exhaust Ducts (Negative Pressure): 2-inch wg (500-Pa).

B. Duct Application Schedule

1. Indoor, concealed: Single-wall, round spiral-seam ducts and formed fittings.
2. Indoor, exposed and Outdoor: Double-wall, round spiral-seam and formed fittings and double-wall rectangular ducts.

3.02 DUCT INSTALLATION

A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.

B. Install round and flat-oval ducts in lengths not less than 12 feet (3.7 m) unless interrupted by fittings.

C. Install ducts with fewest possible joints.

D. Install fabricated fittings for changes in directions, size, and shape and for connections.

E. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches (300 mm), with a minimum of three screws in each coupling.

F. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.

I. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.

J. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.

K. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.

L. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on four sides by at least 1-1/2 inches (38 mm).

N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant. Fire and smoke dampers are specified in Section 23 33 00 "Air Duct Accessories." Firestopping materials and installation methods are specified in Division 07 Section.

O. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's "Duct Cleanliness for New Construction."

P. Paint interiors of metal ducts, that do not have duct liner, for 24 inches (600 mm) upstream of registers and grilles. Apply one coat of flat, black, latex finish coat over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.03 SEAM AND JOINT SEALING

A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated.

B. Pressure Classification Less Than 2-Inch wg (500 Pa): Transverse joints.

C. Seal ducts before external insulation is applied.

3.04 HANGING AND SUPPORTING

A. Support horizontal ducts within 24 inches (600 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.

B. Support vertical ducts at maximum intervals of 16 feet (5 m) and at each floor.

C. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

D. Install concrete inserts before placing concrete.

E. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

1. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.

3.05 CONNECTIONS

A. Make connections to equipment with flexible connectors according to Section 23 33 00 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.06 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:

1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.

2. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give 7 days' advance notice for testing.

3. Maximum Allowable Leakage: Comply with requirements for Leakage Class 3 for round and flat-oval ducts, Leakage Class 12 for rectangular ducts in pressure classes lower than and equal to 2-inch wg (500-Pa) (both positive and negative pressures), and Leakage Class 6 for pressure classes from 2- to 10-inch wg (500- to 2500-Pa).

4. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.

3.07 CLEANING NEW SYSTEMS

A. Mark position of dampers and air-directional mechanical devices before cleaning, and perform cleaning before air balancing.

B. Use service openings, as required, for physical and mechanical entry and for inspection.

1. Create other openings to comply with duct standards.

2. Disconnect flexible ducts as needed for cleaning and inspection.

3. Remove and reinstall ceiling sections to gain access during the cleaning process.

C. Vent vacuuming system to the outside. Include filtration to contain debris removed from HVAC systems, and locate exhaust down wind and away from air intakes and other points of entry into building.

D. Clean the following metal duct systems by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).

2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.

3. Air-handling unit internal surfaces and components including mixing box, coil section, condensate drain pans, filters and filter sections, and condensate collectors and drains.

4. Coils and related components.

5. Return-air ducts, dampers, and actuators except in ceiling plenums and mechanical equipment rooms.

6. Supply-air ducts, dampers, actuators, and turning vanes.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.

2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.

3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.

4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet.

5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

F. Cleanliness Verification:

1. Visually inspect metal ducts for contaminants.
2. Where contaminants are discovered, re-clean and reinspect ducts.

END OF SECTION

23 33 00 AIR DUCT ACCESSORIES

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Backdraft dampers.
2. Manual-volume dampers.
3. Fire and smoke dampers.
4. Turning vanes.
5. Duct-mounted access doors and panels.
6. Flexible ducts.
7. Flexible connectors.
8. Duct accessory hardware.
9. Explosion-proof damper actuator housing.
10. Insect screens.

1.03 SUBMITTALS

A. Product Data: For the following:

1. Backdraft dampers.
2. Manual-volume dampers.
3. Fire and smoke dampers.
4. Duct-mounted access doors and panels.
5. Flexible ducts.

B. Product Certificates: Submit certified test data on dynamic insertion loss; self-noise power levels; and airflow performance data, static-pressure loss, dimensions, and weights.

1.04 QUALITY ASSURANCE

A. NFPA Compliance: Comply with the following NFPA standards:

1. NFPA 90A, “Installation of Air Conditioning and Ventilating Systems.”
2. NFPA 90B, “Installation of Warm Air Heating and Air Conditioning Systems.”

1.05 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

2.00 PRODUCTS

2.01 SHEET METAL MATERIALS

A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A653/A653M, G90 (Z275) coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.

B. Carbon-Steel Sheets: ASTM A366/A366M, cold-rolled sheets, commercial quality, with oiled, exposed matte finish.

C. Aluminum Sheets: ASTM B209 (ASTM B209M), Alloy 3003, Temper H14, sheet form; with standard, one-side bright finish for ducts exposed to view and mill finish for concealed ducts.

D. Extruded Aluminum: ASTM B221 (ASTM B221M), Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for 36-inch (900-mm) length or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.02 BACKDRAFT DAMPERS

A. Description: Suitable for horizontal or vertical installations.

B. Frame: 0.052-inch (1.3-mm) thick, galvanized, sheet steel, with welded corners and mounting flange.

C. Frame: 0.090-inch (2.3-mm) thick extruded aluminum, with mounting flange.

D. Blades: 0.050-inch (1.2-mm) thick extended aluminum sheet.

E. Blade Seals: Vinyl.

F. Blade Axles: Nonferrous (for aluminum dampers).

G. Blade Axles: Galvanized steel (for steel dampers).

H. Tie Bars and Brackets: Aluminum (for aluminum dampers).

I. Tie Bars and Brackets: Galvanized steel (for steel dampers).

J. Return Spring: Adjustable tension.

2.03 MANUAL-VOLUME DAMPERS

A. General: Factory fabricated with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without

vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.

1. Pressure Classifications of 3-inch wg (750 Pa) or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.

B. Low-Leakage Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, low-leakage rating, and suitable for horizontal or vertical applications.

1. Steel Frames: Hat-shaped, galvanized, sheet steel channels, minimum of 0.064 inch (1.62 mm) thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.

2. Roll-Formed Steel Blades: 0.064-inch (1.62-mm) thick, galvanized, sheet steel.

3. Roll-Formed Aluminum Blades: 0.10-inch (2.5-mm) thick aluminum sheet.

4. Blade Seals: Vinyl.

5. Blade Axles: Nonferrous (for aluminum dampers).

6. Blade Axles: Galvanized steel (for steel dampers).

7. Tie Bars and Brackets: Aluminum (for aluminum dampers).

8. Tie Bars and Brackets: Galvanized steel (for steel dampers).

C. Jackshaft: 1-inch (25-mm) diameter, galvanized steel pipe rotating within a pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

1. Length and Number of Mountings: Appropriate to connect linkage of each damper of a multiple-damper assembly.

D. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch (2.4-mm) thick zinc-plated steel, and a 3/4-inch (19-mm) hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.04 FIRE DAMPERS

A. General: Labeled to UL 555.

B. Fire Rating:

1. One and one-half hours for 2-hour walls.

2. Three hours for 4-hour walls.

C. Frame: SMACNA Type A with blades in airstream; fabricated with roll-formed, 0.034-inch (0.85-mm) thick galvanized steel; with mitered and interlocking corners.

D. Frame: SMACNA Type B with blades out of airstream; fabricated with roll-formed, 0.034-inch (0.85-mm) thick galvanized steel; with mitered and interlocking corners.

E. Mounting Sleeve: Factory- or field-installed galvanized, sheet steel.

1. Minimum Thickness: 0.052 inch (1.3 mm) or 0.138 inch (3.5 mm) thick as indicated, and length to suit application.

2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.

F. Mounting Orientation: Vertical or horizontal as indicated.

G. Blades: Roll-formed, interlocking, 0.034-inch (0.85-mm) thick, galvanized, sheet steel. In place of interlocking blades, use full-length, 0.034-inch (0.85-mm) thick, galvanized steel blade connectors.

H. Horizontal Dampers: Include a blade lock and stainless-steel negator closure spring.

I. Fusible Link: Replaceable, 165 or 212 F (74 or 100 C) rated as indicated.

2.05 SMOKE DAMPERS

A. General: Labeled to UL 555S. Combination fire and smoke dampers shall be labeled for 1-1/2 -hour rating to UL 555.

B. Fusible Link: Replaceable, 165 or 212 F (74 or 100 C) rated as indicated.

C. Frame and Blades: 0.064-inch (1.62-mm) thick, galvanized, sheet steel.

D. Mounting Sleeve: Factory-installed, 0.052-inch (1.3-mm) thick, galvanized, sheet steel; length to suit wall or floor application.

E. Damper Motors: Provide for modulating or two-position action.

1. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.

2. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).

3. Outdoor Motors and Motors in Outside-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 F (minus 40 C).

4. Non-spring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).

5. Two-Position Motor: 115 V, 1 phase, 60 Hz.

2.06 TURNING VANES

A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Manufactured Turning Vanes: Fabricate of 1-1/2-inch (38-mm) wide, curved blades set 3/4 inch (19 mm) o.c.; support with bars perpendicular to blades set 2 inches (50 mm) o.c.; and set into side strips suitable for mounting in ducts.

C. Acoustic Turning Vanes: Fabricate of airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

2.07 DUCT-MOUNTED ACCESS DOORS AND PANELS

A. General: Fabricate doors and panels airtight and suitable for duct pressure class.

B. Frame: Galvanized, sheet steel, with bend-over tabs and foam gaskets.

C. Door: Double-wall, galvanized, sheet metal construction with insulation fill and thickness, and number of hinges and locks as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.

D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

E. Insulation: 1-inch (25-mm) thick, fibrous-glass or polystyrene-foam board.

2.08 FLEXIBLE CONNECTORS

A. General: Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

B. Standard Metal-Edged Connectors: Factory fabricated with a strip of fabric 3-1/2 inches (89 mm) wide attached to two strips of 2-3/4-inch (70-mm) wide, 0.028-inch (0.7-mm) thick, galvanized, sheet steel or 0.032-inch (0.8-mm) aluminum sheets. Select metal compatible with connected ducts.

C. Transverse Metal-Edged Connectors: Factory fabricated with a strip of fabric 3-1/2 inches (89 mm) wide attached to two strips of 4-3/8-inch (111-mm) wide, 0.028-inch (0.7-mm) thick, galvanized, sheet steel or 0.032-inch (0.8-mm) aluminum sheets. Select metal compatible with connected ducts.

D. Conventional, Indoor System (minus 10 to plus 250 F) Flexible Connector Fabric: Glass fabric double coated with polychloroprene.

1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).

2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp, and 360 lbf/inch (63 N/mm) in the filling.

E. Conventional, Outdoor System (minus 10 to plus 250 F) Flexible Connector Fabric: Glass fabric double coated with a synthetic-rubber, weatherproof coating resistant to the sun's ultraviolet rays and ozone environment.

1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).

2. Tensile Strength: 530 lbf/inch (93 N/mm) in the warp, and 440 lbf/inch (77 N/mm) in the filling.

2.09 FLEXIBLE DUCTS

A. General: Comply with UL 181, Class 1.

B. Flexible Ducts, Uninsulated: Spiral-wound steel spring with flameproof vinyl sheathing.

C. Flexible Ducts, Uninsulated: Corrugated aluminum.

D. Flexible Ducts, Insulated: Factory-fabricated, insulated, round duct, with an outer jacket enclosing 1-1/2-inch (38-mm) thick, glass-fiber insulation around a continuous inner liner.

1. Reinforcement: Steel-wire helix encapsulated in inner liner.

2. Outer Jacket: Glass-reinforced, silver Mylar with a continuous hanging tab, integral fibrous-glass tape, and nylon hanging cord.

3. Inner Liner: Polyethylene film.

E. Pressure Rating: 6-inch wg (1500-Pa) positive, 1/2-inch wg (125-Pa) negative.

2.10 EXPLOSION-PROOF DAMPER HOUSING

A. Cast aluminum housing (copper-free) with 3/4" conduit knockout. UL and CSA; Class 1, Division 1&2, Groups B, C, D, NEMA 7, Class 2, Division 1&2, Groups E, F, and G, NEMA 9.

2.11 INSECT SCREENS

A. Removable, galvanized steel mesh, Smith Perm-A-Steel Filter in galvanized steel holding frame with foam gasket, Smith model NS-100.

2.12 ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments, and length to suit duct insulation thickness.

B. Splitter Damper Accessories: Zinc-plated damper blade bracket; 1/4-inch (6-mm), zinc-plated operating rod; and a duct-mounted, ball-joint bracket with flat rubber gasket and square-head set screw.

C. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 to 18 inches (75 to 450 mm) to suit duct size.

D. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

3.00 EXECUTION

3.01 INSTALLATION

A. Install duct accessories according to applicable details shown in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts.

B. Provide test holes at fan inlet and outlet and elsewhere as indicated.

C. Install fire and smoke dampers according to manufacturer's UL-approved written instructions.

1. Install fusible links in fire dampers.

D. Install duct access panels for access to both sides of duct coils. Install duct access panels downstream from volume dampers, fire dampers, turning vanes, and equipment.

1. Install duct access panels to allow access to interior of ducts for cleaning, inspecting, adjusting, and maintaining accessories and terminal units.

2. Install access panels on side of duct where adequate clearance is available.

E. Label access doors according to Section 23 05 53 “Identification for HVAC Piping and Equipment.”

3.02 ADJUSTING

A. Adjust duct accessories for proper settings.

B. Adjust fire and smoke dampers for proper action.

C. Final positioning of manual-volume dampers is specified in Section 23 05 93 “Testing, Adjusting, and Balancing for HVAC.”

END OF SECTION

23 34 23 HVAC POWER VENTILATORS

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. In-line centrifugal fans.
2. Propeller fans.

1.03 PERFORMANCE REQUIREMENTS

A. Operating Limits: Classify according to AMCA 99.

1.04 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material gages and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

1.05 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

D. UL Standard: Power ventilators shall comply with UL 705.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

1.07 COORDINATION

A. Coordinate size and location of structural-steel support members.

1.08 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Belts: One set for each belt-driven unit.

2.00 PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Greenheck Fan Corp.

b. Industrial Fans Direct

c. Aerovent; a Twin City Fan Company.

d. Cook, Loren Company.

e. JennFan; Div. of Breidert Air Products, Inc.

f. PennBarry.

2.02 IN-LINE CENTRIFUGAL FANS

A. Description: In-line, belt-driven centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.

B. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

C. Direct-Driven Units: Motor encased in housing outside of airstream, factory wired to disconnect switch located on outside of fan housing.

D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

E. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

F. Accessories:

1. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
2. Companion Flanges: For inlet and outlet duct connections.
3. Fan Guards: 1/2-by-1-inch (13-by-25-mm) mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
4. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

2.03 PROPELLER FANS

A. Description: Belt-driven or direct-driven propeller fans consisting of fan blades, hub, housing, orifice ring, motor, drive assembly, and accessories.

B. Housing: Galvanized steel sheet with flanged edges and integral orifice ring with baked-enamel finish coat applied after assembly. Aluminum housing for caustic chemical rooms.

C. Steel Fan Wheels: Formed-steel blades riveted to heavy-gage steel spider bolted to cast-iron hub.

D. Aluminum Fan Wheel for caustic chemical rooms: Replaceable, cast-aluminum, airfoil blades fastened to cast-aluminum hub; factory set pitch angle of blades.

E. Belt-Driven Drive Assembly: Resiliently mounted to housing, statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.

1. Service Factor Based on Fan Motor: 1.4.
2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
    a. Ball-Bearing Rating Life: ABMA 9, L_{10} of 100,000 hours.
4. Pulleys: Cast iron with split, tapered bushing; dynamically balanced at factory.
5. Motor Pulleys: Adjustable pitch for use with motors through 5 HP; fixed pitch for use with motors larger than 5 HP. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
6. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
7. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.

F. Accessories:

1. Motor-Side Back Guard: Galvanized steel, complying with OSHA specifications, removable for maintenance.
2. Wall Sleeve: Galvanized steel to match fan and accessory size. Aluminum construction for caustic chemical rooms.
3. Weather Hood: 45-degree galvanized steel to match fan and accessory size. Aluminum construction for caustic chemical rooms.
4. Variable-Speed Controller: Solid-state control to reduce speed from 100 percent to less than 50 percent.
5. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.

2.04 MOTORS

A. Refer to Division 23 Section “Motors” for general requirements for factory-installed motors.

B. Motor Construction: NEMA MG 1, general purpose, continuous duty, Design B.

C. Enclosure Type: Guarded drip-proof. Totally enclosed for caustic chemical rooms. Explosion-proof for flammable storage and flammable chemical rooms.

2.05 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, “Methods for Calculating Fan Sound Ratings from Laboratory Test Data.” Factory test fans according to AMCA 300, “Reverberant Room Method for Sound Testing of Fans.” Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, “Laboratory Methods of Testing Fans for Rating.”

3.00 EXECUTION

3.01 INSTALLATION

A. Install power ventilators level and plumb.

B. Install units with clearances for service and maintenance.

C. Label units according to requirements specified in Section 23 05 53 “Identification for HVAC Piping and Equipment.”

3.02 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 23 33 00 “Air Duct Accessories.”

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment.

D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.03 FIELD QUALITY CONTROL

A. Equipment Startup Checks:

1. Verify that shipping, blocking, and bracing are removed.

2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.

3. Verify that cleaning and adjusting are complete.

4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.

5. Verify lubrication for bearings and other moving parts.

6. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.

7. Disable automatic temperature-control operators.

B. Starting Procedures:

1. Energize motor and adjust fan to indicated rpm.

2. Measure and record motor voltage and amperage.

C. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.

D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Shut unit down and reconnect automatic temperature-control operators.

F. Refer to Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

G. Replace fan and motor pulleys as required to achieve design airflow.

H. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

3.04 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Lubricate bearings.

3.05 CLEANING

A. On completion of installation, internally clean fans according to manufacturer's written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.

B. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

END OF SECTION

23 37 13 DIFFUSERS, REGISTERS, AND GRILLES

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes duct-mounted diffusers, registers, and grilles.

1.03 DEFINITIONS

A. Diffuser: Circular, square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air.

B. Grille: A louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.

C. Register: A combination grille and damper assembly over an air opening.

1.04 SUBMITTALS

A. Product Data: For each model indicated, include the following:

1. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.

2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.

1.05 QUALITY ASSURANCE

A. Product Options: Drawings and schedules indicate specific requirements of diffusers, registers, and grilles and are based on the specific requirements of the systems indicated. Other manufacturers' products with equal performance characteristics may be considered. Refer to Division 01.

B. NFPA Compliance: Install diffusers, registers, and grilles according to NFPA 90A “Standard for the Installation of Air-Conditioning and Ventilating Systems.”

2.00 PRODUCTS

2.01 MANUFACTURED UNITS

A. Diffusers, registers, and grilles are scheduled on the Drawings.

2.02 SOURCE QUALITY CONTROL

A. Testing: Test performance according to ASHRAE 70 “Method of Testing for Rating the Performance of Air Outlets and Inlets.”

3.00 EXECUTION

3.01 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb, according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.

B. Duct-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable.

C. Install diffusers, registers, and grilles with airtight connection to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.03 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

3.04 CLEANING

A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION

23 74 09 ROOFTOP AIR CONDITIONERS

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following rooftop air conditioners:

1. Cooling-only units larger than 20 tons (70 kW).

1.03 DEFINITIONS

A. DDC: Direct-digital controls.

1.04 SUBMITTALS

A. Product Data: Include manufacturer's technical data for each model indicated, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection. Prepare the following by or under the supervision of a qualified professional engineer:

1. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.

2. Wiring Diagrams: Power, signal, and control wiring.

3. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

4. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field Quality-Control Test Reports.

D. Operation and Maintenance Data: Include emergency, operation, and maintenance manuals.

E. Warranties: Special warranties specified in this Section.

1.05 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of rooftop air conditioners and are based on the specific system indicated. Refer to Section 01 60 00 "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."

D. Energy-Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings" and International Energy Conservation Code, whichever is greater."

E. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings" and International Energy Conservation Code, whichever is greater."

F. ARI Certification: Units shall be ARI certified and listed.

G. ARI Compliance for Units with Capacities 135,000 BTUH (39.6 kW) and More: Rate rooftop air-conditioner capacity according to ARI 340/360, "Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment."

1. Sound Power Level Ratings: Comply with ARI 270, "Sound Rating of Outdoor Unitary Equipment."

1.06 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of reinforced concrete pad for equipment supports.

1.07 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of rooftop air conditioners that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Compressors: Manufacturer's standard, but not less than 5 years from date of Substantial Completion.

2. Warranty Period for Heat Exchangers: Manufacturer's standard, but not less than 10 years from date of Substantial Completion.

3. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

4. Warranty Period for Variable-Speed Fan Motors: Manufacturer's standard, but not less than 3 years from date of Substantial Completion.

5. Warranty Period for Electronic Thermostats: Manufacturer's standard, but not less than 3 years from date of Substantial Completion.

1.08 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fan Belts: two sets for each belt-drive fan.

2. Filters: two sets of filters for each unit.

2.00 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 ROOFTOP AIR CONDITIONERS LARGER THAN 20 TONS (70 KW)

A. Manufacturers:

1. Trane.

2. Carrier Corp.

3. Engineered Air.

4. York.

B. Description: Factory assembled and tested; designed for exterior installation; consisting of compressor, indoor and outside refrigerant coils, indoor fan and outside coil fan, refrigeration and temperature controls, filters, and dampers.

C. Casing: Manufacturer's standard double-wall galvanized sheet metal construction with exterior enamel paint finish, hinged access doors with neoprene gaskets for inspection and access to internal parts, minimum 1-inch (25-mm) thick thermal insulation, perforated-metal liner knockouts for electrical and piping connections, exterior condensate drain connection, and lifting lugs.

D. Return-Air Fan: Forward curved, centrifugal, belt driven with adjustable motor sheaves, grease-lubricated ball bearings, and motor. Mount fan and motor assembly on base with rubber in shear isolators.

E. Outside Coil Fan: Propeller type, directly driven by permanently lubricated motor.

F. Refrigerant Coils: Aluminum-plate fin and seamless copper tube in galvanized-steel casing with equalizing-type vertical distributor and thermal expansion valve; tested to 450 psig (3105 kPa) and leak tested to 300 psig (2070 kPa) with air under water. Insulate coil section. Provide phenolic epoxy corrosion-protection coating to both coils. Provide stainless-steel drain pan under indoor coil.

G. Compressor(s): Two hermetic reciprocating compressors with integral vibration isolators, internal overcurrent and overtemperature protection, internal pressure relief.

H. Refrigeration System:

1. Compressor(s).
2. Outside coil and fan.
3. Four-way reversing valve and suction line accumulator.
4. Check valves.
5. Expansion valves with replaceable thermostatic elements.
6. Refrigerant dryers.
7. High-pressure switches.
8. Low-pressure switches.
9. Thermostats for coil freeze-up protection during low-ambient temperature operation or loss of air.
10. Independent refrigerant circuits.
11. Brass service valves installed in discharge and liquid lines.
12. Charge of refrigerant.
13. Timed Off Control: Automatic-reset control shuts compressor off after 5 minutes.
14. Refrigerant Circuits: Interlaced refrigerant-coil circuiting with circuit for each compressor.
15. Capacity Control: Cylinder unloaders with steps as scheduled.
16. Compressor Motor Overload Protection: Manual reset.
17. Antirecycling Timing Device: Prevents compressor restart for 5 minutes after shutdown.
18. Adjustable, Low-Ambient, Head-Pressure Control: Designed to operate at temperatures as low as 0 F (minus 18 C) by cycling outside coil fans and controlling speed of last fan of each circuit.
19. Oil-Pressure Switch: Designed to shut down compressors on low oil pressure.

I. Filters: 2-inch (50-mm) thick, high-efficiency, throwaway filters in filter rack; with 25 to 35 percent dust-spot efficiency and 90 percent average arrestance.

J. Outside-Air Damper: Linked damper blades, for 0 to 25 percent outside air, with fully modulating, spring-return damper motor and hood.

K. Economizer: Return- and outside-air dampers with neoprene seals, outside-air filter, and hood.

1. Damper Motor: Fully modulating spring return with adjustable minimum position.
2. Control: Electronic-control system uses mixed-air temperature and selects between outside-air and return-air enthalpy to adjust mixing dampers.
3. Relief Damper: Gravity actuated with bird screen and hood.

4. Maximum leakage 2.5 percent at nominal airflow of 400 cfm per ton (54 L/s per kW) with 1-inch wg (250 Pa) pressure differential.

L. Power Connection: Provide for single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in circuit breaker.

M. Unit Controls: Solid-state control board and components contain at least the following features:

1. Default control to ensure proper operation after power interruption.
2. Service relay output.
3. Unit diagnostics and diagnostic code storage.
4. Field-adjustable control parameters.

N. Thermostat: Programmable, electronic; with heating setback and cooling setup with 7-day programming; and the following:

1. Touch sensitive keyboard.
2. Automatic switching.
3. Degrees F readout.
4. LED indicators.
5. Hour/day programming.
6. Manual override capability.
7. Time and operational mode readout.
8. Status indicator.
9. Battery backup.
10. Sub-base with manual system switch (on-heat-auto-cool) and fan switch (auto-on).
11. Fan-proving switch to lock out unit if fan fails.
12. Dirty-filter switch.

O. Optional Accessories:

1. Service Outlets: Two, 115-V, ground-fault, circuit-interrupter type.
2. Copper condensate drain trap.
3. Dirty-filter switch.
4. Coil guards of painted, galvanized-steel wire.
5. Flush diffuser with aluminum grilles, insulated diffuser box with flanges, and interior transition.
6. Power exhaust fan, forward curved, centrifugal, belt driven with adjustable sheaves.
7. Vertical vent extension.

2.03 MOTORS

A. General requirements for motors are specified in Section 23 05 13 “Common Motor Requirements for HVAC.”

B. Motor Sizes: Minimum size as indicated; if not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

C. Controllers, electrical devices, and wiring are specified in Division 26 Sections.

3.00 EXECUTION

3.01 INSTALLATION

A. Install units level and plumb, maintaining manufacturer’s recommended clearances.

B. Reinforced Concrete Pad Support: Install and secure rooftop air conditioners on pad.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts.

D. Electrical System Connections: Comply with applicable requirements in Division 26 Sections for power wiring, switches, and motor controls.

E. Ground equipment according to Division 26.

F. Tighten electrical connectors and terminals according to manufacturer’s published torque-tightening values. If manufacturer’s torque values are not indicated, use those specified in UL 486A and UL 486B.

3.03 FIELD QUALITY CONTROL

A. Perform the following field quality-control tests and inspections and prepare test reports:

1. After installing rooftop air conditioners and after electrical circuitry has been energized, test units for compliance with requirements.

2. Inspect for and remove shipping bolts, blocks, and tie-down straps.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Remove malfunctioning units, replace with new units, and retest as specified above.

3.04 STARTUP SERVICE

A. Complete installation and startup checks according to manufacturer's written instructions and do the following:

1. Inspect for visible damage to unit casing.
2. Inspect for visible damage to compressor, air-cooled outside coil, and fans.
3. Inspect internal insulation.
4. Verify that labels are clearly visible.
5. Verify that clearances have been provided for servicing.
6. Verify that controls are connected and operable.
7. Verify that filters are installed.
8. Clean outside coil and inspect for construction debris.
9. Calibrate thermostats.
10. Adjust and inspect high-temperature limits.
11. Inspect outside-air dampers for proper stroke and interlock with return-air dampers.
12. Start refrigeration system and measure and record the following:
    a. Coil leaving-air, dry- and wet-bulb temperatures.
    b. Coil entering-air, dry- and wet-bulb temperatures.
    c. Outside-air, dry-bulb temperature.
    d. Outside-air-coil, discharge-air, dry-bulb temperature.
13. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
14. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
    a. Supply-air volume.
    b. Return-air volume.
    c. Relief-air volume.
    d. Outside-air intake volume.
15. Simulate maximum cooling demand and inspect the following:
    a. Compressor refrigerant suction and hot-gas pressures.
    b. Short circuiting of air through outside coil or from outside coil to outside-air intake.
16. Verify operation of remote panel, including pilot-light operation and failure modes. Inspect the following:
    a. Economizer to limited outside-air changeover.
    b. Alarms.

17. After startup and performance testing, change filters, vacuum heat exchanger and cooling and outside coils, lubricate bearings, adjust belt tension, and inspect operation of power vents.

3.05 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose, without additional cost.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain rooftop air conditioners. Refer to Section 01 70 00 "Execution and Closeout Requirements."

END OF SECTION

23 81 13.13 WALL-MOUNTED AIR CONDITIONERS

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes packaged, terminal, outdoor, wall-mounted air conditioners.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For packaged, terminal air conditioners.

1. Include plans, elevations, sections, details for wall penetrations, and attachments to other work.

2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Include diagrams for power, signal, and control wiring.

C. Color Samples: For unit cabinet, discharge grille, and exterior louver, and for each color and texture specified.

1.04 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For packaged, terminal air conditioners, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For packaged terminal air conditioners to include in emergency, operation, and maintenance manuals.

1.06 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of packaged, terminal air conditioners that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Sealed Refrigeration System: Manufacturer's standard, but not less than five years from date of Substantial Completion, including components and labor.

2. Warranty Period for Non-sealed System Parts: Manufacturer's standard, but not less than five years from date of Substantial Completion, including only components and excluding labor.

2.00 PRODUCTS

2.01 MANUFACTURERS

A. Bard

B. Marvair

2.02 MANUFACTURED UNITS

A. Description: Factory-assembled and -tested, self-contained, packaged, terminal air conditioner with outdoor-rated cabinet, electric refrigeration system, and temperature controls; fully charged with refrigerant and filled with oil; with hardwired chassis and circuit breaker.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

D. ASHRAE Thermal Comfort: Applicable requirements in ASHRAE 55.

E. AHRI Rating: Applicable requirements in AHRI 1060.

F. UL listed and ETL performance certified.

2.03 CHASSIS

A. Cabinet: Sloped top, 0.052-inch- (1.32-mm-) thick steel or aluminum with removable front panel with concealed latches.

1. Mounting: On exterior wall.

2. Discharge Grille: Extruded aluminum discharge grille.

3. Return Grille: Extruded aluminum grille.

4. Louvers: Stamped aluminum with clear-anodized finish.

5. Finish: Epoxy coating or baked enamel.

6. Access Door: Hinged door on side of cabinet for access to controls.

7. Insulation: Cooling sections fully insulated with 1-inch (25-mm)-thick fiberglass insulation.

8. Wall Sleeves: Galvanized steel with polyester finish.

B. Refrigeration System: Direct-expansion indoor coil with capillary restrictor and hermetically sealed scroll compressor with crankcase heater, liquid line filter dryer, externally equalized expansion valve, high-pressure switch, low-pressure switch, lockout relay, isolation, and overload protection.

1. Indoor and Outdoor Coils: Seamless copper tubes mechanically expanded into aluminum fins with capillary tube type distributor on indoor coil.

2. Accumulator.

3. Constant-pressure expansion valve.

4. Reversing valve.

5. Charge: R-410A.

C. Indoor Fan: Forward curved, centrifugal; with constant-speed motor(s) and positive-pressure ventilation damper with electric operator.

D. Filters: Washable polyurethane in molded plastic, optional 2-inch (25-mm), pleated, disposable MERV 8, serviceable from side or rear of the unit.

E. Condensate Drain: Coated galvanized-steel drain pan and piping to direct condensate to building waste and vent piping.

F. Outdoor Fan: Propeller type with separate motor.

a. Fan Motors: Permanently lubricated split capacitor.

b. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

c. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

2.04 CONTROLS

A. Control Module: remote-mounted digital panel with touchpad temperature control and with touchpad for cooling, and fan operation.

B. Remote Control: Standard controls with remote-mounted, low-voltage, adjustable thermostat; off-cool-auto switch; and on-auto fan switch.

2.05 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Factory test to comply with AHRI 300, "Sound Rating and Sound Transmission Loss of Packaged Terminal Equipment."

B. Unit Performance Ratings: Factory test to comply with AHRI 310/380/CSA C744, "Packaged Terminal Air-Conditioners and Heat Pumps."

3.00 EXECUTION

3.01 INSTALLATION

A. Install units level and plumb, maintaining manufacturer's recommended clearances and tolerances.

B. Install wall sleeves in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Section 07 92 00 "Joint Sealants."

3.02 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.

1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
2. After installing packaged, terminal air conditioners and after electrical circuitry has been energized, test for compliance with requirements.
3. Unit is level on base and is flashed in exterior wall.
4. Unit casing has no visible damage.
5. Compressor, air-cooled condenser coil, and fans have no visible damage.
6. Labels are clearly visible.
7. Controls are connected and operable.
8. Shipping bolts, blocks, and tie-down straps are removed.
9. Filters are installed and clean.
10. Drain pan and drain line are installed correctly.

11. Electrical wiring installation complies with manufacturer's submittal and installation requirements in electrical Sections.

12. Installation: Perform startup checks according to manufacturer's written instructions, including the following:

    a. Lubricate bearings on fan.

    b. Check fan-wheel rotation for correct direction without vibration and binding.

13. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

14. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. After performance test, change filters.

C. Prepare test and inspection reports.

3.03 ADJUSTING

A. Adjust initial temperature set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.04 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged, terminal air conditioners.

END OF SECTION

23 81 26 SPLIT-SYSTEM AIR-CONDITIONERS

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Wiring Diagrams: For power, signal, and control wiring.

C. Samples for Initial Selection: For units with factory-applied color finishes.

1.04 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Warranty: Sample of special warranty.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.06 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set for each air-handling unit.

2. Gaskets: One set for each access door.

3. Fan Belts: One set for each air-handling unit fan.

1.07 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, “Safety Standard for Refrigeration Systems.”

2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - “Outdoor Air Quality,” Section 5 - “Systems and Equipment,” Section 6 - “Procedures,” and Section 7 - “Construction and System Start-up.”

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.08 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 03 30 00 “Cast-in-Place Concrete.”

1.09 WARRANTY

A. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. For Compressor: Five years from date of Substantial Completion.

b. For Parts: Five years from date of Substantial Completion.

c. For Labor: Five years from date of Substantial Completion.

2.00 PRODUCTS

2.01 MANUFACTURERS

A. Trane

B. Carrier

C. Mitsubishi

D. Daikin

E. LG

2.02 INDOOR UNITS (5 TONS (18 KW) OR LESS)

A. Wall-Mounted, Evaporator-Fan Components:

1. Cabinet: Galvanized or enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.

2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
3. Fan: Direct drive, centrifugal.
4. Fan Motors:
    a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 23 05 13 “Common Motor Requirements for HVAC Equipment.”
    b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
    c. Enclosure Type: Totally enclosed, fan cooled.
    d. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
    e. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
    f. Mount unit-mounted disconnect switches on exterior of unit.
5. Condensate Drain Pans:
    a. Fabricated with two percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
        1). Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
        2). Depth: A minimum of 1 inch (25 mm) deep.
    b. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
        1). Minimum Connection Size: NPS 1 (DN 25)
6. Air Filtration Section:
    a. General Requirements for Air Filtration Section:
        1). Comply with NFPA 90A.
        2). Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.
        3). Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
    b. Disposable Panel Filters:
        1). Factory-fabricated, viscous-coated, flat-panel type.
        2). Thickness: 2 inches (50 mm).
        3). MERV according to ASHRAE 52.2: 4.
        4). Media: Interlaced glass fibers sprayed with nonflammable adhesive.

5). Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.

B. Ceiling-Supported, Evaporator-Fan Components:

1. Cabinet: Galvanized or enameled steel with removable panels on front and ends in color selected by Architect.

2. Insulation: Faced, glass-fiber duct liner.

3. Condensate Drain Pans:

a. Fabricated with one percent slope to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends), and to direct water toward drain connection.

1). Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.

2). Depth: A minimum of 2 inches (50 mm) deep.

b. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.

1). Minimum Connection Size: NPS 1 (DN 25)

c. Pan-Top Surface Coating: Asphaltic waterproofing compound.

d. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

4. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.

5. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.

6. Fan: Direct drive, centrifugal.

7. Fan Motors:

a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 23 05 13 “Common Motor Requirements for HVAC Equipment.”

b. Multitapped, multispeed with internal thermal protection and permanent lubrication.

c. Enclosure Type: Totally enclosed, fan cooled.

d. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.

e. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

f. Mount unit-mounted disconnect switches on exterior of unit.

8. Air Filtration Section:

    a. General Requirements for Air Filtration Section:

        1). Comply with NFPA 90A.

        2). Minimum Arrestance: According to ASHRAE 52.1 and a MERV according to ASHRAE 52.2.

        3). Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.

    b. Disposable Panel Filters:

        1). Factory-fabricated, viscous-coated, flat-panel type.

        2). Thickness: 2 inches (50 mm).

        3). MERV according to ASHRAE 52.2: 8.

        4). Media: Interlaced glass fibers sprayed with nonflammable adhesive.

        5). Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.

2.03 OUTDOOR UNITS (5 TONS (18 KW) OR LESS)

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.

2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

    a. Compressor Type: Scroll.

    b. Refrigerant Charge: R-410A.

    c. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.

2.04 ACCESSORIES

A. Thermostat: Low voltage with subbase to control compressor and evaporator fan.

B. Automatic-reset timer to prevent rapid cycling of compressor.

C. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

D. Drain Hose: For condensate.

E. Additional Monitoring:

1. Monitor constant and variable motor loads.

2. Monitor variable-frequency-drive operation.
3. Monitor cooling load.
4. Monitor air distribution static pressure and ventilation air volumes.

3.00 EXECUTION

3.01 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Equipment Mounting:

1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."

D. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

3.03 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

C. Prepare test and inspection reports.

3.04 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION

23 82 39 UNIT HEATERS

1.00 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes wall-mounted unit heaters.

1.03 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each project indicated.

B. Field Test Reports: Written reports of tests specified in Part 3 of this Section.

C. Maintenance Data: For unit heaters to include in maintenance manuals specified in Division 01. Include the following:

1. Maintenance schedules and repair parts lists for motors, coils, integral controls, and filters.

1.04 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.05 COORDINATION

A. Coordinate layout and installation of unit heaters and suspension system components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

2.00 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the followings:

1. Chromalox
2. Indeeco
3. Reznor
4. Markel Products; a division of TPI Corporation

2.02 UNIT HEATERS

A. Description

1. Assembly including casing, coil, fan, and motor in horizontal discharge configuration with adjustable discharge louvers.

2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

3. Comply with UL 2021.

4. Comply with UL 823.

2.03 PERFORMANCE REQUIREMENTS

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

2.04 HOUSINGS

A. Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested unit heaters before shipping.

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.

2.05 ELECTRIC-RESISTANCE HEATING ELEMENTS

A. Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium-oxide insulating refractory and sealed in high-mass steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch (4 mm). Element ends shall be enclosed in terminal box. Fin surface temperature shall not exceed 550 F (288 C) at any point during normal operation.

1. Circuit Protection: One-time fuses in terminal box for overcurrent protection and limit controls for overtemperature protection of heaters.

2. Wiring Terminations: Match conductor materials and sizes indicated.

2.06 FAN

A. Delayed-action fan with aluminum blades connected to enclosed motor.

2.07 FAN MOTORS

A. Motors, 1/2 HP and Smaller: shaded-pole or permanent-split capacitor, multispeed motor with integral thermal-overload protection.

B. Motors, 3/4 HP and Larger: Totally enclosed with permanently lubricated ball bearings.

C. Explosion-proof for flammable storage and flammable chemical rooms.

2.08 ACCESSORIES

A. Horizontal Configuration: Louver fin diffuser.

2.09 CONTROLS

A. Control Devices: Unit-mounted fan-speed switch and thermostat.

2.10 SOURCE QUALITY CONTROL

A. Test unit heater coils according to ASHRAE 33.

3.00 EXECUTION

3.01 EXAMINATION

A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for electrical connections to verify actual locations before unit heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install unit heaters level and plumb.

B. Install unit heaters to comply with NFPA 90A.

C. Suspend unit heaters from structure with all-thread hanger rods and rubber-in-shear vibration isolators (rubber hangers). Hanger rods and attachments to structure are specified in Section 230529 “Hangers and Supports for HVAC Piping and Equipment.”

D. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

3.03 CONNECTIONS

A. Ground equipment according to Section 260526 “Grounding and Bonding for Electrical Systems.”

B. Connect wiring according to Section 260519 “Low-Voltage Electrical Power Conductors and Cables.”

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

D. Comply with safety requirements in UL 1995.

3.04 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing and report results in writing:

1. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

2. Operate electric heating elements through each stage to verify proper operation and electrical connections.

3. Test and adjust controls and safeties.

B. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

3.05 ADJUSTING

A. Adjust initial temperature set points.

3.06 CLEANING

A. After installing units, clean unit heaters internally according to manufacturer's written instructions.

B. Install new filters in each unit heater within 2 weeks after Substantial Completion.

END OF SECTION

DIVISION 25

INTEGRATED AUTOMATION

25 26 30 PROCESS ANALYZERS

1.00 GENERAL

1.01 DESCRIPTION

A. Scope: CONTRACTOR shall provide all labor, materials, tools, services, equipment and incidentals required to furnish, install, test and place in satisfactory operation, process analyzers as shown on the Drawings and as specified herein. This Section includes:

1. Chlorine Analyzers
2. Ammonia Analyzers

B. Related Sections:

1. Section 40 90 01, Instrumentation
2. Section 40 05 56, Process Valves Four-Inch and Smaller

1.02 QUALITY ASSURANCE

A. Manufacturer Responsibility: All equipment required under this specification shall be supplied by a single supplier who shall assume responsibility for the adequacy, and performance of all the equipment.

1. The Supplier shall identify those components furnished by him that are not of his manufacturer.

B. Manufacturer Qualifications:

1. Equipment furnished shall duplicate manufacturer's equipment that has been in satisfactory operation in similar service for at least 5 years.

C. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. American Society for Testing and Materials (ASTM).
2. American National Standards Institute (ANSI).
3. National Electric Code (NEC).
4. Standards of National Electrical Manufacturers Associations (NEMA).
5. Institute of Electrical and Electronic Engineers (IEEE).
6. Hydraulic Institute (HI)

D. Manufacturer's Field Services:

1. Retain factory trained representatives of the process analyzer manufacturer with demonstrated ability and experience in the installation and operation of the analyzers to perform the services listed below:

a. Inspect the completed installation and prepare an inspection report.

b. Test, calibrate and adjust all components for optimum performance.

c. Assist in initial start-up and field testing.

d. Instruct OWNER'S personnel in the operation and user maintenance of all components. Conduct a minimum of 4 hours training.

1.03 MEASUREMENT AND PAYMENT

A. No separate payment will be made this work. Contractor will include all costs of the requirements of these items in the appropriate bid item(s) on the Bid Form.

1.04 SUBMITTALS

A. Shop Drawings: Provide the following:

1. Manufacturer's literature, catalog cuts and specifications for analyzers, and accessories, showing dimensions, materials of construction and performance data.

2. Manufacturer’s data demonstrating chemical compatibility between materials of all wetted parts of analyzers with the chemical being utilized.

B. Operation and Maintenance Data:

1. Submit Operations and Maintenance Manuals.

2.00 PRODUCTS

2.01 CHLORINE ANALYZER

A. The Chlorine analyzer shall be a microprocessor-controlled process amperometric chlorine residual analyzer with direct reading bare electrodes that provides continuous online free chlorine or total chlorine residual measurements.

B. Performance Requirements:

1. Accuracy: ± 0.25 % of full scale

2. Measurement Range: 0.0-20.0 mg/L

3. Data Communication: RS485, MODBUS

C. Sampling Locations and Parameters Analyzed

1. Yard Piping Influent Sampling Station: total chlorine, free chlorine

2. Yard Piping Distribution Sampling Station: total chlorine, free chlorine

D. Details of Construction

1. Power Supplies: All electrically powered equipment and devices shall be suitable for operation on 120 VAC (+/- 10%), 60 Hz, 10 Amp maximum power. The PA should come equipped with a duplex plug

2. Mounting: Panel shall be equipped with all Type 316 stainless steel hardware required for wall mounting the analyzer.

3. Analog Outputs: 4-20 mA

E. Manufacturer:

1. Hach Company, Model CL-17

2.02 AMMONIA ANALYZER

A. The ammonia analyzer shall be a continuous and reagent less on-line measurement of ammonia using pH appropriate sensor technology using specific sensor adapted to operational pH range to ensure correct measurement and determine free ammonia, total ammonia and NH3-N.

B. Sampling Locations and Parameters Analyzed

1. Yard Piping Influent Sampling Station: total ammonia, free ammonia, pH, and temperature.

2. Yard Piping Distribution Sampling Station: total ammonia, free ammonia, pH, and temperature.

C. Details of Construction

1. Power Supplies: All electrically powered equipment and devices shall be suitable for operation on 120 VAC (+/- 10%), 60 Hz, 10 Amp maximum power. The PA should come equipped with a duplex plug

2. Complete system mounted on wall mountable backpanel to facilitate installation. Sample header includes ammonia sensor, pH sensor, and temperature sensor.

3. Panel shall be equipped with all Type 316 stainless steel hardware required for wall mounting the analyzer.

4. Analog Outputs: 4-20 mA

5. Data Communication: RS485, MODBUS

D. Sensor

1. Ammonia – Sensor shall be Potentiometric used to determine NH3 in aqueous solutions. A gas-permeable hydrophobic PTFE membrane constitutes the interface between the sample solution and the electrolyte of the sensor. A hydrogen ion-selectable electrode dips into this electrolyte. If ammonia diffuses through the PTFE membrane the pH of the electrolyte changes.

2. Measurement accuracy shall be better than +/- 3% of the sensor signal.

3. Drift shall be less than 2% per month. The sensor shall include automatic temperature compensation.

4. The signal to the electronic monitor shall be 4-20 mA via 2-wire technology.

5. The sensor range shall be 0-20 PPM unless dictated otherwise based on the application.

6. The sensor shall be capable of withstanding a temperature range of 0 to 50 degrees C.

7. pH – Sensor shall be flat glass membrane and double junction (2) ceramic diaphragms. The flow shall be directed at the sensor in such a manner that if the flow is stopped, the sensor membrane is continuously submerged in the sensor holder and to provide continuous cleaning action.

8. Sensor shall be platinum resistance thermometer, glass-jacketed. Temperature range 32 – 212 degrees F

E. Sensor Holder

1. The Ammonia/pH/Temperature sensor holder shall be PVC material with integral flow control valve and rotameter for setting the sample flow rate.
2. The flow shall be controlled by a needle valve. Inlet water line shall include a pressure regulator if necessary to control the sample pressure.
3. Sensor housing shall also include calibration assembly for calibration of free ammonia sensor.
4. Mounting brackets for wall mounting shall be included. The sample line connections shall be 1/4" MNPT unions.
5. Sensor Holders shall be mounted on a back panel including a pressure regulating device and rotameter calibrated in GPH.
6. Bronze, Cooper, or Galvanized flow regulators are not allowed.

F. Electronic Monitor and Transmitter

1. The monitor shall be a single channel microprocessor-based, with illuminated LCD display of measured value, status and error annunciation.
2. Unit shall feature non-volatile memory to retain settings in the event of power failure; menu-driven calibration, limit and control settings; sensor monitoring to alarm upon sensor failure or loss of sensitivity; programmable access code allowing calibration but not unauthorized adjustment of limits and outputs.
3. Unit shall automatically convert NH3 and display the corresponding NH3-N value.
4. Mounting shall be a wall mounted NEMA 4x enclosure with removable wall mount bracket.
5. Monitor will measure Ammonia PPM.
6. Two (2) electronically isolated analog (4 to 20 mA) outputs, with 600 Ohm maximum load, shall be proportional to the measured ammonia and spanable with the programmed measuring range.
7. Relay outputs, rated 250 VAC, 3A, shall include one general fault alarm relay to change state upon exceeding limits, loss of input signals or sensor failure and two limit relays.
8. Accuracy: Display (+/- 0.1% of input span), recording (+/- 0.25% of input span), supply voltage (less than 0.025% of span within +/- 10% of reference operating supply voltage)

G. Manufacturer:

1. ProMinent Fluid Controls, DACa Ammonia Probe Series 20401

3.00 EXECUTION

3.01 INSPECTION

A. Inspect all equipment immediately upon delivery to site. All surfaces shall be smooth, free of voids and porosity, without dry spots, crazes or unreinforced areas. If damaged, notify OWNER and manufacturer at once.

B. Do not install damaged equipment until repairs are made in accordance with manufacturer's written instructions and approved by the OWNER. Only minor repair work shall be permitted in the field. All other damaged items shall be sent to factory for repair or replacement.

3.02 INSTALLATION

A. Install equipment in complete conformance with manufacturer's instructions.

B. Manufacturer's Field Services:

1. Retain factory trained representatives of the manufacturer with demonstrated ability and experience in the installation and operation of the analyzers to perform the services listed below:

a. Inspect the completed installation and prepare an inspection report.

b. Test, calibrate and adjust all components for optimum performance.

c. Assist in initial start-up and field testing.

d. Instruct OWNER'S personnel in the operation and user maintenance of all components. Conduct a training seminar at the site.

e. Supervise the correction of any defective or faulty work before and after acceptance by OWNER.

C. Make all electrical connections in conformance with the requirements of Division 26, Electrical.

3.03 TESTING

A. General:

1. The ENGINEER or his representative shall be furnished all facilities, including labor, and shall be allowed proper time for inspection and testing of material and equipment.

2. Materials and equipment shall be tested or inspected as required by the ENGINEER, and the cost of such work shall be included in the cost of the equipment.

3. Furnish the services of a factory representative who has complete knowledge of proper operation and maintenance to inspect the final installation and supervise a test run of the equipment.

4. Field tests shall not be conducted until the entire installation is complete and ready for testing.

END OF SECTION

DIVISION 31

EARTHWORK

31 05 13 SOILS FOR EARTHWORK

1.00 GENERAL

1.01 WORK INCLUDED

A. This Section of the specifications describes the various classes of Earth Fill. All of the classes of Earth Fill contained in this specification may not be used on this project. The classes of Earth Fill used on this project are shown on the drawings or specified in other sections of the specifications. This Section does not include specifications for placement and compaction of Earth Fill. Specifications for placement and compaction of Earth Fill are included in other sections of the specifications and/or shown on the drawings.

1.02 STANDARDS

A. Soil materials shall be classified into the appropriate class of Earth Fill shown below according to ASTM D2487 “Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)” or other appropriate methods as designated by the Engineer.

2.00 PRODUCTS

2.01 MATERIALS; CLASSIFICATIONS

A. Class 1 Earth Fill: Limited to clays and sandy clays classified as CH material with a liquid limit greater than or equal to 50, a plasticity index greater than or equal to 25, and a minimum of 60 percent passing the No. 200 sieve, which are free of organic materials.

B. Class 2 Earth Fill: Limited to clays and sandy clays classified as CH and CL materials with a coefficient of permeability less than or equal to 1.0×10^{-7} cm/sec, a liquid limit greater than or equal to 30, a plasticity index greater than or equal to 15, and more than 50 percent passing the No. 200 sieve, which are free of organic materials.

C. Class 3 Earth Fill: Consist of any materials classified as CH, CL, SM, SP, SP-SM, SC, and GC, which have a minimum plasticity index of 4, which are free of organic materials.

D. Class 4 Earth Fill: Consist of materials which are classified as SP, SM, SC, CL, or dual classifications thereof, which have a liquid limit less than or equal to 35 and a plasticity index of a minimum of 4 and a maximum of 15, which are free of organic materials.

E. Class 5 Earth Fill: Consist of materials classified as SP or SP-SM which have a plasticity index less than or equal to 4 and a maximum of 12 percent passing the No. 200 sieve, which are free of organic materials.

F. (Class 6 through Class 11 Reserved)

G. Class 12 Earth Fill: Consist of soils suitable for topsoil which are relatively free of stones or other objectionable debris, which have sufficient humus content to readily support vegetative growth. The suitability of soils for topsoil shall be subject to the approval of the Engineer.

3.00 EXECUTION (NOT APPLICABLE)

END OF SECTION

31 05 13.13 OFFSITE SOIL BORROW

1.00 GENERAL

1.01 WORK INCLUDED

A. The work covered by this Section consists of obtaining and furnishing to the job site, soil borrow material from offsite borrow pits or other sources as required for the various embankments, fills and backfills.

1.02 QUALITY ASSURANCE

A. Classification Testing:

1. Laboratory Testing:

a. Owner shall arrange and pay for the services of an independent soil testing firm to sample and test proposed borrow soils from the offsite borrow source(s). A minimum of one set of tests will be required from each representative soil from the various sources. Composite samples may be taken for each representative soil, but samples shall not be mixed from different representative soils or from different borrow sources.

b. Contractor shall submit the classification test results on the borrow sources to the Engineer for approval prior to proceeding with furnishing of offsite soil borrow.

2. Field Testing:

a. Owner will provide the services of an independent soil testing firm to provide the required in-place compaction tests and additional classification tests on the offsite soil borrow during construction as required by the Contract Documents or as deemed necessary by the Engineer.

3. Test Methods:

a. Classification testing on all offsite soil borrow materials, except Class 12 earth fill, shall be performed to allow for classification of the material in accordance with ASTM D2487, “Classification of Soils for Engineering Purposes” or other standard test methods as designated by the Engineer.

b. Class 12 earth fill will not require specific classification testing but its suitability shall be subject to the approval of the Engineer and suitability testing shall be performed by the Contractor if deemed necessary by the Engineer. A minimum of a 2 cubic foot representative sample of proposed Class 12 earth fill shall be delivered to the job site for observation by the Engineer. The Contractor shall also arrange for observation of the proposed Class 12 earth fill at the source, if desired by the Engineer. The Contractor shall not proceed with furnishing Class 12 earth fill to the site until its suitability has been approved by the Engineer.

4. Certification: All independent soils testing firms shall be registered with the Texas Board of Professional Engineers. Documentation shall be provided of the firm’s registration number with the test reports.

B. Contamination Testing and Certification:

1. Contamination Testing:

a. The Contractor shall arrange and pay for the services of an EPA approved laboratory to perform a toxic contaminant scan of composite soil samples representative of each separate borrow source in accordance with the U.S. Environmental Protection Agency protocol for the list of contaminants described in 40 CFR, Part 261, Appendix VIII and by EPA Methods SW-846.

b. The results of the laboratory scan shall be submitted to the Engineer by the Contractor prior to proceeding with delivery of soil materials to the site. Any potential offsite soil borrow on which scan test results indicate the presence of contaminants above background levels will be rejected as an offsite soil borrow source.

2. Certification:

a. The laboratory performing the scan test for contaminants for the Contractor shall provide a written certification along with the test results which states that the laboratory is EPA approved and that the tests were performed according to EPA guidelines.

b. The Contractor shall obtain a written, notarized certification from the landowner of each proposed offsite soil borrow source stating that to the best of the landowner's knowledge and belief there has never been contamination of the borrow source site with hazardous or toxic materials. These certifications shall be submitted to the Engineer by the Contractor prior to proceeding to furnish soil materials to the site. The lack of such certification on a potential offsite soil borrow source will be cause for rejection of that source.

1.03 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00 "Submittal Procedures" and shall be include:

1. Classification Test Reports.

2. Certified Contamination Test Reports.

3. Contamination Testing Laboratory Certification.

4. Landowner Certification of Borrow Source.

1.04 STANDARDS

A. ASTM D2487 "Classification of Soils for Engineering Purposes" or other appropriate methods as designated by the Engineer.

B. U.S. Environmental Protection Agency - 40 CFR, Part 261, Appendix VIII.

C. EPA Method SW-846.

1.05 DELIVERY AND STORAGE

A. Contractor shall be responsible for properly handling offsite soil borrow material once it reaches the job site until unloading at the point of use or at approved stockpile areas.

B. Handling of the soil borrow material once unloaded from the transport vehicle, either at the point of use or stockpile area, is not a part of this Section, but is included in other Specification Sections.

C. Stockpile offsite soil borrow material only in stockpile areas approved by the Engineer. Minimize stockpiling of the material. The majority of the material will generally require transportation to the point of use as needed from the offsite source unless otherwise approved or requested by the Engineer. Material shall not be stockpiled along the crest of slopes, excavations or other sensitive areas unless approved by the Engineer.

D. The maintenance of stockpiles including dressing of surfaces to be free draining is not a part of this Section, but is included in other Specification Sections.

E. It shall be the sole responsibility of the Contractor to see that soil borrow is transported from the source to the job site in appropriate vehicles which comply with all applicable codes, laws, and ordinances and which are acceptable to the Owner and Engineer for compatibility with conditions and existing facilities at the job site. An adequate number of vehicles will be used for transporting the soil borrow so as to prevent undue delays in the construction sequence.

F. The Contractor shall have sole responsibility for control and cleanup of dust, mud, dirt, or other debris on streets or other areas as a result of his transporting operations.

G. Methods of handling of soil borrow materials at the source including excavation, segregation, blending, wetting or drying, stockpiling, loading and other necessary handling shall be the sole responsibility of the Contractor. The Contractor shall comply with all applicable codes, laws, and ordinances.

H. If the soil in place must meet appropriate moisture criteria, then the borrow site shall be irrigated prior to removal as needed to allow proper placement, compaction, and/or porosity in place.

2.00 PRODUCTS

2.01 MATERIALS

A. Offsite soil borrow materials shall be classified into one of the classifications listed herein.

1. Class 1 Through Class 12 Earth Fill: Shall meet the requirements of Section 31 05 13 “Soils for Earthwork.”

2. Structural Backfill: Shall consist of the classes of earth fill as shown on the Drawings for structural backfill.

3.00 EXECUTION (NOT APPLICABLE)

END OF SECTION

31 05 16 AGGREGATES FOR EARTHWORK

1.00 GENERAL

1.01 WORK INCLUDED

A. This Section of the specifications describes the various classes of Aggregate Fill. All of the classes of Aggregate Fill contained in this specification may not be used on this project. The classes of Aggregate Fill used on this project are shown on the drawings or specified in other sections of the specifications. This Section does not include installation. Installation of Aggregate Fill is included in other sections of the specifications and/or on the drawings.

1.02 QUALITY ASSURANCE

A. Classification Testing:

1. Contractor Testing:

a. Arrange and pay for the services of an independent testing laboratory to sample and test proposed Aggregate Fill materials.

b. Submit the test results to the Engineer, and obtain approval prior to providing Aggregate Fill.

2. Owner Testing: The Owner shall arrange and pay for additional testing on the Aggregate Fill after delivery to the project site as determined necessary by the Engineer.

B. Contamination Certification:

1. Obtain a written, notarized certification from the Supplier of each proposed Aggregate Fill source stating that to the best of the Supplier's knowledge and belief there has never been contamination of the source with hazardous or toxic materials.

2. Submit these certifications to the Engineer prior to proceeding to furnish Aggregate Fill to the site. The lack of such certification on a potential Aggregate Fill source shall be cause for rejection of that source.

1.03 STANDARDS

A. Aggregate Fill shall be classified into the appropriate class listed below according to ASTM testing procedures as specified for the various classes.

1. American Society for Testing and Materials (ASTM) Standards:

ASTM C33	Specification for Concrete Aggregates
ASTM C88	Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium sulfate
ASTM C125	Terminology Relating to Concrete and Concrete Aggregates
ASTM C131	Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C535	Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM D448	Classification for Sizes of Aggregate for Road and Bridge Construction

2.00 PRODUCTS

2.01 MATERIALS; CLASSIFICATIONS

A. Class 1 Aggregate Fill: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable materials and have a percentage of wear of not more than 40 percent when tested in accordance with ASTM C131 or C535. When material is subjected to five cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12 percent. The source of the material shall be approved by the Engineer and meet the following gradation in accordance with ASTM D448, size number 57:

Sieve Size Square Opening	Percent Passing
1-1/2”	100
1”	95-100
1/2”	25-60
No. 4	0-10
No. 8	0-5

B. Class 2 Aggregate Fill: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable materials and have a percentage of wear of not more than 40 percent when tested in accordance with ASTM C131 or C535. When material is subjected to five cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12 percent. The source of the material shall be approved by the Engineer and meet the following gradation in accordance with ASTM D448, size number 67:

Sieve Size Square Opening	Percent Passing
1”	100
3/4”	90-100
3/8”	20-55
No. 4	0-10
No. 8	0-5

C. Class 3 Aggregate Fill: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable materials and have a percentage of wear of not more than 40 percent when tested in accordance with ASTM C131 or C535. When material is subjected to five cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12 percent. The source of the material shall be approved by the Engineer and meet the following gradation in accordance with ASTM D448, size number 7:

Sieve Size Square Opening	Percent Passing
3/4”	100

1/2”	90-100
3/8”	40-70
No. 4	0-15
No. 8	0-5

D. Class 4 Aggregate Fill: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable materials and have a percentage of wear of not more than 40 percent when tested in accordance with ASTM C131 or C535. When material is subjected to five cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12 percent. The source of the material shall be approved by the Engineer and meet the following gradation in accordance with ASTM D448, size number 467:

Sieve Size Square Opening	Percent Passing
2”	100
1-1/2”	95-100
3/4”	35-70
3/8”	10-30
No. 4	0-5

E. Class 5 Aggregate Fill: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable materials and have a percentage of wear of not more than 40 percent when tested in accordance with ASTM C131 or C535. When material is subjected to five cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12 percent. The source of the material shall be approved by the Engineer and meet the following gradation in accordance with ASTM D448, size number 357:

Sieve Size Square Opening	Percent Passing
2-1/2”	100
2”	95-100
1”	35-70
1/2”	10-30
No. 4	0-5

F. Class 6 Aggregate Fill: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable materials and have a percentage of wear of not more than 40 percent when tested in accordance with ASTM C131 or C535. When material is subjected to five cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12 percent. The source of the material shall be approved by the Engineer and meet the following gradation in accordance with ASTM D448, size number 1:

Sieve Size Square Opening	Percent Passing
4”	100
3-1/2”	90-100
2-1/2”	25-60
1-1/2”	0-15
3/4”	0-5

G. Class 7 Aggregate Fill: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable materials and shall have a percentage of wear of not more than 40 percent when tested in accordance with ASTM C131 or C535. When material is subjected to five cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12 percent. The source of the material shall be approved by the Engineer and meet the following gradation in accordance with ASTM D448, size number 6:

Sieve Size Square Opening	Percent Passing
1”	100
3/4”	90-100
1/2”	20-55
3/8”	0-15
No. 4	0-5

H. Class 8 Aggregate Fill: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable materials and shall have a percentage of wear of not more than 40 percent when tested in accordance with ASTM C131 or C535. When material is subjected to five cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12 percent. The source of the material shall be approved by the Engineer and meet the following gradation in accordance with ASTM D448, size number 56:

Sieve Size Square Opening	Percent Passing
1-1/2”	100
1”	90-100
3/4”	40-85
1/2”	10-40
3/8”	0-15
No. 4	0-5

I. Class 9 Aggregate Fill:

1. Consist of washed and screened gravel and natural sands or sands manufactured by crushing stones complying with the requirements of ASTM C33, except that the gradation shall be as follows:

Sieve Size Square Opening	Percent Passing
1/2”	100
3/8”	95-100
No. 4	80-95
No. 8	65-85
No. 16	50-75
No. 30	25-60
No. 50	10-30
No. 100	0-10

2. Class 9 Aggregate Fill shall have not more than 45 percent passing any sieve and retained on the next consecutive sieve of those shown above, and its fineness modulus, as defined in ASTM C125, shall be not less than 2.3 nor more than 3.1.

J. Class 10 Aggregate Fill:

1. Consist of washed and screened natural sands or sands manufactured by crushing stones complying with the requirements and tests of ASTM C33. The gradation as included in ASTM C33 is as follows:

Sieve Size Square Opening	Percent Passing
3/8”	100
No. 4	95-100
No. 8	80-100
No. 16	50-85
No. 30	25-60
No. 50	10-30
No. 100	0-10

2. Class 10 Aggregate Fill shall have not more than 45 percent passing any sieve and retained on the next consecutive sieve of those shown above, and its fineness modulus, as defined in ASTM C125, shall be not less than 2.3 nor more than 3.1.

K. Class 11 Aggregate Fill: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable material and have a percentage of wear of not more than 40 percent when tested in accordance with ASTM C131 or C535. When material is subjected to five cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12 percent. The source of the material shall be approved by the Engineer and meet the following gradation:

Sieve Size Square Opening	Percent Passing
1-3/4”	100
7/8”	65-90
3/8”	50-70
No. 4	35-55
No. 40	15-30
No. 100	0-12 (Wet Sieve Method)

L. Class 12 Aggregate Fill: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable material and have a percentage of wear of not more than 40 percent when tested in accordance with ASTM C131 or C535. When material is subjected to five cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12 percent. The source of the material shall be approved by the Engineer and meet the following gradation:

Sieve Size Square Opening	Percent Passing
1-1/2”	100
1”	85-100
3/4”	60-95
3/8”	50-80
No. 4	40-65
No. 16	20-40
No. 100	0-12 (Wet Sieve Method)

M. Class 13 Aggregate Fill: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable material and have a percentage of wear of not more than 40 percent when tested in accordance with ASTM C131 or C535. When material is subjected to five cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12 percent. The source of the material shall be approved by the Engineer and shall meet the following gradation:

Sieve Size Square Opening	Percent Passing
1-3/4”	100
7/8”	65-90
3/8”	50-70
No. 4	35-55
No. 40	15-30
No. 100	0-3 (Wet Sieve Method)

N. Class 14 Aggregate Fill: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable material and have a percentage of wear of not more than 40 percent when tested in accordance with ASTM C131 or C535. When material is subjected to five cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12 percent. The source of the material shall be approved by the Engineer and meet the following gradation:

Sieve Size Square Opening	Percent Passing
1-1/2"	100
1"	85-100
3/4"	60-95
3/8"	50-80
No. 4	40-65
No. 16	20-40
No. 100	0-3 (Wet Sieve Method)

O. Class 15 Aggregate Fill: Consist of durable particles of silica sand, washed clean, chemically inert, and packaged by the Supplier. The material shall meet applicable regulatory requirements for monitor well filter pack. The source of the material shall be approved by the Engineer and shall meet the following gradation requirements:

Sieve Size Square Opening	Percent Passing
No. 20	98-100
No. 40	0-2

3.00 EXECUTION (NOT APPLICABLE)

END OF SECTION

31 11 00 CLEARING AND GRUBBING

1.00 GENERAL

1.01 WORK INCLUDED

A. Provide labor, materials, equipment and incidentals necessary to perform operations in connection with clearing, grubbing, and disposal of cleared and grubbed materials.

1.02 QUALITY ASSURANCE; DEFINITIONS

A. Clearing: Clearing is defined as the removal of trees, shrubs, bushes, and other organic matter at or above original ground level.

B. Grubbing: Grubbing is defined as the removal of stumps, roots, boards, logs, and other organic matter found at or below ground level.

2.00 PRODUCTS (NOT APPLICABLE)

3.00 EXECUTION

3.01 PREPARATION

A. Mark areas to be cleared and grubbed prior to commencing clearing operations. The Owner's Representative shall approve clearing and grubbing limits prior to commencement of clearing operations.

B. Trees and shrubs outside of the clearing limits, which are within 10 feet of the clearing limits, shall be clearly marked to avoid damage during clearing and grubbing operations.

C. Remove trees and brush outside the clearing limits, but within the immediate vicinity of the work, upon receipt of approval by the Owner's Representative, when the trees or brush interfere with the progress of construction operations.

D. Clearly mark trees and shrubs within the clearing limits, which are to remain, and protect the trees and shrubs from damage during the clearing and grubbing operations.

E. The clearing limits shall not extend beyond the project limits.

F. Establish the clearing limits as follows:

1. Embankments plus 10 feet beyond the toe of the embankment.
2. Excavations plus 5 feet beyond the top of the excavation.
3. Concrete structures plus 10 feet beyond the edge of the footing.
4. Roadways, runways, taxiways, and parking areas plus 5 feet beyond the edge of pavement or R.O.W. limits.
5. Retaining walls plus 10 feet beyond the edge of the footing.
6. Railroads plus 10 feet beyond the edge of the subgrade.
7. Underground utility trench top width plus 8 feet.
8. Along the centerline of the overhead utility lines.

G. Establish the grubbing limits as follows:

1. Embankments plus 2 feet beyond the toe of the embankment.
2. Concrete structures plus 2 feet beyond the edge of the footing.
3. Roadways, runways, taxiways, and parking areas plus 1 foot beyond the edge of pavement.
4. Retaining walls plus 2 feet beyond the edge of the footing.
5. Railroads plus 2 feet beyond the edge of the subgrade.

3.02 INSTALLATION

A. Clearing: Clearing shall consist of the felling, cutting up, and the satisfactory disposal of trees and other vegetation, together with the down timber, snags, brush, rubbish, fences, and debris occurring within the area to be cleared.

B. Grubbing:

1. Grubbing shall consist of the removal and disposal of stumps and roots larger than 1 inch in diameter.
2. Extend grubbing to the depth indicated below: In the case of multiple construction items, the greater depth shall apply.
    a. Footings: 18 inches below the bottom of the footing.
    b. Walks: 12 inches below the bottom of the walk.
    c. Roads and Taxiways: 18 inches below the bottom of the subgrade.
    d. Parking Areas: 12 inches below the bottom of the subgrade.
    e. Runways: 24 inches below the bottom of the subgrade.
    f. Embankments: 24 inches below existing ground.
    g. Railroads: 24 inches below the bottom of the subgrade.
    h. Concrete Structures: 18 inches below the bottom of the concrete.
    i. Retaining Walls: 18 inches below the bottom of the footing.

3.03 FIELD QUALITY CONTROL

A. Completely remove timber, logs, roots, brush, rotten wood, and other refuse from the Owner's property. Disposal of materials in streams shall not be permitted and no materials shall be piled in stream channels or in areas where it might be washed away by floods. Timber within the area to be cleared shall become the property of the Contractor, and the Contractor may cut, trim, hew, saw, or otherwise dress felled timber within the limits of the Owner's property, provided timber and waste material is disposed of in a satisfactory manner. Materials shall be removed from the site daily, unless permission is granted by the Engineer to store the materials for longer periods.

END OF SECTION

31 23 10 STRUCTURAL EXCAVATION AND BACKFILL

1.00 GENERAL

1.01 WORK INCLUDED

A. Furnish labor, materials, equipment and incidentals necessary to complete structural excavation, filling, backfilling, and compacting; to provide protection to equipment and cuts; to include backfill material; the construction or installation of cofferdams, and other similar facilities which may be necessary to perform excavations and/or backfilling; to include the necessary pumping, bailing, or associated drainage; to remove and dispose of surplus materials, cofferdams, and debris; and to provide final grading, as required.

B. The work does not include excavation, filling, and backfilling for utility lines, manholes, vaults, valve boxes, and related structures. Work shall be performed in accordance with Section 31 23 33 “Trenching and Backfill [Utilities].”

1.02 QUALITY ASSURANCE; DEFINITIONS

A. Cofferdams: Cofferdam designates any temporary or removable structure constructed to hold the surrounding earth and/or water out of the excavation, whether the structure is formed of soil, timber, steel, concrete, or a combination thereof. It shall be understood also to include the use of pumping wells or well points.

1.03 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00 “Submittal Procedures” and shall include:

1. Structural calculations for cofferdams. Submit calculations for approval by the Engineer prior to the start of the cofferdam construction. The calculations shall be sealed by a registered professional engineer in accordance with the laws of the state where the project is constructed. The calculations shall be site specific.

2. Submit qualifications of independent testing laboratory for approval.

3. Backfill material classifications. Provide certification by an approved independent testing laboratory.

4. Compaction test results. Provide compaction test results within 24 hours.

1.04 STANDARDS

A. The following publications, referred to hereafter by basic designation only, form a part of this specification as if written herein in their entirety:

1. American Society for Testing and Materials (ASTM) Standards:

ASTM D698	Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))
ASTM D1556	Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method

ASTM D6938	Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM D4253	Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
ASTM D4254	Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density

B. Any other testing required by these specifications and not specifically referenced to a standard shall be performed under ASTM or other appropriate standards as designated by the Engineer.

C. References herein or on the drawings to soil classifications shall be understood to be according to ASTM D2487, "Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)" unless indicated otherwise.

1.05 DELIVERY AND STORAGE

A. Deposit material to be used for backfill in storage piles at points convenient for handling of the material during the backfilling operations.

1.06 JOB CONDITIONS

A. Review subsurface investigations. A limited subsurface investigation has been performed by HVJ Associates, Inc. A geotechnical report from that investigation is available at the Engineer's office. However, the precise profile of soil and rock strata beneath this site is not known.

B. Review the site and determine the conditions which may affect the structural excavation, prior to the commencement of the excavation.

2.00 PRODUCTS

2.01 MATERIALS

A. Structural Earth Backfill: Structural backfill shall be Class 4 Earth Fill as specified in Section 31 05 13 "Soils for Earthwork."

B. Structural Aggregate Backfill: Structural aggregate backfill shall be Class 1 Aggregate Fill as specified in Section 31 05 16 "Aggregates for Earthwork."

C. Lean Concrete Backfill: Lean concrete shall be in accordance with Section 03 30 00 "Cast-In-Place Concrete."

D. Topsoil: Topsoil shall be Class 12 Earth Fill as specified in Section 31 05 13 "Soils for Earthwork."

E. Compacted Select Fill: Fill shall be Class 5 Earth Fill as specified in Section 31 05 13 "Soils for Earthwork."

F. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D448, Size 10, with 100 percent passing a 3/8-inch sieve, 10 to 30 percent passing a No. 100 sieve, and 5 to 15 percent passing No. 200 sieve; maximum plasticity index of 7; complying with deleterious substance limits of ASTM C33 for fine aggregates.

2.02 COMPACTION EQUIPMENT

A. Compaction equipment shall conform to the following requirements and shall be utilized as specified herein.

1. Pneumatic Rollers: Pneumatic rollers shall have a minimum of four wheels equipped with pneumatic tires. The tires shall be such size and ply as can be maintained at tire pressures between 80 and 100 pounds per square inch for a 25,000-pound wheel load during roller operations. The roller wheels shall be located abreast and be designed so that each wheel will carry approximately equal load in transversing uneven ground. The spacing of the wheels shall be such that the distance between the nearest edges of adjacent tires will not be greater than 50 percent of the tire width of a single tire at the operating pressure of a 25,000-pound wheel load. The roller shall be provided with a body suitable for ballast loading such that the load per wheel may be varied, from 18,000 to 25,000 pounds. The roller shall be towed at speeds not to exceed 10 miles per hour. The character and efficiency of this equipment shall be subject to the approval of the Engineer.

2. Vibratory Rollers: Vibratory rollers shall have a total static weight of not less than 20,000 pounds, with at least 90 percent of the weight transmitted to the ground through a single smooth drum when the roller is standing in a level position. The diameter of the drum shall be between 5 and 5-1/2 feet and the width between 6 and 9 feet. The unsprung weight of the drum, shaft, and internal mechanism shall not be less than 12,000 pounds. The frequency of vibration during operation shall be between 1100 and 1500 i.e., and dynamic force shall not be less than 40,000 pounds at 1400 i.e. No backing of the vibratory roller will be allowed on the embankment unless the vibrating mechanism is capable of being reversed. Self-propelled and towed vibratory rollers shall be operated at speeds not exceeding 3 miles per hour and 1-1/2 miles per hour, respectively.

3. Power Hand Tampers and Vibratory Plate Hand Compactors: Compaction of material in areas where it is impracticable to use a roller or tractor shall be performed with approved power hand tampers, vibratory plate hand compactors, or other approved equipment. Approval shall be based upon performance in a test section.

3.00 EXECUTION

3.01 PREPARATION

A. Clear and grub the area to be excavated prior to the start of excavation in accordance with Section 31 11 00 “Clearing and Grubbing [Civil].”

3.02 EXCAVATION

A. When footing concrete or masonry is to rest upon rock, remove the rock to a depth sufficient to expose sound rock. Level off or cut the rock to approximate grades, and roughen the area. When footing concrete or masonry is to rest on an excavated surface other than rock, take care not to disturb the bottom of the excavation, and do not make final removal of the foundation material to grade until just before the concrete or masonry is placed.

B. For footings where the soil encountered at established footing grade is an unstable material, use the following procedure unless other methods are specified: Remove unstable soil. Carry the excavation at least 1 foot beyond the horizontal limits of the structure on all sides. Replace the unstable soil with compacted select fill. Place in uniform layers at a suitable depth for compaction. Wet each layer if necessary and compact by rolling or tamping to provide a stable foundation for the structure.

C. When unfeasible to construct a stable footing as outlined above, construct footing by the use of special materials, such as flexible base, cement stabilized base, cement stabilized backfill, or other material, as directed by the Engineer.

D. Perform excavation to permit surfaces to be brought to final line and grade within plus or minus 0.1 foot. Restore over-break at the Contractor's expense. In general, perform excavation in open-cut from the surface of the ground and at the line and grade indicated.

E. The sides of the excavation, from the bottom of the excavation to the top of the ground shall be supported in accordance with OSHA requirements. Maintain the supports throughout construction. Remove supports after the completion of the work.

3.03 DEWATERING OF SITE

A. Pumping or bailing from the interior of any foundation enclosure shall be done in a manner which precludes the possibility of movement of water through or alongside any concrete being placed. No pumping or bailing shall be permitted during the placing of structural concrete, or for a period of at least 24 hours thereafter, unless from a suitable sump separated from the concrete work by a water-tight wall. Pumping or bailing during placement of seal concrete shall be only to the extent necessary to maintain a static head of water within a cofferdam. Do not start pumping or bailing to de-water a sealed cofferdam until the seal has aged at least 36 hours.

3.04 PLACEMENT OF MATERIAL

A. General:

1. Backfill excavated spaces and areas not occupied by the permanent structure, except that no backfill shall be placed against any structure until the concrete has reached its 28-day compressive strength or 7 days whichever is longer. Do not place backfill adjacent to support walls until the top slab has been in place at least 4 days.

2. Take care to prevent wedging action when placing backfill around structures. If backfill is to be placed on two or more sides of the structure or facility, simultaneously place the backfill on all sides to avoid uneven loading on the structure.

3. Do not permit rollers to operate within 3 feet of structures.

4. Maximum placement lifts measured in the loose condition are as follows:

   a. 8 inches when heavy compaction equipment is used.

   b. 4 inches when hand-directed compaction equipment is used.

5. Subgrade preparation for slab-on-grade:

   a. Provide a 3-inch layer of compacted Fine-Graded Granular Material.

B. Moisture Control:

1. General: The materials in each layer of the fill shall uniformly contain the amount of moisture within the limits specified below necessary to obtain the maximum dry density for the soil. Compact Class 1 and Class 2 Earth Fill with a moisture content of at or within 5 percentage points wet of optimum moisture content. Compact Class 3, Class 4, and Class 5 Earth Fill with a moisture content within 2 percentage points dry to 5 percentage points wet of optimum moisture content. The moisture content ranges specified above for the various classes of earth fill represent maximum upper and lower limits of the particular range. Determination of the maximum dry density-optimum moisture shall be by one or more of the following ASTM procedures D 1556 or D 6938. Completely cohesionless materials which are to be compacted to a specified relative density shall be at a moisture content which will allow use of the specified compaction equipment and consistent achievement of the specified density.

2. Moisture Control During Placement: After spreading the soil, adjust the moisture content of the soil if necessary by either aeration or the addition of water to bring the moisture content within the range specified. Uniformly distribute the moisture content throughout the layer of soil to be compacted. In order to accomplish this distribution, thoroughly mix the layer of soil by disking, harrowing, or by the use of a power-driven pulverizer. Should the surface of a previously compacted layer become dry due to exposure to the elements, appropriately wet surface of the compacted layer prior to placing the succeeding layer of soil, and properly disk or harrow the surface. Should a layer of soil be over wet, allow the layer to dry to a proper moisture content prior to compacting. Should the surface of a layer become smooth and hard, roughen the surface by scarifying, and wet the surface if necessary prior to placing the next layer of soil. Reprocess any layer which becomes damaged by weather conditions to meet the specification requirements. There shall be no additional payment made for such reprocessing.

C. Compaction:

1. Compaction shall be by power hand equipment or rubber tired equipment, provided the rubber tired equipment does no damage. Compaction by power hand equipment or rubber tired equipment shall be completed such that there will be a 24-inch overlap by roller compaction.

2. Compact the Class 1 and Class 2 Earth Fill zones by a minimum of eight passes with a tamping roller. Compact the Class 3, Class 4, and Class 5 Earth Fill zones by a minimum of eight passes with a tamping roller or by a minimum of four passes with a tamping roller, followed by a minimum of four passes with a pneumatic roller. A vibratory roller shall be required if the material is sandy and if requested by the Engineer. A pass shall consist of one trip over the area being compacted. The front and rear axle rollers on self-propelled models shall only be considered as one pass per trip. The initial and final area to be rolled shall each have eight passes. Stagger passes between the initial and final area in order to establish overlapping with at least eight passes at all locations. Approve the exact method based upon the test section. Dumping, spreading, sprinkling, and compacting may be performed at the same time at different points along a section where there is sufficient area to permit these operations to proceed simultaneously.

3. Areas of the fill being compacted with power hand tampers or vibratory plate hand compactors shall receive a minimum of eight passes of the equipment with an overlap of 50 percent of the equipment base plate width.

4. The in-place density of Class 1 through Class 5 Earth Fill shall not be less than 95 percent of maximum dry density as determined by ASTM D698, Standard Proctor, except compact the top 12 inches of fill underneath roadways and parking areas to not less than 100 percent of maximum dry density as determined by ASTM D698, Standard Proctor. In areas cut underneath roadways and parking areas scarify and re-compact the top 8 inches of the subgrade within the specified moisture content, to not less than 100 percent of maximum dry density as determined by ASTM D698, Standard Proctor.

5. Compact cohesionless materials, on which it is not practical to control the density by proctor methods, to a minimum of 95 percent of the maximum density as determined by ASTM D4253. At the discretion of the Engineer, an alternate method of determining the maximum density may be used which has been correlated with methods ASTM D4253 and ASTM D4254.

6. If necessary, to achieve the specified density, increase the number of passes of the compaction equipment, and/or modify the weight of the compaction equipment.

7. Regardless of the density achieved, the number of passes of the compaction equipment shall not be less than eight.

3.05 FIELD QUALITY CONTROL

A. The Owner is responsible for the costs involved in providing an approved testing laboratory to perform quality control testing of backfill operations. The testing laboratory shall make tests of in-place density in accordance with ASTM Standards. The testing laboratory shall monitor backfill operation continuously or at intervals acceptable to the Owner and Engineer at structures. It shall be the responsibility of the Contractor to notify the testing laboratory before backfill operations begin.

   1. Unless noted otherwise, in-place density tests shall be conducted at a rate of one test per 1500 square feet for every lift.

END OF SECTION

31 23 23.16 COMPACTED EARTH FILL

1.00 GENERAL

1.01 WORK INCLUDED

A. Furnish labor, materials, equipment and incidentals, and perform the necessary operations in connection with preparing the subgrades for the embankments and placing and compacting the permanent earth fill and backfill not otherwise specified. See specification Section 31 05 13.13 “Offsite Soil Borrow.”

B. Backfill for pipelines is not a part of this Section.

1.02 QUALITY ASSURANCE

A. Definitions: The term “embankment” as used in these specifications is defined as the earth fill portions of the levee structures, pond liner, construction pads, channel fill, roadway fill, topsoil and any other earth fill as specified or shown on the drawings. Earth spoils shall not be considered as embankments and are not a part of this Section.

B. Classification: Classifications shall be in accordance with Section 31 05 13 “Soils for Earthwork.”

C. General Provisions:

1. Lines and Grades: The embankments shall be constructed to the lines, grades, and cross sections indicated on the drawings. The embankments and fills shall be final graded to a tolerance of plus or minus 0.1 foot, except earth fill underneath roadways shall be graded to a tolerance of plus or minus 0.04 foot. There will be no payment for shrinkage or consolidation that occurs during construction. The end slopes and side slopes of fill sections shall not be steeper than those shown on the plans.

2. Conduct of the Work:

a. Maintain and protect the embankments in a satisfactory condition at all times until final completion and acceptance of the work. If the hauling equipment causes horizontal shears or slickensides, rutting, quaking, heaving, cracking, or excessive deformation of the embankments, limit the type, load, travel speed, and/or haul pattern of the hauling equipment on the embankments. Excavate and remove from the embankments any material which the Engineer considers objectionable and dispose of such material and refill the excavated area. Remove any embankment material placed outside of prescribed lines shown on the drawings. Replacement of any material rendered unsuitable as a result of the operation will be at the Contractor’s own expense.

b. Do not place frozen earth fill or fill upon frozen subgrade. Previously frozen fill shall be recompacted prior to placement of additional fill.

3. Haul Roads: Locate and construct haul roads at approved locations. Construct roads to maintain the intended traffic and be free draining. Maintain roads in good condition throughout the contract period. When no longer needed, remove haul roads and topsoil and seed the area as requested by the Owner.

4. Stockpiling from Approved Borrow Sources: Stockpile the excavated material, adjacent to the work until used, at locations approved by the Owner when the excavation from approved borrow sources or from required excavation progresses at a faster rate than placement of the fill is being accomplished. Plan operations to minimize stockpiling. Dress and maintain stockpiles so that the surfaces will be free draining. Suitable erosion control methods are to be incorporated adjacent to stockpile areas in accordance with Section 01 57 00 "Storm Water Pollution Prevention Control."

5. Quality Control Testing:

    a. The Owner will provide for quality control tests on the materials incorporated in the work, including classification testing of borrow materials from on-site sources. Copies of the results of the tests performed will be furnished to the Contractor upon request. The testing performed by the Owner in no way relieves the Contractor of the responsibility of completing the work in accordance with the specifications. The Contractor shall assist the testing personnel in taking tests to the extent of furnishing labor and equipment to prepare the areas for testing and curtailing operations in the vicinity of the test area during testing.

    b. The Contractor has the right to conduct such tests as deemed necessary to assure compliance with the contract specifications. Conflicting results between the Owner's tests and those made by the Contractor will be resolved by the Engineer, and his decision shall be final.

    c. The Contractor shall have the sole responsibility for seeing that the appropriate class of earth fill is placed in each zone. To this end, the Contractor will be responsible for determining any changes in materials from borrow sources, excavations, and stockpiles, and see that appropriate classification tests are requested in a timely manner. Any earth fill which does not meet the classification requirements for the zone in which it is placed, shall be removed and properly replaced with conforming material by the Contractor at no additional cost to the Owner.

6. Slides: In the event of slides in any part of the embankments prior to final acceptance of the work, remove all loose material from the slide area and rebuild the portion of the embankment as requested by the Engineer, at no additional cost to the Owner.

1.03 STANDARDS

A. The following publications, referred to hereafter by basic designation only, form a part of this specification to the extent indicated by the references thereto:

1. American Society for Testing and Materials (ASTM) Standards:

ASTM D698	Moisture-Density Relationship of Soils and Soil Aggregate Mixtures, Using 5.5-lb. Rammer and 12-Inch Drop
ASTM D1556	Density of Soil in Place by the Sand Cone Method
ASTM D2922	Density of Soil and Soil-Aggregate In-Place by Nuclear Methods
ASTM D3017	Moisture Content of Soil and Soil-Aggregate In-Place by Nuclear Methods

ASTM D4253	Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
ASTM D4254	Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density

B. Any other testing required by these specifications and not specifically referenced to a standard shall be performed under ASTM or other appropriate standards as designated by the Engineer.

C. References herein or on the drawings to soil classifications shall be understood to be according to ASTM D2487, "Classification of Soils for Engineering Purposes" unless indicated otherwise.

2.00 PRODUCTS

2.01 MATERIALS; EARTH FILL ZONES

A. General: Materials for embankment fills shall be secured from required excavations, from the borrow areas indicated on the drawings, or from offsite borrow areas approved by the Engineer. The intention is to use the most suitable materials obtainable from these sources. Materials containing brush, roots, sod, or other perishable materials will not be considered suitable. The suitability of the materials shall be subject to approval of the Engineer. Mixing of materials during the excavating process at the borrow area may be required for Class 3 earth fill.

B. Embankments and Backfill: Consist of Class 4 earth fill or of the class shown on the drawings or specified herein for the various zones of fill for all areas beneath structures or paving.

C. Structural Backfill: Consist of earth fill of the classes shown on the drawings, unless otherwise specified in this section or 31 23 10 – Structural Excavation and Backfill.

D. Additional Structural Backfill – Soil: Consist of Class 4 earth fill unless shown otherwise on the drawings.

E. Additional Structural Backfill - Lean Concrete: Class E concrete as specified in specification Section 03 30 00 "Cast-In-Place Concrete."

F. Undercutting Backfill: Consists of the same class of earth fill as the fill zone or structure to be placed on the subgrade. Appropriate foundation treatment is needed prior to placement of undercutting backfill.

2.02 COMPACTION EQUIPMENT

A. Compaction equipment shall conform to the following requirements and shall be utilized as hereinafter specified.

1. Tamping Rollers (Sheepsfoot):

a. Tamping rollers shall consist of a heavy duty double drum unit with a drum diameter not less than 60 inches and an individual drum length of not less than 60 inches. The drums shall be water or sand and water ballasted. Each drum shall have staggered feet uniformly spaced over the cylindrical surface such as to provide approximately 3 tamping feet for each 2 square feet of drum surface. The tamping feet shall be 7 to 9 inches in clear projection from the cylindrical surface of the roller

and shall have a face area of not less than 7 nor more than 10 square inches. Self-propelled rollers with tamping feet surface areas greater than 10 but less than 30 square inches can be utilized provided the feet have tapered heads that add to the compactive effort. The roller shall be equipped with cleaning fingers, designed and attached to prevent the accumulation of material between the tamping feet, and these cleaning fingers shall be maintained at their full length throughout the periods of use of the roller. The weight of the roller shall not be less than 3500 pounds per foot of linear drum length weighted and shall not be less than 1500 pounds per foot of drum length empty. The two drums comprising one roller unit shall be designed such that they will both function when traversing uneven ground. The roller shall be self-propelled or tractor drawn at a speed that will give optimum compactive effort.

b. The design, operation, and use of the tamping roller shall be approved by the Engineer based on the results of the construction of a test section. The test section shall be constructed using the proposed roller and the materials from designated and/or planned borrow areas. The roller shall provide uniform compaction throughout the lift and shall insure bonding by its kneading action. The roller shall not cause scaring of the fill or laminations in the fill. The roller shall not walk across a lift until uniform compaction is obtained. Additional testing will be required if the materials change during construction. When necessary repairs shall be made to the tamping feet, minor alterations shall be made to the roller, and variations in the weight of roller shall be made.

2. Pneumatic Rollers: Pneumatic rollers shall have a minimum of four wheels equipped with pneumatic tires. The tires shall be of such size and ply as can be maintained at tire pressures between 80 and 100 pounds per square inch for a 25,000-pound wheel load during rolling operations. The roller wheels shall be located abreast and be designed so that each wheel will carry approximately equal load in traversing uneven ground. The spacing of the wheels shall be such that the distance between the nearest edges of adjacent tires will not be greater than 50 percent of the tire width of a single tire at the operating pressure of a 25,000-pound wheel load. The roller shall be provided with a body suitable for ballast loading such that the load per wheel may be varied, from 18,000 to 25,000 pounds. The roller shall be towed at speeds not to exceed ten miles per hour. The character and efficiency of this equipment shall be subject to the approval of the Engineer.

3. Vibratory Rollers: Vibratory rollers shall have a total static weight of not less than 20,000 pounds, with at least 90 percent of the weight transmitted to the ground through a single smooth drum when the roller is standing in a level position. The diameter of the drum shall be between 5 and 5-1/2 feet and the width between 6 and 9 feet. The unsprung weight of drum, shaft, and internal mechanism shall be not less than 12,000 pounds. The frequency of vibration during operation shall be between 1100 and 1500 cpm, and the dynamic force shall be not less than 40,000 pounds at 1,400 cpm. No backing of the vibratory roller will be allowed on the embankment unless the vibrating mechanism is capable of being reversed. The Equipment Manufacturer shall furnish sufficient data, drawings and computations for verification of the above specifications, and the character and efficiency of this equipment shall be subject to the approval of the Engineer. Self-propelled and towed vibratory rollers shall be operated at speeds not exceeding 3 miles per hour and 1.5 miles per hour, respectively.

4. Power Hand Tampers and Vibratory Plate Hand Compactors: Compaction of material in areas where it is impracticable to use a roller or tractor shall be performed with approved power hand tampers, vibratory plate hand compactors, or other approved equipment. Approval shall be based upon performance in a test section.

3.00 EXECUTION

3.01 PREPARATION OF SUBGRADE

A. Stable Subgrades: After excavation or stripping of the subgrades and excavation of the undesirable material to the extent indicated on the drawings or otherwise required, break down the sides of stump holes, test pits, and other similar cavities or depressions to flatten out the slopes to no steeper than five horizontal to one vertical (5:1). Scarify the sides of the cut or hole to provide bond between the subgrade material and the fill. Scarify the slopes and bottom of all excavations. Fill each depression with the appropriate class of earth fill material, depending upon the type of material which is to be placed immediately above the subgrade. Place the fill in layers, moistened, and compacted in accordance with the applicable provisions. Spread materials which cannot be compacted by roller equipment because of inadequate clearances in 4-inch layers and compact with power tampers to a density and moisture content specified herein for the particular material being placed. After filling of depressions and trenches and immediately prior to placement of compacted fill in any section of the embankment, loosen the subgrade of such section thoroughly by scarifying, plowing, discing, or hallowing to a minimum depth of 6 inches. The moisture content shall be within the limits specified in Paragraph 3.03 of this specification for the appropriate type of material. After removal of roots or other debris turned up in the process of loosing, compact the entire surface of the embankment subgrade area as specified in Paragraph 3.04 of this specification.

B. Unstable Subgrades:

1. In areas of the subgrade which, in the opinion of the Engineer, are too soft, wet, or otherwise unstable to allow embankment construction to begin, the Engineer may request soft ground stabilization techniques. Soft ground stabilization techniques shall consist of plating and/or plating in combination with a geogrid.

2. Plating shall consist of covering the unstable areas with an approximate 12-inch lift of dry cohesive soil meeting the earth fill classification requirements for the particular zone. Spread and initially compact the lift with low ground pressure equipment such as D-3 Caterpillar bulldozer or equivalent. The lift shall receive a minimum of three coverages of the bulldozer tracks prior to beginning compaction with the equipment specified in Paragraph 2.05 of this specification. The lift shall receive the specified number of passes of the specified compaction equipment for the particular class of earth fill. In areas which will not support the specified number of passes of the compaction equipment without severe rutting or pumping, place an additional 8-inch lift of dry cohesive soil over the previous lift and apply the specified number of passes of the specified compaction equipment. This process shall continue until all areas will support the compaction equipment for the specified number of passes without significant rutting or pumping.

3. Plating in combination with a geogrid shall consist of the placement of a geogrid on the subgrade and/or between selected plating lifts in conjunction with plating as described above. Furnish and install the geogrid in accordance with Section 31 32 19.13 "Geogrid Soil Reinforcement." Prior to placing the geogrid on the subgrade, grade the surface of the subgrade to the tolerance of plus or minus 0.2 foot.

4. Each lift of plating (with or without a geogrid) will be tested for moisture and density by the Owner's independent testing personnel. These tests on the plating will be for informational purposes. No specific moisture or compaction criteria will be required in areas of plating which will not support the specified number of passes of the compaction equipment without significant rutting or pumping; however, when requested by the Engineer, the Contractor shall adjust the moisture content of the earth fill material being used for plating prior to spreading on the plating areas. This adjustment shall be within a range as designated by the Engineer. The minimum and maximum percentages of moisture content of the range designated by the Engineer shall be separated by no less than 5 percentage points. Once the lifts of plating are built up in an area to the point that the plating will support the specified number of passes of the specified compaction equipment, these areas will then be considered as stable subgrade areas. Embankment construction shall then proceed and all additional lifts of earth fill shall meet the requirements for placing, moisture, and density as specified in this specification for the particular class of earth fill.

5. Soft ground stabilization techniques in relation to embankment construction will not be undertaken by the Contractor without prior approval of the Engineer. When soft ground stabilization techniques are approved or requested by the Engineer, each lift of plating and each layer of geogrid will require specific approval by the Engineer prior to the Contractor proceeding to the next lift or layer. Any soft ground stabilization techniques performed by the Contractor without prior specific approval of the Engineer shall be subject to removal and proper replacement by the Contractor at no cost to the Owner.

6. Soft ground stabilization techniques shall not be used within any portion of a constructed soil liner used for containment purposes.

3.02 PLACING OF MATERIAL

A. Class 1 through Class 5 Earth Fill:

1. Place embankment materials on properly prepared subgrade as specified above. The combined excavation, placing, and spreading operation shall be done in such manner to obtain blending of material and to ensure that the materials, when compacted in the embankment, will have the best practicable degree of compaction, impermeability, and stability. The placing of materials from the borrow sources shall be in the zones as shown on the drawings or specified. Spread the earth materials that can be compacted with the specified tamping and pneumatic rollers with approved equipment in approximate horizontal layers not more than 8 inches thick for Class 1 and 2 earth fill and not more than 8 inches thick for Class 3 through 5 earth fill, before compacting over the length and breadth of the section of embankment under construction. Lift thickness will be reduced if required to consistently achieve the specified density. In areas where the specified tamping and pneumatic rollers cannot be utilized, spread the earth

materials in approximately horizontal layers not more than 4 inches thick before compacting. If the surface of the embankment is too smooth and hard to bond properly with succeeding layer, roughen and loosen the surface by scarifying before the succeeding layer is placed. Where fill is to be placed next to existing fill, remove fill to unweathered, dense material, sloped to no steeper than 1H:1V if existing fill face is parallel to the centerline of the embankment and 5H: 1V if the face is perpendicular to the centerline of the embankment. Bench and scarify each layer as adjoining lifts are placed. Route material hauling equipment over the surface of the embankment to distribute the added compaction afforded by the rolling equipment and to prevent the formation of ruts on the embankment surface.

2. As soon as practicable after commencement of construction of any section of the embankment, raise or crown the appropriate portions with grades not to exceed 2 percent so that the surface of the fill will drain freely and can be maintained throughout construction. During the dumping and spreading process, maintain at all times a force of men adequate to remove all roots and debris and all stones greater than 3 inches in maximum dimension from all embankment materials. Remove roots, stones and debris from the embankment and dispose of material in an approved manner.

B. Structural Backfill: Place structural backfill as shown on the drawings or as required for the various structures and in accordance with the provisions of Paragraph A above or 31 23 10 – Structural Excavation and Backfill.

C. Class 12 Earth Fill:

1. Prior to and immediately preceding spreading of Class 12 earth fill, lightly scarify the surface of the area to receive Class 12 earth fill and lightly wet the surface if unusually dry, as determined by the Engineer.

2. Uniformly spread Class 12 earth fill over the areas and to the thickness shown on the drawings or specified. Class 12 earth fill thickness shall be 4 inches if not shown or specified otherwise.

3. Remove stones 1-1/2 inches or larger in maximum dimension, stumps, large roots, or other objectionable debris from the Class 12 earth fill at the time of spreading, and dispose of material in an approved manner.

3.03 MOISTURE CONTROL - CLASS 1 THROUGH CLASS 5 EARTH FILL

A. General: The materials in each layer of the fill shall uniformly contain the amount of moisture within the limits specified below necessary to obtain the maximum dry density for the soil. Compact Class 1 and Class 2 earth fill with a moisture content at or within 5 percentage points wet of optimum moisture content. Compact Class 3, Class 4, and Class 5 earth fill with a moisture content within 3 percentage points dry to optimum moisture content. The moisture content ranges specified above for the various classes of earth fill represent maximum upper and lower limits of the particular range. Determination of the maximum dry density-optimum moisture is specified in Paragraph 3.04 of this specification. Completely cohesionless materials which are to be compacted to a specified percentage of maximum density and shall be at a moisture content which will allow use of the specified compaction equipment and consistent achievement of the specified density.

B. Irrigation of Borrow: Irrigation of borrow shall be done with distributing or sprinkling equipment that will uniformly produce the required results. Wet the material at the source of borrow to within 3 percentage points of optimum moisture content. Wet the material in the borrow pits by irrigation sprinkler system, by flooding, or by another approved method. Allow an adequate amount of time to wet the borrow source in advance of excavation operations to permit thorough and uniform distribution and penetration of moisture throughout the material. Divide the borrow area into sufficient sections to be worked in rotational order, for example, while one section is being worked, the previously worked section will be in the process of wetting, and the other sections will be in the process of curing to obtain uniform distribution and penetration of moisture.

C. Drying of Borrow: Drying of borrow prior to placing may be required if the placed material is wet enough to adversely affect the moisture and/or density of the underlying lifts.

D. Moisture Control During Placement: After spreading the soil on the embankment, adjust the moisture content of the soil if necessary by either aeration or the addition of water to bring the moisture content within the range specified. Uniformly distribute the moisture content throughout the layer of soil to be compacted. In order to accomplish this distribution, thoroughly mix the layer of soil by discing, harrowing, or by the use of a power-driven pulverizer. Should the surface of a previously compacted layer become dry due to exposure to the elements, appropriately wet the surface of the compacted layer prior to placing the succeeding layer of soil, and properly disk or harrow the surface. Should a layer of soil be over wet, allow the layer to dry to a proper moisture content prior to compacting. Should the surface of a layer become smooth and hard, roughen the surface by scarifying, and wet the surface if necessary prior to placing the next layer of soil. Reprocess any layer which becomes damaged by weather conditions to meet the specification requirements. There shall be no additional payment made for such reprocessing. The prescribed moisture and density characteristics of the compacted fill shall be met immediately prior to placement of any fill on top of it.

3.04 PROCESSING AND COMPACTION

A. Class 1 through Class 5 Earth Fill:

1. After a layer of fill material has been dumped and spread, thoroughly process the material to break up and blend the fill materials. Perform harrowing with a heavy disc plow or other approved harrow to the full depth of the layer. If the power-driven pulverizer is used, a minimum of three passes shall be required. If a heavy disc plow or other similar harrow is used, a minimum of five passes shall be required. Where space permits, each pass shall be in a direction perpendicular to the previous pass. Regardless of the type of equipment used, a greater number of passes than specified above shall be used if necessary to accomplish the breaking up and blending of the materials. When the moisture content and the condition of the layer is satisfactory, compact the lift of material by at least the specified number of passes to the percent of maximum density specified below.

2. Compact the Class 1 and Class 2 earth fill zones by a minimum of eight passes with a tamping roller. Compact the Class 3, Class 4, and Class 5 earth fill zones by a minimum of eight passes with a tamping roller or by a minimum of four passes with a tamping roller, followed by a minimum of four passes with a pneumatic roller. A vibratory roller

shall be required if the material is sandy and if requested by the Engineer. A pass shall consist of one trip over the area being compacted. The front and rear axle rollers on self-propelled models will only be considered as one pass per trip. The initial and final area to be rolled shall each have eight passes. Stagger passes between the initial and final area in order to establish overlapping with at least eight passes at all locations. Dumping, spreading, sprinkling and compacting may be performed at the same time at different points along a section where there is sufficient area to permit these operations including approximate testing to proceed simultaneously.

3. Areas of the fill being compacted with power hand tampers or vibratory plate hand compactors shall receive a minimum of eight passes of the equipment with an overlap of 50 percent of the equipment base plate width.

4. The in-place density of Class 1 through Class 5 earth fill shall not be less than 95 percent of maximum dry density as determined by ASTM D698, Standard Proctor, except compact the top 12 inches of fill underneath roadways and parking areas to not less than 100 percent of maximum dry density as determined by ASTM D698, Standard Proctor. In areas of cut underneath roadways and parking areas scarify and recompact the top 8 inches of the subgrade within the specified moisture content, to not less than 100 percent of maximum dry density as determined by ASTM D698, Standard Proctor.

5. Cohensionless materials on which are not practical to control the density by proctor methods shall be compacted to a minimum of 95 percent of the maximum density as determined by ASTM D4253.

6. Determine the moisture and density of in-place materials by one or more of the following ASTM procedures: D1556, D3017, or D2922.

7. If necessary to achieve the specified density, the number of passes of the compaction equipment shall be increased and/or the weight of the compaction equipment shall be modified.

8. Regardless of the density achieved, the number of passes of the compaction equipment shall not be less than eight.

B. Structural Backfill:

1. Place structural backfill as specified in Paragraph 3.02 at the moisture content specified in Paragraph 3.03 and to the density specified in Paragraph A above or as described in 31 23 10 – Structural Excavation and Backfill. Compaction shall be by power hand equipment or rubber tired equipment, provided the rubber tired equipment does no damage to the structure. Compaction by power hand equipment or rubber tired equipment shall be completed such that there will be a 24-inch overlap by roller compaction.

2. Do not permit rollers to operate within 3 feet of structures. Do not place backfill or other loads on or against concrete surfaces until at least 14 days have elapsed since placement. Before passage of hauling and rolling equipment over the top of a concrete structure will be permitted, the depth of fill over the concrete shall be sufficient to permit such passage without inducing harmful stresses or vibrations in the structures. Keep backfill on structures receiving fill on both sides within 2 feet of the opposite side.

C. Class 12 Earth Fill: Class 12 earth fill does not require specific compaction but roll with suitable construction equipment as required for initial stability. Finish grade Class 12 earth fill to a tolerance of plus or minus 0.1 foot. Repair any erosion of Class 12 earth fill at the Contractor's expense until final acceptance by the Owner.

END OF SECTION

31 23 23.34 FLOWABLE FILL

1.00 GENERAL

1.01 WORK INCLUDED

A. Furnish labor, materials, equipment, and incidentals necessary to mix and place flowable fill, consisting of Portland cement, fine aggregate, fly ash, and water in the proper proportions as specified hereinafter. Flowable fill (Controlled Low-Strength Material, CLSM) shall be used to bed and backfill around piping, utilities, and structures where indicated.

1.02 QUALITY ASSURANCE

A. Design Criteria – Flowable Fill Proportions and Consistency: Flowable fill shall be proportioned to give the necessary workability, strength, and consistency, and shall conform to the following governing requirements:

1. Permeability: Maximum permeability limit of $1x10^{-6}$ cm/sec. This limit shall apply at all locations where flowable fill is used as a utility trench plug (dam) within trench backfill materials.

1. Subsidence: Evaporation of bleed water shall not result in shrinkage of more than 10.4 mm per m (1/8 inch per ft.) of flowable fill depth. Measurement of a Final Bleeding shall be as measured in Section 10 of ASTM C940.

2. Strength for Excavatable Flowable Fill: Unconfined compressive strength at 28-days when tested in accordance with ASTM D4832: 100 psi (+/- 50 psi).

   a. The 1-year strength shall not exceed 150 psi.

   b. Where indicated provide Excavatable Flowable Fill around utilities, unless noted otherwise.

   c. Excavatable Flowable Fill shall be excavatable with hand tools and conventional machinery such as backhoes.

3. Strength for Non-Excavatable Flowable Fill: Unconfined compressive strength at 28-days when tested in accordance with ASTM D4832: 150 psi minimum.

   a. Where indicated provide Non-Excavatable Flowable Fill below structures and/or around structures, unless noted otherwise.

4. Fluidity: Flowable fill shall be self-consolidating and non-segregating in accordance with ASTM C1611:

   a. Slump Flow Test: Minimum 20-inch mean spread.

   b. Visual Stability Index (VSI) Test: Less than or equal to 1.

B. Factory Testing: The Contractor shall be responsible for the design of the material. A trial mix shall be designed by an independent testing laboratory, retained by the Contractor. The testing laboratory shall submit verification that the materials and proportions of the trial mix design meets the requirement of the Specifications. In lieu of trial mix design, Contractor may submit historical data for a mix design used successfully in previous similar work. The Contractor shall not make changes in materials, either in gradation, source, or

brand, or proportions of the mixture after having been approved, except by specific approval of the Engineer.

C. Owner Testing: It is the responsibility of the Contractor to achieve and maintain the quality of material required by this Section. However, the Owner may secure the services of an independent testing laboratory to verify the quality of the flowable fill. The Owner shall have the right to require additional testing, strengthening, or replacement of flowable fill which has failed to meet the minimum requirements of this Section.

1.03 SUBMITTALS

A. Submit mix design on each material required. Provide backup data as required below.

B. Submit historical or trial mix data and test results as a basis for mix design approval. Required data shall include:

1. Permeability test results if plugs are required on Project.
2. Subsidence test results.
3. Strength test results for Excavatable and Non-Excavatable Flowable Fill if used on Project.
4. Fluidity test results.

1.04 STANDARDS AND REFERENCES

A. Materials shall meet recommendation for mix design and placement, as published by National Ready Mixed Concrete Association.

B. The applicable provisions of the following references and standards shall apply to this Section as if written herein in their entirety.

1. American Society for Testing and Materials (ASTM) Standards:

ASTM C33	Specification for Concrete Aggregates
ASTM C40	Test Method for Organic Impurities in Fine Aggregates for Concrete
ASTM C150	Specification for Portland Cement
ASTM C618	Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as Mineral Admixture in Portland Cement Concrete
ASTM C 940	Standard Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory
ASTM C 1611	Standard Test Method for Slump flow of Self Consolidating Concrete
ASTM D 4832	Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders

2.00 PRODUCTS

2.01 MATERIALS

A. Cement: Portland cement conforming to the specifications and test for Type I Portland cement of the American Society for Testing and Materials, Designation C-150.

B. Fine Aggregate: Fine aggregate consisting of natural, washed and screened sand having clean, hard, strong, durable, uncoated grains complying with the requirements for ASTM C33. The sand shall generally be of such size that all will pass a 3/8-inch sieve, at least 95 percent pass a 1/4-inch screen and at least 80 percent pass a No. 8 sieve. Aggregate shall not contain strong alkali, or organic material which gives a color darker than the standard color when tested in accordance with ASTM Specification Designation C40.

C. Fly Ash/Pozzolans: Fly ash shall be an ASTM C618, Class "C" fly ash. The fly ash may be used in controlled low-strength material.

D. Water: Water for flowable fill shall be clean and free from oil, acid, alkali, organic matter or other harmful impurities. Water which is suitable for drinking or for ordinary household use will be acceptable for concrete. Where available, water shall be obtained from mains of a waterworks system.

E. Performance Additive: As required to meet specification requirements:

1. "Darafill" by Grace Construction Products.
2. Rheocell Rheofill by BASF The Chemical Company.
3. Sika Lightcrete Powder by Sika Corporation.
4. Approved equal.

F. Chemical Admixtures for Concrete per ASTM C 494, as required by performance requirements.

2.02 MIXES

A. In the determination of the amount of water required for mix, consideration shall be given to the moisture content of the aggregate. The net amount of water in the mix will be the amount added at the mixer; plus the free water in the aggregate; and minus the absorption of the aggregate, based on a 30 minute absorption period. No water allowance shall be made for evaporation after batching.

B. The methods of measurement of materials shall be such that the proportions of water to cement can be closely controlled during the progress of the Work and easily checked at any time by the Owner's representative. To avoid unnecessary or haphazard changes in consistency, the aggregate shall be obtained from sources which will insure a uniform quality and grading during any single day's operation and they shall be delivered to the Work and handled in such a manner that the variation in moisture content will not interfere with the steady production of flowable fill of reasonable degree of uniformity. Sources of supply shall be approved by the Owner's representative.

C. All material shall be separately and accurately measured. Measurement may be made by weight or by volume, as determined by the Contractor; however; all equipment for measurement of materials shall be subject to approval by the Owner's representative.

3.00 EXECUTION

3.01 INSTALLATION

A. Contractor shall give the Owner's representative sufficient advance notice before starting to place material in any area, to permit inspection of the area, and preparation for pouring.

B. Conduct the operation of depositing the material so as to form a compact, dense, impervious mass, and so as not to develop air pockets in confined spaces.

C. Unless specified otherwise, flowable fill shall be uniformly placed to the depth shown on the Drawings. The fill shall be brought up uniformly to the top of excavation elevation. Placement of flowable fill shall then cease and the fill protected from traffic for a period of 72 hours.

   1. To prevent pipe flotation place material in lifts or provide alternate means.

   2. Around structures, material shall be placed in lifts. Lift depth shall not exceed one-tenth of total structure embedment into subgrade nor 5 feet, whichever is less.

   3. When multiple lifts are required, material shall be allowed to harden before placing next lift. Hardening time varies with each mix. Verify flowable fill has reached a penetration number of 1500, in accordance with ASTM C 403, but not less than 5 hours.

D. The material shall be placed against undisturbed trench walls, and shall not be placed on or against frozen ground.

E. At time of placement the ambient temperature shall be 35 F and rising.

3.02 FIELD QUALITY CONTROL

A. An approved testing laboratory shall perform the quality control testing of backfill operations. The testing laboratory shall sample material in accordance with ASTM D5971. The testing laboratory shall monitor backfill operation continuously or at intervals acceptable to the Owner and Engineer at structures. It shall be the responsibility of the Contractor to provide sufficient advance notification to the testing laboratory before backfill operations begin.

   1. Strength: A strength test is the average of two cylinders per ASTM D4832.

   2. Fluidity: A fluidity test is a Slump Flow Test and a VSI Test per ASTM C1611.

   3. For all tests required, at a minimum perform one test per day, but not less than one per 150 cubic yards.

END OF SECTION

31 23 33.14 TRENCH SAFETY

1.00 GENERAL

1.01 WORK INCLUDED

A. This specification consists of the basic requirements which the Contractor must comply with in order to provide for the safety and health of workers in a trench. This specification is for the purpose of providing minimum performance specifications, and the Contractor shall develop, design, and implement the trench safety system. The Contractor shall bear the sole responsibility for the adequacy of the trench safety system and providing “a safe place to work” for the workman.

B. Should the trench safety protection system require wider trenches than specified elsewhere, the Contractor shall be responsible for the costs associated with determining adequacy of pipe bedding and class, as well as, purchase and installation of alternate materials.

1.02 STANDARDS

A. The following standard shall be the minimum governing requirement of this specification and is hereby made a part of this specification as if written in its entirety.

1. Occupational Safety and Health Standards - Excavations (29CFR Part 1926), U.S. Department of Labor, latest edition.

B. Comply with the applicable federal, state, and local rules, regulations, and ordinances.

2.00 PRODUCTS (NOT APPLICABLE)

3.00 EXECUTION (NOT APPLICABLE)

END OF SECTION

31 23 33.16 TRENCHING AND BACKFILL

1.00 GENERAL

1.01 WORK INCLUDED

A. Furnish labor, materials, equipment and incidentals necessary to excavate and backfill as required for the construction of the facilities to the line, grade and extent indicated.

1.02 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00 “Submittal Procedures” and shall include:

1. Certified test reports for embedment material, course gravel, and flexbase. Certified Test Reports shall be from an independent laboratory. Test reports shall include sieve analysis, soil classification, and Atterburg limits, and soil resistivity tests for embedment material.

1.03 STANDARDS

A. The applicable provisions of the following standards shall apply as if written here in their entirety:

1. American Society for Testing and Materials (ASTM) Standards:

ASTM C33	Specifications for Concrete Aggregates
ASTM D698	Test Methods for Moisture-Density Relations of Soils and Soil Aggregate Mixtures, Using 5.5-lb Rammer and 12-Inch Drop
ASTM D2487	Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D4253	Maximum Index Density and Unit Weight of Soils Using Vibratory Tests
ASTM G57	Method for Field Measurement of Soil Resistivity Using the Wenner Four-Electrode Method

2. American Water Works Association (AWWA) Standards:

AWWA C151	Ductile Iron Pipe
AWWA C200	Steel Water Pipe 6 Inches and Larger
AWWA C301	Prestressed Concrete Pressure Pipe - Steel Cylinder Type for Water and Other Liquids
AWWA C303	Concrete Pressure Pipe – Steel Cylinder Type for Water and other Liquids

3. Texas Highway Department Standard Specifications for Road and Bridge Construction, latest edition.

1.04 JOB CONDITIONS

A. Classification of Excavation: Excavation shall be “unclassified” and involves the removing of the necessary materials to provide the trench to the required width and depth. The

Contractor, prior to submitting a proposal, must satisfy himself as to the actual sub surface conditions. No extra or separate payments shall be made for rock, dewatering, or any other condition.

B. City, County, and Private Road Crossings: Where the work is in the right of way of City, County and privately owned roads, the Owner will secure the necessary permits and easements for the work. Work to be performed within the limits of the public right of way shall be in full accordance with the requirements of the easements and permits and as requested by the City, County, or private owner. Provide temporary access and detours for roads and driveways cut off during pipe laying operations.

C. Protection of Existing Structures and Utilities:

1. Prior to the start of construction and preparation of pipe layout sheets, the Contractor shall communicate with the local representative of the utility companies including, but not limited to the oil companies, gas company, electric company, telephone company, water utilities, sanitary sewer utilities, and any other public and private utility companies in the location of the proposed construction in order to obtain the assistance of the utility companies in locating utility lines and in the avoidance of conflicts with utility lines. The Contractor shall uncover and determine the elevation and location of conflicts well ahead of the manufacture of the pipe. No additional compensation will be considered for lowering or raising the pipe grade to accommodate existing utilities. The Engineer has shown the estimated location of existing utilities as determined from field surveys and record data from utility companies. The fact that some utilities are not shown or are incorrectly shown in no way relieves the Contractor from his responsibility to locate all existing utilities.

2. The Contractor shall advise the Engineer of any existing utilities which are not shown on the plans, incorrectly shown, and which “affect the pipe layout.” Contractor shall also propose a resolution of the utility conflict. The Engineer will decide if the existing utility should be relocated, or whether the proposed pipeline location will be revised. If the proposed pipeline is adjusted, an adjustment in contract price will be made by adjusting quantities for the various unit price pay items. If the proposed pipe grade is adjusted by 2 vertical feet or less, no contract price adjustment will be made. If the proposed pipe grade is adjusted by more than 2 vertical feet, a contract price adjustment will be agreed to per the General Conditions.

3. Utilities which “affect the pipe layout” will be interpreted by the Engineer as follows:

   a. Utilities which conflict with the grade of the proposed pipe will be interpreted as “affecting the pipe layout.”

   b. Utilities which would conflict with operations and maintenance of the proposed pipe will be interpreted as “affecting the pipe layout.”

4. Where excavation endangers adjacent slopes, structures and utilities, the Contractor shall, at his own expense, carefully support and protect such structures and/or utilities so that there shall be no damage. Costs of temporarily or permanently relocating the conflicting utilities shall be borne by the Contractor without extra compensation from the Owner.

5. If in the opinion of the Engineer, concrete backfill is necessary for the support of utility lines crossing trenches, the Engineer may direct 2000 psi concrete backfill to be used.

Payment shall be made to the Contractor at the unit price bid for the installation of such quantity of the concrete backfill as directed by the Engineer.

1.05 GUARANTEES; MAINTENANCE AGREEMENT

A. Following the certification of completion by the Engineer, maintain paved surfaces, unpaved trench surfaces, fences, curbs, sidewalks, and gutters, for a period of 12 months thereafter. Material and labor required for the maintenance shall be supplied by the Contractor, and the work shall be done in a manner satisfactory to the Engineer.

2.00 PRODUCTS

2.01 MATERIALS

A. Concrete Embedment, Cap, Blocking, and Encasement: Where concrete embedment, cap, blocking, or encasement is indicated or requested by the Engineer, it shall be 2000 psi unless otherwise indicated.

B. Granular Embedment:

1. Granular embedment material shall be sandy gravel or blended sand and crushed rock, free from large stones, clay, and organic material. Embedment material shall be a soil classification of GW, GP, SW, or SP as determined by ASTM D2487. The embedment material shall be such that when wet, the fine material shall not form mud or muck or be dispersive. The embedment material shall be composed of tough durable particles, reasonably free from thin, flat and elongated pieces, and of suitable quality to insure permanence in the trench. The P.I. of the fines shall not exceed 3. Light weight aggregate is not acceptable for granular embedment. Material used for granular embedment shall have a resistivity of not less than 5000 ohms/cm as measured by ASTM G57.

2. Granular Embedment for Rigid Pipe: This shall be cohesionless material meeting the following gradation requirements:

Sieve Size Square Opening	Percent Passing
1/2”	100
3/8”	85-100
No. 4	10-30
No. 8	0-10
No. 16	0-5

3. Pipe Classification:

a. For the purpose of this specification, “rigid pipe” shall be defined as the following:

1). All diameters Prestressed Concrete Pressure Pipe (AWWA C301).

2). 24-inch and smaller diameters Bar-Wrapped Concrete Cylinder Pipe (AWWA C303).

3). All diameters Ductile Iron Pipe (AWWA C151).

b. For the purpose of this specification, “semi-rigid pipe” shall be defined as the following:

1). 27-inch and larger diameters Bar-Wrapped Concrete Cylinder Pipe (AWWA C303).

2). All diameters Steel Water Pipe (AWWA C200).

C. Coarse Gravel: Where coarse gravel is required for water drainage, restoration of trench foundation, or other uses, it shall be crushed stone or washer gravel and in compliance with ASTM C33 for Coarse Concrete Aggregate. Gradation shall be ASTM C33 No. 57, No. 67, or as follows:

Sieve Size Square Opening	Percent Passing
1”	95-100
3/4”	55-85
1/2”	25-50
No. 4	0-5

D. Select Material: This material shall consist of soil material with a liquid limit (LL) less than or equal to 40, a plasticity index (PI) less than or equal to 20, a maximum of 70 percent passing the No. 200 mesh sieve, a minimum of 80 percent passing the No. 4 mesh sieve, 100 percent passing a 1-1/2-inch square mesh sieve. The material shall be free of organic or other deleterious materials.

E. Ordinary Backfill Material: Trench excavated material free from rock fragments and clods larger than 6 inches greatest dimension. The ordinary material shall be free from organic materials.

F. Flexible Base Course: Complying with Item 248 of the Texas Highway Department Standard Specifications for Road and Bridge Construction, latest edition, Type A, Grade 1 or 2, Flexible Base (Crushed Stone) or Type F, Grade 2 or 3 (Caliche).

G. Hot Mix Asphalt Concrete (HMAC): Complying with Item 340 of the Texas Highway Department Standard Specifications for Road and Bridge Construction, latest edition.

H. Flowable Fill: Flowable fill shall be as specified in Section 31 23 23.16 “Flowable Fill.”

3.00 EXECUTION

3.01 TRENCH EXCAVATION

A. General:

1. Excavate trenches to the alignment, width, and depth as indicated or as required for the proper installation of the pipe. Brace the trench and/or dewater the trench if necessary so that the workmen may work safely and efficiently.

2. Comply with all applicable laws, ordinances, rules, regulations and orders of any public body having jurisdiction for the safety of persons or property or to protect them from damage, injury or loss. Comply with the requirements of Section 31 23 33.14 “Trench Safety.”

3. Dewater excavations so that the work is performed in the "dry." Bailing, pumping, and dewatering shall be at the Contractor's expense. Use coarse gravel instead of embedment material under the pipe at no extra cost to the Owner to provide for the free drainage and flow of water in the pipe trench, where it is necessary, in order to keep the water level below the pipe barrel and bell holes for joints. The water removed from trenches shall be conducted to natural drainage ways, drains, or storm sewers in such a manner as to prevent damage to adjacent property or to the public. Pumps of ample capacity and in duplicate must be provided to insure that once an excavation is made dry, the water is kept down until that part of the work under construction is completed.

4. It is intended that the line be laid to the grades as shown on the plans. The precise and detailed pipe layout is to be prepared by the Contractor and submitted to the Engineer for information and review. The responsibility for the workability of the detailed layout remains with the Contractor. High points shall be located at air valves and the pipe sections containing air valves shall have a horizontal grade. At drainage crossings, the depth of cut shall be increased to prevent uncovering of the pipe by surface erosion, as shown on the plans.

5. Where unforeseen conditions warrant a revised grade during construction, the Contractor shall submit a revised pipe layout to the Engineer for approval. No intermediate "highs" or "lows" will be allowed in the pipe grade without the approval of the Engineer.

B. Pipe Trench:

1. For the purpose of this specification, the "pipe zone" shall be defined as the zone from the bottom of the trench to 6 inches above the top of the pipe.

2. The trench walls in the "pipe zone" shall be vertical.

3. Trench width shall be as follows:

Pipe Diameter	Minimum Trench Width	Maximum Trench Width
32" and Smaller	Pipe O.D. plus 20"	Pipe O.D. plus 24"
33" and Larger	Pipe O.D. plus 24"	Pipe O.D. plus 36"

4. Trench walls above the pipe zone may be laid back or benched where room permits as necessary to meet the requirements of OSHA.

5. Where the character of the trench walls is loose, unstable, saturated soft clays, quicksand, or otherwise unable to provide adequate side support to maintain the required pipe deflection, the Contractor shall modify the trenching and backfill to keep the pipe within the limits of the specified deflection. The Contractor shall widen the trench excavation one pipe diameter on each side of the pipe. The trench shall then be backfilled with coarse gravel to the top of the pipe. The coarse gravel shall be compacted to 95 percent maximum density as measured by ASTM D4253. Care shall be used so that the exterior pipe coating is not damaged. Concrete encasement, soil cement, or some other method approved by the Engineer, may be used in lieu of this procedure. Payment shall be made to the Contractor at the unit price bid for the installation of such quantity of coarse gravel as directed by the Engineer.

C. Pipe Foundation:

1. Excavate the trench to an even grade so that the full length of the pipe barrel is supported and joints make up properly. Excavate the trench to the line and grade indicated and as directed by the Engineer. Grades shall be uniform between high points and low points to eliminate intermediate "highs and lows."

2. For 32-inch diameter and smaller pipe, the trench shall be "rough cut" a minimum of 4 inches below the bottom of the pipe. For 33-inch and larger pipe, the trench shall be "rough cut" a minimum of 6 inches below the bottom of the pipe. The "rough cut" dimension shall be increased as necessary to provide a minimum clearance of 2 inches from the bottom of the trench to the bottom of the bells, flanges, valves, fittings, etc.

3. The entire foundation area in the bottom of all excavations shall be firm, stable material. Loose material shall be removed, leaving a clean, flat trench bottom, and material shall not be disturbed below required sub grade except as hereinafter described. If the subgrade is soft, spongy, disintegrated, or where the character of the foundation materials is such that a proper foundation cannot be obtained at the elevation specified, then when directed by the Engineer the Contractor shall deepen the excavation to a depth where a satisfactory foundation can be obtained. The sub grade shall then be brought back to the required grade with course gravel, thoroughly compacted to 95 percent of maximum density in accordance with ASTM D4253. Payment shall be made to the Contractor at the unit price bid for the installation of such quantity of coarse gravel as directed by the Engineer.

D. Correcting Faulty Grade: If the trench is excavated to a faulty grade (at a lower elevation than indicated), correct the faulty grade as specified below:

1. In uniform, stable dry soils, correct the faulty grade with granular embedment material thoroughly compacted to 95 percent of maximum density.

2. In soft spongy disintegrated soils or where necessary to allow proper drainage, correct the faulty grade with course gravel compacted to 95 percent of maximum density.

3. No extra payment will be made for coarse gravel or other material to correct faulty grade.

E. Pipe Clearance in Rock: Remove ledge rock, rock fragments, or unyielding shale or marl to provide a clearance of at least 6 inches below the parts of the pipe, valves or fittings. Provide adequate clearance for properly jointing pipe laid in rock trenches at bell holes. Refill the excavation to grade with granular embedment material.

F. Blasting Procedure: Blasting will not be allowed.

G. Bell Holes Required: Bell holes of ample dimension shall be dug in trenches at each joint of pipe to permit the jointing to be made properly, visually inspected, and so that the pipe will rest on the full length of the barrel. Polyurethane, coated steel pipe shall have the joints excavated to a sufficient depth to allow proper cleaning, application, testing and inspection of field applied coating system.

H. Care of Surface Material for Reuse: Surface materials such as top soil in its natural state, suitable for reuse in restoring the excavated surface, shall be kept separate from the general excavation material. The top 12 inches of the trench backfill shall be topsoil. Save the topsoil to be used as backfill of the top 12 inches of the trench after pipe laying. Where the

natural topsoil is less than 12 inches deep and with the approval of the Engineer, the Contractor may strip less than 12 inches of topsoil.

I. Manner of Piling Excavated Material: Place excavated material so that work is not endangered or interferes with public traffic or other construction. Do not place excavated material over buried pipelines or existing utilities unless adequate provisions are made to protect those pipelines and/or utilities. Roads and driveways must be kept open in every case. Keep drainage channels clear of obstructions or make other satisfactory provisions for drainage.

J. Trenching by Machine or by Hand: The use of trench digging machinery is approved except in places where operations of same will cause damage to existing structures or pipelines above or below ground, in which case employ hand methods.

K. Open Trench: Owner's Representative shall have the right to limit the amount of trench which may be opened or partially opened at any time in advance of the completed line; and also the amount of trench left not backfilled. Not over 500 feet of trench in open country or pasture land shall be opened at any one time, and not more than 150 feet of trench in populated areas shall be left open unless otherwise permitted in writing by the Owner. Backfill and/or protect trenches as necessary to prevent injury to livestock, adjacent property, and the public. Trenches left open overnight in public areas shall be fenced with adequate construction fencing. No trenches shall be left open overnight in streets.

L. Structural Excavation: Excavation shall extend a sufficient distance from walls and footings to allow for form installation and inspection, except where concrete for walls and footings is authorized or required to be deposited directly against excavated surfaces. Where excavation, through the fault of the Contractor, is made below the elevation specified or directed by the Engineer, restore the excavation to the proper elevation with stabilized backfill (lean concrete) or other approved material at the Contractor's expense.

3.02 BACKFILLING OF TRENCHES OUTSIDE ROADWAYS

A. General: This Section of the specification is intended to cover the requirements for trench backfill where trench is in open fields, unimproved alleys, fields, and other similar open areas outside of existing or proposed public and private roadways.

B. Time of Backfilling: Backfill operations shall immediately follow pipe jointing, joint coating application, and curing.

C. Braced and Sheeted Trenches: Remove sheeting and shoring as backfilling operations progress. Incorporate methods so that a good bond is obtained between the backfill material and the undisturbed trench walls.

D. Protection of Pipe During Backfilling Operations: Take the necessary precautions to protect the pipe during backfilling operations. Take care to prevent damage to the pipe or to the pipe coating, and repair any damaged pipe before being "covered up." Backfill the trench to prevent the deformation or otherwise deflection of the cylindrical shape of the pipe by more than the allowable pipe deflection as specified elsewhere. Use methods such as stulling or ellipsing as necessary.

E. Site and Preparation: In addition to clearing and grubbing of brush and trees along the right of way for this project, alteration to the topography shall be done if indicated on the Plans, at the locations and to the extent shown.

F. Backfill Procedures in the Pipe Zone for Rigid Pipe:

1. Place the specified granular embedment material on satisfactory trench foundation to the indicated dimensions in two lifts. The first lift shall extend from the bottom of the trench to slightly above the bottom of the pipe grade. Lay pipe on the first lift of embedment material to the indicated grade. The second lift shall be the remainder of the embedment material to 0.25 of the outside diameter of the pipe. Compact granular embedment material on both sides of the pipe to 95 percent of the maximum density as measured by ASTM D4253. Compact embedment by vibration, mechanical tamping, or a combination thereof.

2. Place first lift of embedment material true to line and grade with bell holes of ample dimension to permit the pipe to rest on the full length of the barrel and to permit joint make-up and coating application at joints.

3. Place second lift of embedment material carefully to prevent voids under the haunches of the pipe and to prevent disturbing pipe alignment.

4. After placement of the embedment material, deposit select material in the trench simultaneously and evenly on both sides of the pipe for the full width of the trench to the top of the pipe zone. Consolidate this material by mechanical compaction within 2 percent of optimum moisture content. Compaction in this zone shall be a minimum of 95 percent of Standard Proctor Density.

5. Mechanical compaction of select backfill material shall be in lifts not exceeding 18 inches loose depth.

6. Perform the mechanical compaction to prevent floating or damaging the pipe. Relay any pipe which is floated or otherwise disturbed to the original grade at the Contractor's expense.

G. Backfill Procedure in the Pipe Zone for Semi Rigid Pipe:

1. Place the first lift of granular embedment material to a depth slightly above the bottom of pipe grade. Lay pipe on this embedment material to the indicated grade. Provide bell holes to permit the pipe to rest on the full length of the barrel and to permit joint make-up and coating.

2. For semi-rigid pipe construction, extend the embedment material from the bottom of the trench to 6 inches over the top of pipe.

3. Place the second lift of embedment material, uniformly on both sides of the pipe to a loose depth of one-half of the outside diameter of the pipe, taking precautions not to disturb the pipe alignment. Compact the second lift of embedment material using vibration or mechanical tamping to produce a uniformly blended and compacted backfill. Contractor shall take precautions to ensure no voids occur under the haunches of the pipe and to prevent disturbance of the pipe alignment.

4. Place the third lift of granular embedment material in the trench simultaneously and evenly on both sides of the pipe for the full width of the trench to an elevation of 6 inches above the top of the pipe using vibration or mechanical tamping. Compaction of granular embedment in this zone shall be at a minimum of 95 percent Maximum Density in accordance with ASTM D4253.

5. After placement and compaction of the third lift, add additional granular embedment to fill the voids and strike-off the embedment to be level at an elevation 6 inches above the pipe.

H. Procedure Above Pipe Zone: Mechanical compaction may be utilized. Place the ordinary backfill material above the pipe zone in lifts not exceeding 18 inches loose depth and compacted to 90 percent Standard Proctor density in areas outside of existing or proposed roadways. The Contractor shall be responsible for any damage which may occur to the pipe using his method of compaction.

I. Surface Material Replacement:

1. The top 12 inches of the trench backfill shall be composed of the original surface material or topsoil excavated from the trench. Place the topsoil over the consolidated trench backfill material and neatly round over the trench to a sufficient height to allow settlement to grade after consolidation. Grade the surface to allow drainage in the same manner as existed prior to construction.

2. Topsoil shall not contain rocks or clods larger than those adjacent to the trench in the undisturbed condition.

J. Backfill Around Structures:

1. After completion of foundations, walls, etc., remove forms and clean excavation of debris or other objectionable matter prior to placing backfill. Comply with the requirements of Section 31 23 10 “Structural Excavation and Backfill” for backfill adjacent to cast-in-place structures.

2. In areas where structures such as slabs, foundations, or pipes are to be constructed on backfill, backfill shall be lean concrete or; flowable fill, unless otherwise indicated.

3. For pre-cast concrete structures, mechanically tamp earth backfill around and over structures, using select material, and placed in layers not to exceed 8 inches, loose thickness. Bring material to within 2 percent of optimum moisture content and compact each layer to a uniform density of not less than 95 percent of maximum density as determined by ASTM D698. Laboratory control shall be used to secure compliance with this requirement.

K. Inspection and Test Pits:

1. Excavate test pits after the embedment has been placed and compacted in the pipe zone for the purpose of taking field density tests and inspecting the haunch areas under the pipe for voids.

2. Excavate the test pits to a depth and area of sufficient size to allow the inspector to visually inspect the haunch area of the pipe for voids or loose material next to the pipe and to make a field density test. Provide a safety trench shield to protect the inspector while in the pit.

3. After inspection, backfill and compact the test pit area in accordance with the applicable specification herein.

4. Dig one test pit for inspection of each day’s work if deemed necessary or may be required more or less frequently as determined by the Owner’s representative. Repair

and replace areas which are found not to be in compliance with the specification requirements, until satisfactory results are consistently and uniformly attained.

5. Provide special attention to assure that the material flows under the pipe haunches. This may require the removal of pipe joints to observe the results and make density tests. Pipe laying shall not begin until satisfactory results are achieved by the Contractor's proposed method.

3.03 BACKFILL PROCEDURE FOR PUBLIC AND PRIVATE ROADS

A. Trench excavation, pipe laying, backfill within the pipe zone and other general requirements shall be as indicated for trenches outside roadways. Backfill material above the pipe zone for existing roads including City Roads, County Roads, paved or improved private roads, driveways, and any proposed roads as indicated shall consist of granular embedment material for the full depth of the trench to subgrade of flexible base. Compact the backfill to 95 percent maximum density per ASTM D4253. Replace flexbase roads with a minimum of 12 inches of flexbase material compacted in 6-inch lifts to 95 percent Standard Proctor Density. Replace asphalt paved roads with 8 inches of flexbase material compacted in 4-inch lifts to 95 percent Standard Proctor Density and 4 inches of HMAC. Replace concrete roadways with 3000 psi concrete reinforced equal or better than existing. Saw-cut asphalt roads prior to placement of HMAC. Cut concrete roads back to expose reinforcing prior to replacing concrete paving. Backfill and compact unimproved field road as per the backfill requirements for open areas, except compact the top 12 inches to 95 percent Standard Proctor Density.

3.04 MAINTENANCE OF SURFACES

A. Rock and Organic Material Exclusion: Rock and organic material removed from the trench excavated material shall be removed from the right of way at the Contractor's expense.

B. Deficiency of Backfill - by Who Supplied: Any deficiency in the quantity of material for backfilling the trenches or for filling depressions caused by settlement shall be supplied by the Contractor at his expense. Make-up material shall be approved by the Owner's representative.

C. Restoration of Surfaces: Replace surface material and restore paving, curbing, sidewalks, gutters, shrubbery, fences, grass or turf, and other surfaces disturbed, as nearly as possible to a condition equal to that before the work begin.

D. Seeding and Sodding: See Specification Section 31 25 13.13 – "Seeding for Erosion Control".

3.05 CLEAN AND ADJUST

A. Remove surplus pipeline materials, tools, rubbish, trees, and temporary structures, and leave the construction site clean, to the satisfaction of the Engineer. Grade the surface, and re-establish drainage. Removal of rock and other excess excavated material and general leveling and grading of the right of way surface to a presentable appearance shall proceed so as to not be further than 2500 feet behind the backfilling operations. The Contractor shall be responsible for location of sites for disposal of excess material and the Owner shall make no additional payment for expenses incurred in such disposal.

END OF SECTION

31 25 13.13 SEEDING FOR EROSION CONTROL

1.00 GENERAL

1.01 WORK INCLUDED

A. Provide labor, materials, equipment and incidentals necessary to seed the slopes and other areas as specified. This specification includes seedbed fertilization, watering, mulching, and emulsifying or tacking the mulch and maintenance until final acceptance by the Owner.

1.02 QUALITY ASSURANCE

A. Soil Testing: Fertilizer requirements for each planting area and for significantly different soil types within planting areas, will be determined by a qualified laboratory such as the Texas A&M University - Agricultural Extension Service soil testing laboratory. Representative composite soil samples will be collected from the planting areas and submitted to an approved soil testing laboratory.

1.03 STANDARDS

A. The seed used on this project will conform to ITEM 164.2 Standard Specifications for Construction of Highways, Streets and Bridges, Texas Department of Transportation.

1.04 DELIVERY AND STORAGE

A. Deliver seed with each variety separately bagged.

1.05 OPTIONS

A. If dry mechanical methods are used, the fertilizer may be spread at the same time as the seed. After sowing, straw mulch will be mechanically spread over the seeded area.

B. When seed and fertilizer are to be distributed as a water slurry, apply the mixture within 30 minutes of mixing.

2.00 PRODUCTS

2.01 MATERIALS

A. Seed: From the previous season's crop, labeled in accordance with the Texas Seed Law.

1. Seed for Fall planting (temporary) shall be one or more of the following small grains as designated by the Engineer: Wheat, oats, rye, or barley.

2. Seed for spring planting (permanent) shall be Bermuda grass.

B. Fertilizer: Insert requirements.

C. Mulch:

1. Consisting of straw, wood-fiber, mulch nettings, wood chips or other suitable material approved by the Engineer and free of Johnson grass and other noxious weed seeds.

2. Straw mulch shall be oat, wheat or rice straw, prairie hay, Bermuda grass hay, or other hay harvested before seed production and approved by the Engineer. The straw mulch

will be kept dry and shall not be rotted or molded. A minimum of 50 percent by weight of the herbage making up the hay shall be 10 inches in length or longer.

D. Topsoil: As specified for Class 12 earth fill in Section 31 05 13 “Soils for Earthwork.”

E. Herbicide: Contractor shall be responsible for using herbicides in a manner consistent with label requirements and precautions. Only registered herbicides having a minimal residual effect shall be used. Contractor shall strictly adhere to all Federal, State, and local laws governing herbicide usage.

3.00 EXECUTION

3.01 TOPSOIL PLACEMENT

A. Place topsoil as specified for Class 12 earth fill in Section 31 23 23.16 “Compacted Earth Fill [Landfills and Heavy Earthwork Projects, Excluding Dams].”

3.02 FALL PLANTING

A. Fall planting will be temporary only and will be required if construction is completed between May 15 and November 30. The fall planting is to be followed by a spring planting of perennial vegetation.

B. Seedbed Preparation: Use a one-way plow, tandem disk, bedder, or equipment which will accomplish similar results. Break or mix the surface of the soil with the tillage equipment. Additional tillage operations will be necessary if required so planting can be on a clean, firm seedbed. Chiseling will be necessary on areas which have been severely compacted.

C. Seeding:

1. Seeding will be required on disturbed or excavated areas and on new embankments of whatever nature unless requested otherwise by the Engineer.

2. Optimum fall planting dates are September 1 to November 30. Accomplish the seeding for fall planting within these dates unless approval to do otherwise is obtained from the Engineer. Planting rates when drilled or broadcast are as follows:

Seeding	lb./acre
Wheat	120 lb./acre
Oats	128 lb./acre
Rye	112 lb./acre
Barley	114 lb./acre

3.03 SPRING PLANTING

A. Follow procedures for spring planting if construction is completed between November 30 and May 15, or after a temporary fall planting has been made:

1. Seedbed Preparation: Seedbed preparation for Spring planting is the same as that stated in the Fall planting of temporary cover with one addition: Any temporary cover crop must be top killed using an approved contact herbicide or by mechanically undercutting the growing cover crop, leaving residues on or near the soil surface.

2. Mulching:

    a. Spread mulch material on the area to be planted if construction was completed too late for planting a temporary fall crop or if insufficient residues are produced by the fall planting. Mulch the planting areas to control soil erosion and seed loss by wind and water and to promote grass establishment. Apply Mulch hay at the rate of 2 tons per acre and spread uniformly so that about 25 percent of the ground surface is uniformly visible through the mulch.

    b. Anchor the mulch hay by treading into the soil with a straight disk type mulch tiller. Perform disking across the slope along contours. Other types of mulch such as wood cellulose fiber or cotton bur mulch may be used at recommended rates, if approved by the Engineer. Apply mulch in a manner that will not hinder emergence of seedlings.

    c. Other methods of mulch anchoring are available, including mulch netting, peg and twine, pick chain, slit, and asphalt mulch tie-down. Descriptions of these methods are available in the 1976 Soil Conservation Service report entitled, “Erosion and Sediment Control Guidelines for Developing Areas in Texas.”

3. Seeding:

    a. Plant Bermuda grass seed between March 1 and May 15. Sow the seed at the rate of 50 pounds of pure live seed (PLS) per acre, or more if required to obtain a complete stand of grass. The PLS content is determined by multiplying the seed package weight by the product of the percent purity and the percent germination, which are contained on the seed label.

    b. Accomplish seeding by mechanical means using either broadcasting or drilling type equipment to provide uniform distribution of the seed in the planting areas. Cover Bermuda grass seed by 1/4 to 1/2 inch of soil. If seed is drilled, the distance between drill rows shall not exceed 12 inches. Hydro seeding may be used to apply seed, fertilizer, and wood-fiber mulch with the approval of the Engineer.

3.04 MAINTENANCE

A. Irrigation: Supply the seeded areas with adequate moisture (3- to 4-inch penetration) at 10-day intervals, if needed, for seed germination and plant growth until acceptance by the Owner. Water the seed in a manner which will prevent erosion of the soil. Furnish all water to be used.

B. Repair: Repair washouts and other bare soil areas in a seeded area either by re-seeding, sprigging, or spot sodding, and perform maintenance as needed to establish grass in the area.

C. Weed Control:

1. Control competitive weed growth during the establishment period by mowing and/or with herbicides. Chemical usage shall be in accordance with the current recommendations of the Texas Agricultural Experiment Station or local Soil Conservation Service Field Office Technical Guides. Strictly adhere to all Federal, State, and local laws governing herbicides.

2. Weed control shall be the Contractor's responsibility whether topsoil is from on-site or off-site sources and also for seeded areas which are specified not to receive topsoil.

3.05 SEEDING OF DISTURBED AREAS

A. Disturbed areas will require seeding as specified in this Section unless requested otherwise by the Engineer or shown otherwise on the drawings or in the specifications.

B. Any areas which are disturbed by the Contractor which are not shown on the drawings or specified to require disturbance including any approved areas not shown on the drawings, shall be considered as unauthorized disturbed areas. Any such areas shall be seeded as specified in this Section at the Contractor's expense and shall not be measured or paid under this Section.

3.06 FIELD QUALITY CONTROL; OBSERVATION AND ACCEPTANCE

A. Observation: Upon completion of the site preparation, mulching, fertilizing, seeding, and maintenance of seeded areas, the Engineer will observe the seeded areas periodically to determine the establishment success. The Engineer will consider soil coverage, purity of the grass stand, and maturity of the plants.

B. Establishment of Stand and Acceptance:

1. The Engineer will determine that a grassed area is established upon fulfillment of the following conditions:

2. The permanent grass stand uniformly covers the planting area, with no exposed soil areas more than 36 inches across in any dimension.

3. The permanent grass stand is free of over-topping weed species which would compete for sunlight, moisture, and nutrients. In addition, no area of pure weed species greater than 36 inches across in any dimension shall occur within a permanent grass stand.

4. The majority of the grass plants in a stand shall have a well-established root system to survive if irrigation is discontinued.

5. Establish the permanent grass stand before October 1 to preclude having to perform a temporary Fall seeding. In the event a fall seeding must be performed, follow-up the temporary seeding with a permanent seeding as specified. Upon final acceptance of the work under this contract, the Owner will assume the responsibility of maintaining the grassed areas.

END OF SECTION

31 32 19.24 GEOTEXTILE/GEONET COMPOSITE LAYER SEPARATION

1.00 GENERAL

1.01 WORK INCLUDED

A. Furnish labor, materials, equipment and incidentals necessary to install geonet/composite with geotextile. Use the geonet/composite with geotextile between the leveling course and the granular base fill.

1.02 QUALITY ASSURANCE

A. Design Criteria:

1. The geonet shall be a high density polyethylene net structure. The minimum roll value (MRV) for strength properties of any individual geonet roll tested from the manufacturing lot or lots of a particular shipment shall meet or be in excess of minimum roll value (MRV) as stipulated herein.
2. The geotextile fabric shall be inert to commonly encountered chemicals, hydrocarbons, mildew and rot resistant, resistant to ultraviolet light exposure, insect and rodent resistant, and conform to the properties in the following table.
3. The minimum roll value (weakest principle direction) for strength properties of any individual geotextile roll tested from the manufacturing lot or lots of a particular shipment shall be in excess of the minimum average roll value (weakest principle direction) stipulated herein.

Geonet			
Property	**Test Method**	**Units**	**MRV**
Density	ASTM D1505	g/cc	0.94
Tensile Strength (MD) @ Break	ASTM D5035	lb./in.	60
Thickness	ASTM D5199	In.	0.25

Geotextile			
Property	**Test Method**	**Units**	**MRV**
Grab Tensile Strength	ASTM D4632-91	lb.	200
Trapezoidal Tear Strength	ASTM D4533-91	lb.	80
Puncture Resistance	ASTM D4833-88	lb.	120
AOS	ASTM D4751-87	US Sieve	80
Porosity		%	
Permittivity	ASTM D4491-92	Sec^{-1}	1.3

Geonet/Composite with Geotextile – Both Sides			
Property	**Test Method**	**Units**	**MRV**
Transmissivity @ 1 Gradient; 5000 psf Compressive Load	ASTM D4716	M^2/sec	

B. Packing and Identification Requirements: Provide the geonet/composite with geotextile in rolls wrapped with protective covering to protect the fabric from mud, dirt, dust, and debris. The geonet/composite with geotextile shall be free of defects or flaws which significantly affect its physical properties. Label each roll of geonet/composite with geotextile in the shipment with a number or symbol to identify that production run.

C. Sampling and Compliance Requirements: A competent laboratory must be maintained by the producer of the fabric at the point of manufacture to insure quality control in accordance with ASTM testing procedures. The laboratory shall maintain records of its quality control results and provide a manufacturer's certificate upon request to the Engineer prior to shipment. The certificate shall include:

1. Name of manufacturer.
2. Chemical composition.
3. Product description.
4. Statement of compliance to specification requirements.
5. Signature of legally authorized official attesting to the information required.

1.03 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00 "Document Management" and shall include:

1. Submit Manufacturer's certificate as stipulated in Paragraph 1.02C.

2.00 PRODUCTS

2.01 MATERIALS

A. Geonet: The geonet shall be an integrally formed high density polyethylene net structure. It shall have uniform channels, open area and thickness. The geonet sheets shall contain a minimum of 97.5 percent polymer and a minimum 2.0 percent carbon black tested in accordance with ASTM D4218.

B. Geotextile: Non-woven fabric consisting only of continuous chain polymer filaments or yarns of polyester, formed into a stable network by needle punching.

C. Geonet Composite with Geotextile: The drainage composite shall consist of a geotextile bonded to both sides of a geonet for the bottom and sidewalls of the landfill. The drainage composite shall be made from the geonet and geotextile products whose property requirements are identified in Paragraph 1.02A of this specification.

3.00 EXECUTION

3.01 INSTALLATION

A. Install geonet/composite with geotextile (both sides) in accordance with the plans. On longitudinal runs, there shall be a minimum 4 inches overlap with plastic ties every 5 feet along the overlap. Overlaps shall be oriented in the same direction for all laps in a particular area. On end ties, butt ties or repairs, there should be a minimum 12 inches overlap, with plastic ties every 6 inches along the overlap. Construction vehicles will not be allowed to traffic on liner or drainage composite.

B. Spread the leveling course in the same direction as the overlaps. Back-dump the leveling course onto the geonet composite and spread in a uniform lift while maintaining the design thickness .

END OF SECTION

31 34 19.13 GEOGRID SOIL REINFORCEMENT

1.00 GENERAL

1.01 WORK INCLUDED

A. Furnish labor, materials, equipment and incidentals necessary to install geogrids for soil reinforcement purposes in conjunction with constructed or reconstructed earth slopes and other earth structures.

1.02 QUALITY ASSURANCE

A. Design Criteria:

1. Biaxial Geogrid Properties: The properties specified below are minimum average roll values. Test methods other than those listed in the tables below may be considered by the Engineer if the test method is comparable to that specified and is performed by an independent testing organization acceptable to the Engineer. Consideration and acceptance of alternate test methods shall be at the sole discretion of the Engineer and the decision shall be final.

a. MD = Machine Direction (along roll length).

b. CMD = Cross Machine Direction (across roll width).

GB350			
Property	**Test Method**	**Units**	**Min. Value**
Tensile Strength @ 2% Strain-MD	ASTM D4595-86	lb./ft.	350
Tensile Strength @ 2% Strain-CMD	ASTM D4595-86	lb./ft.	570
Tensile Modulus @ 2% Strain-MD	GRI-GG1-87	lb./ft.	17,500
Tensile Modulus @ 2% Strain-CMD	GRI-GG1-87	lb./ft.	28,500
Junction Strength-MD	GRI-GG1-87	lb./ft.	995
Junction Strength-CMD	GRI-GG1-87	lb./ft.	1800
Open Area	COE-CW02215	%	70

B. Labeling, Packaging and Certification:

1. The Manufacturer shall clearly label each roll of geogrid in a weather resistant manner prior to shipment. The label shall identify the specific product and the production run.

2. A certificate of specification compliance shall be furnished by the Manufacturer on each production run of each specific product. The production run numbers shall be coordinated to the production run numbers on the individual roll labeling.

1.03 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00 “Submittal Procedures” and shall include:

1. Standard roll widths and lengths to be furnished.
2. Specified property data.

1.04 STANDARDS

A. Standards published by the following agencies or organizations are referenced in this Section:

ASTM	American Society for Testing and Materials, Philadelphia, PA.
GRI	Geosynthetics Research Institute, Drexel University, Philadelphia, PA.
COE	U.S. Army Corps of Engineers, Washington, D.C.

1.05 DELIVERY AND STORAGE

A. Store the geogrid in a suitable location and in a manner which prevents damage to the product. Do not store different types or strengths of geogrid directly together. Take care to maintain the labels until the product is used. Provide ultra-violet and weather protective coverings until the product is used and properly cover any interim unused portion until used.

B. Take care during unloading and handling of geogrid to prevent damage from construction equipment or other sources. Do not use any damaged product.

2.00 PRODUCTS

2.01 MATERIALS

A. The geogrid shall consist of a polypropylene or high density polyethylene material as specified below.

1. Polypropylene Geogrid: A grid structure formed by bi-axially or uni-axially drawing a continuous sheet of polypropylene material. The sheets shall contain a minimum of 98 percent of Group 1, Class 1, Grade 2 materials in accordance with ASTM D4101. The sheets shall contain a minimum of 0.50 percent carbon black in accordance with ASTM D1603.
2. High Density Polyethylene Geogrid: A grid structure formed by bi-axially or uni-axially drawing a continuous sheet of high density polyethylene material. The sheets shall contain a minimum of 97 percent of Type III, Class A, Grade 5 materials in accordance with ASTM D1248. The sheets shall contain a minimum of 2 percent carbon black in accordance with ASTM D4218.

2.02 MANUFACTURED PRODUCTS; ANCHORING DEVICES

A. Anchoring devices shall be as recommended by the Geogrid Manufacturer and shall be constructed of metal or plastic material.

B. Anchoring devices for connecting geogrid joints shall consist of split rings, draw-ties, or other suitable devices which will not damage the geogrid nor interfere with adjacent work.

C. Anchoring devices for attaching the geogrid to the subgrade or embankment shall consist of soil staples, stakes, or pins of suitable length with anchoring lugs or washers at the top. The anchors shall not have significant protrusion above grade when installed and shall not be of a type that will damage the geogrid nor interfere with adjacent work.

3.00 EXECUTION

3.01 PREPARATION

A. Perform subgrade preparation as specified in Section 33 16 13.18 “Precast Wire Wound Prestressed Concrete Tank”.

3.02 INSTALLATION

A. In the event that any of the Manufacturer’s recommendations for geogrid installation are more restrictive or stringent than the requirements of this Section, the Manufacturer’s recommendations shall be followed..

1. The limits of the geogrid shall be as indicated. Roll out the geogrid onto the prepared subgrade or previously placed lift of embankment. Pull tightly by hand to take up the slack and anchor to the subgrade with appropriate anchoring devices at a maximum of 30 feet on center (or closer if required) along the centerline of the roll and along the edges and ends. A minimum of two anchors shall be required on any edge or end.

2. Place the length of the roll (MD) of the geogrid through the center of the tank. Do not allow end joints unless specifically shown otherwise on the drawings. Butt side joints without overlap unless specifically shown otherwise on the drawings.

3. Repair any damaged areas in the geogrid by replacing with undamaged geogrid. Perform the necessary cutting of the geogrid with suitable shears or similar devices so that the adjacent geogrid is not damaged.

4. Do not expose the geogrid to sunlight for more than 3 consecutive days before being covered. Backdump the indicated fill onto the installed geogrid and spread ahead of the equipment to the prescribed thickness by low ground pressure track-type equipment equivalent to a D-3 Caterpillar bulldozer. Spread the material in a direction that will not be against exposed edges of the geogrid at side or end laps. Do not allow equipment or vehicles to traffic directly on the geogrid. The lift thickness, processing, and compaction of the earth fill shall be in accordance with the requirements of the appropriate specification section.

5. Fill any ruts or depressions which develop during placement of the earth fill with additional material instead of blading material from adjacent areas.

END OF SECTION

31 35 23.23 ARTICULATED CONCRETE BLOCK

1.00 GENERAL

1.01 WORK INCLUDED

A. The Contractor shall furnish all labor, materials, equipment, and incidentals required and perform all operations in connection with the installation of articulated concrete blocks or cable concrete erosion control mats in accordance with the lines, grades, design and dimensions shown on the Drawings and as specified herein.

1.02 QUALITY ASSURANCE

A. Experience: The Contractor shall demonstrate at least three jobs in the last three years where installation of similar scope and scale have been completed. If experience is not available, the supplier shall have a technician experienced in the installation of the Cable Concrete available at the start of an installation to assist in any special techniques needed to assure a proper installation. Documentation of this experience shall be provided to the Engineer.

1.03 SUBMITTALS

A. Submit to the Owner all Supplier's performance research results and calculations in support of the concrete mat system and geotextile proposed for use. All calculations must be made in accordance with PART 2 of this Section.

B. Furnish Supplier's certificates of compliance for concrete blocks/mats, revetment cable, and any revetment cable fittings, anchors and connectors to the Owner prior to the start of mat fabrication.

C. Furnish to the Owner all Supplier's specifications, literature, shop drawings for the fabrication of the mats, anchor layouts and any recommendations, if applicable, that are specifically related to this project, 14 days prior to assembly of the cable mats.

D. Submit experience of the installer as described in paragraph 1.02.

1.04 STANDARDS AND REFERENCES

The applicable provisions of the following standards shall apply as if written herein in their entirety:

ASTM C33	Specifications for Concrete Aggregates
ASTM C39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C42	Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C140 .	Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
ASTM C150	Standard Specification for Portland Cement

ASTM C207	Standard Specification for Hydrated Lime for Masonry
ASTM C595	Standard Specification for Blended Hydraulic Cements
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM D18.25.04	Articulating Concrete Block Revetments
ASTM D698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft3)
ASTM D3786	Standard Test Method for Bursting Strength of Textile Fabrics— Diaphragm Bursting Strength Tester Method
ASTM D4355	Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
ASTM D4491	Standard Test Methods for Water Permeability of Geotextiles by Permittivity
ASTM D4533	Standard Test Method for Trapezoid Tearing Strength of Geotextiles
ASTM D4632	Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
ASTM D4751	Standard Test Method for Determining Apparent Opening Size of a Geotextile
ASTM D4833	Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
ASTM D5101	Standard Test Method for Measuring the Soil-Geotextile System Clogging Potential by the Gradient Ratio
ASTM D5567	Standard Test Method for Hydraulic Conductivity Ratio (HCR) Testing of Soil/Geotextile Systems
AASHTO T88	Standard Method of Test for Particle Size Analysis of Soils
AASHTO M288-96	Standard Specification for Geotextile Specification for Highway Applications
FHWA-RD-89-199	Standard Testing for Hydraulic Stability of Articulated Concrete Block Revetment Systems During Overtopping Flow

FHWA-RD-88-181 Minimizing Embankment Damage During Overtopping Flow

2.00 PRODUCTS

2.01 MATERIALS

A. CABLE CONCRETE MATS

1. All cellular concrete mats shall be pre-manufactured as an assembly of concrete blocks, with specific hydraulic capacities, bound into mats by the use of stainless steel cables or hand placed interlocking concrete blocks woven into a mat system with stainless steel cables.

2. Certification (Open-Channel Flow): All articulated concrete mats will only be accepted when accompanied by documented hydraulic performance characteristics, derived from tests under controlled flow conditions. Testing guidelines should conform to U.S. Federal Highway Administration and U.S. Bureau of Reclamation Testing Protocol as documented in "November 1989 - Standard Testing for Hydraulic Stability of Concrete Revetment System During Overtopping Flow", Report No. FHWA-RD-89-199. In addition, system restraints (such as mechanical anchors) and ancillary components (such as a synthetic drainage medium) used in the full-scale testing program must be incorporated in field installations in an identical manner.

3. Performance (Overtopping Flow): The design of the articulated concrete mats shall be in accordance with the Factor-of-Safety design methodology as described in "Sediment Transport Technology" by D. B. Simons and F. Senturk, Water Resources Publication, 1977. The articulated concrete mats shall be designed to a minimum safety factor of 2.184 and design shear stress of 5 psf. The analysis shall be performed based upon the stability of the mat due to gravity forces alone, neglecting forces which may be due to cabling, mechanical anchorage, contact with adjacent blocks, or other restraint not attributable to gravity based forces. The analysis must account for a subgrade variation of up to 0.5. (For a level surfaced block this would result in a 0.5 inch block projection height). The individual blocks comprising the mat shall have an open area of not less than 10% and not more than 20%. Extrapolation of tested shear stress values to the performance of thicker units may be considered only for units within the same "family" of blocks having the same geometric dimensions (length and width) and interlock of the tested units.

4. Concrete: The minimum required concrete strength should be 4000 psi as determined by ASTM C42 for wet-cast blocks and C140 for dry cast blocks. Wet-cast blocks shall contain 4% to 7% air entrainment. All ASTM standards will be met in the production of the concrete.

5. Cables: The cables shall be made of stainless steel aircraft cable of type 304. The cable shall be of type 1 X 19 construction. Size varies with block size. Supplier's recommendation for size shall be used.

6. Geotextile:

   a. Geotextile shall be Geotex 801 as manufactured by Propex Geosynthetics of Chattanooga TN or approved equal.

b. For installations in the wet (sub-aqueous), the geotextile shall be attached to the base of the concrete block mats. An overlap of 2 ft to 3 ft shall be incorporated on three sides of the mat. The overlap shall provide an area for the adjoining mats to be placed upon and prevent undermining of the erosion control system.

7. Clamps: Sufficient stainless steel wire rope clamps shall be used to secure loops of adjoining Cable Concrete mats. The type of clamp needed shall be determined by the Supplier. The number of loop connections is based on project specifics, and shall be shown in the Shop Drawings. Clamping in field must follow project layout details to be acceptable.

8. Anchoring: Cable Concrete mats are designed to take velocities in certain slope and bedding situations. Manta Ray anchors by Foresight Products, Commerce City, Colorado or approved equal shall be used. All anchors shall be stainless steel. At a minimum, the anchor is placed at perimeters of individual mats. The anchor is attached to the loops of the mat after placement. There shall be no slack in the driven anchor cable when it is attached to the loops of the mat. Anchoring must follow project layout details to be acceptable.

9. Concrete Block Matrix Assembly: Concrete blocks shall have interlocking keys that limit lateral expansion. Joint freeplay shall allow articulation of each individual block. Concrete surface shall be sufficiently rough to prevent sliding of the blocks on the geotextile. Cable tied concrete block shall be interconnected by flexible cables running through the blocks. Each block shall be penetrated by interconnecting cable that allows articulation of the blocks, but restrains removal of individual blocks.

2.02 VISUAL INSPECTION

A. All units shall be sound and free of defects that would interfere with the proper placing of the unit or impair the strength or permanence of the construction. Surface cracks incidental to the usual methods of manufacture, or surface chipping resulting from customary methods of handling in shipment and delivery, shall not be deemed grounds for rejection.

B. Cracks exceeding 0.25 inches (.635 cm) in width and/or 1.0 inch (2.54 cm) in depth shall be deemed grounds for rejection.

C. Chipping larger than 2 inches in any dimension shall be deemed grounds for rejection.

D. Blocks rejected at the job site shall be replaced at the expense of the Contractor.

2.03 SAMPLING AND TESTING

A. The purchaser or his authorized representative and the OPT shall be accorded proper access to facilities to inspect and sample the units at the place of manufacture from lots ready for delivery. Additional testing, other than that provided by the Supplier, shall be borne by the Contractor.

3.00 EXECUTION

3.01 FOUNDATION PREPARATION

A. General: Areas on which filter fabric and cellular concrete blocks are to be placed shall be constructed to the lines and grades shown on the Drawings and to the tolerances specified in the Contract Documents, and approved by the Owner.

B. Grading: The slope shall be graded to a smooth plane surface to ensure that intimate contact is achieved between the slope face and the geotextile (filter fabric), and between the geotextile and the entire bottom surface of the cellular concrete blocks. All slope deformities, roots, grade stakes, and stones which project normal to the local slope face must be regraded or removed. No holes, "pockmarks", slope board teeth marks, footprints, or other voids greater than 1.0 inch in depth normal to the local slope face shall be permitted. No grooves or depressions greater than 0.5 inches in depth normal to the local slope face with a dimension exceeding 1.0 foot in any direction shall be permitted. Where such areas are evident, they shall be brought to grade by placing compacted homogeneous material. The slope and slope face shall be uniformly compacted, and the depth of layers, homogeneity of soil, and amount of compaction shall be as required by the Owner.

C. Excavation and preparation for anchor trenches, side trenches, and toe trenches or aprons shall be done in accordance to the lines, grades and dimensions shown in the Drawings. The anchor trench hinge-point at the top of the slope shall be uniformly graded so that no dips or bumps greater than 0.5 inches over or under the local grade occur. The width of the anchor trench hinge-point shall also be graded uniformly to assure intimate contact between all cellular concrete blocks and the underlying grade at the hinge-point.

D. Inspection: Immediately prior to placing the filter fabric and cellular concrete blocks, the prepared area shall be inspected by the Owner and by the Supplier. No fabric or blocks shall be placed thereon until that area has been approved by each of these parties.

E. Provide smooth transition between sharp grade changes to allow for smooth installation of cable concrete mats or hand placed blocks.

3.02 INSTALLATION

A. General: Cable concrete block/mats, shall be constructed within the specified lines and grades shown on the Drawings.

B. Placement: The cable concrete blocks shall be placed with the filter fabric in such a manner as to produce a smooth plane surface in intimate contact with the filter fabric. No individual block within the plane of placed cable concrete blocks shall protrude more than one-half inch or as otherwise specified by the Owner. To ensure that the cable concrete blocks are flush and develop intimate contact with the subgrade, the blocks shall be "seated" with a roller or other means as approved by the Owner. Place concrete blocks on geotextile fabric within seven (7) days of placing geotextile fabric to limit fabric exposure to UV light.

C. If assembled and placed as large mattresses, the cable concrete mats shall be attached to a spreader bar or other approved device to aid in the lifting and placing of the mats in their proper position by the use of a crane or other approved equipment. The equipment used should have adequate capacity to place the mats without bumping, dragging, tearing or otherwise damaging the underlying fabric. The mats shall be placed side by side and/or end

to end, so that the mats abut each other. Mat seams or openings between mats greater than two (2) inches shall be filled with grout or lean concrete. Anchor holes shall be covered with lean concrete or grout. Pipe penetrations shall be grouted in place. Whether placed by hand or in large mattresses, distinct changes in grade that results in a discontinuous revetment surface in the direction of flow shall require a grout or lean concrete seam at the grade change location so as to produce a continuous surface.

D. Anchor trenches and side trenches shall be backfilled and compacted flush with the top of the blocks. The integrity of a soil trench backfill must be maintained so as to ensure a surface that is flush with the top surface of the cable concrete blocks for its entire service life. Toe trenches shall be backfilled as shown on the Drawings. Backfilling and compaction of trenches shall be completed in a timely fashion.

E. Anchors shall be placed at a minimum on adjoining mats along the sides. A minimum of one anchor is required along the short side of the mat and a minimum of 3 anchors are required along the long side of the mat. A minimum of two (2) extra anchors shall be placed at the upstream edge of the cable mat. Additional anchoring shall be installed at the recommendation of the Supplier. Anchors shall be placed perpendicular to the mat.

F. Backfill: The cable concrete mats shall be backfilled as shown on the Drawings. Backfill materials shall consist of crushed stone aggregate on the driving surfaces, channel bottoms, and topsoil (Class 12 Earthfill) and Bermuda grass seed on the other slopes.

G. Finishing: The openings in the cable concrete blocks shall be backfilled and compacted as specified immediately with suitable material to assure that there are not voids and so that compacted material extends from the filter fabric to the surface of the cellular concrete block.

END OF SECTION

DIVISION 32

EXTERIOR IMPROVEMENTS

32 31 13.53 WELDED WIRE FENCES AND GATES

1.00 GENERAL

1.01 WORK INCLUDED

A. This specification covers fencing materials for a complete galvanized welded wire fence system and gates.

1.02 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00 “Submittal Procedures” and shall include:

1. Shop Drawings

1.03 STANDARDS

A. The applicable provisions of the following ASTM standards shall apply as if written here in their entirety:

1. B 117-07 – Standard Practice for Operating Salt Spray (Fog) Apparatus.
2. A 121-07 – Standard Specification for Metallic-Coated Carbon Steel Barbed Wire
3. A 123/A123M-02 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
4. A 153/A153M-05 – Standard Specification for Zinc Coating on Iron and Steel Hardware.
5. A 307-07a – Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
6. A 780-00 – Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
7. A 853-04 – Standard Specification for Steel Wire, Carbon, for General Use.
8. C 94/C94M-07 – Standard Specification for Ready-Mix Concrete.
9. F 567-07 – Standard Practice for Installation of Chain-Link Fence.
10. F 626-96a(2003) – Standard Specification for Fence Fittings.
11. F 900-05 – Standard Specification for Industrial and Commercial Swing Gates.
12. F 934-96(2003) – Standard Specification for Strength and Protective Coatings on Steel Industrial Chain-Link Fence Framework.
13. F 1043-06 – Standard Specification for Strength and Protective Coatings on Steel Industrial Chain-Link Fence Framework.
14. F 2453/F2453M-05 – Standard Specification for Welded Wire Mesh Fence Fabric (Metallic-Coated or Polymer Coated) for Meshes of 6in. 2 (3871mm2) or Less, in Panels or Rolls, with Uniform Meshes.

2.00 PRODUCTS

2.01 MATERIALS

A. All accessories shall be hot-dipped galvanized in accordance with ASTM A 123 or as specified herein. Hardware coatings shall conform to ASTM A 153. Steel pipe and other framework shall be hot-dip galvanized in accordance with ASTM F 1043. Strength requirements for pipe shall also conform to ASTM F 1043 (SS40). The product of the yield strength and section modulus shall not be less than that for pipe conforming to ASTM F 1043.

B. Products shall be new from recognized, reputable manufacturers. The manufacturers shall have a minimum of two years' experience. Used, re-rolled or re-galvanized material is not acceptable.

C. Welded Wire Fabric shall be fabricated from low carbon steel wire and electronically control welded, forming a specific mesh size. Welded mesh shall meet or exceed the requirements of ASTM F 2453, having a nominal tensile strength of 73,000 PSI (503 MPa).

D. Fabric Heights:

1. Single welded mesh fence 8 ft. (2.3 m) plus 12 in. (305 mm) as it pertains to "V" or 45 degree extension arm: the welded mesh fabric 0.5 in. x 2 in. or 0.5 in. x 3 in. x 10 gauge x 8 ft. (2.3 m) in height shall extend from the top of the concrete or finished grade to 4 in. above the top rail.

E. Framework: Strength and Coating Shall be in Accordance with ASTM F 1043.

1. Terminal Posts: Hot-dipped galvanized Sch. 40 pipe conforming to ASTM F 1043 Group 1 A.

2. Line Posts and Rails: Roll formed C-Posts 3.25 in. x 2.5 in. (.130 wall for 12 ft. and less) (.150 wall from 12 ft. to 16 ft. fence height) conforming to ASTM F 1043 with minimum yield strength of 60,000 PSI. Coatings in accordance with ASTM F 1043.

3. Performance: all tubular framework shall meet the following performance in accordance with test method ASTM B 117 (Salt Spray Test).

a. Exterior: 1000 hours with maximum 5 percent red rust.

b. Interior: 650 hours with maximum 5 percent red rust.

4. Wind loads: Post shall withstand 70 MPH minimum wind load.

F. Post Sizes: determined in accordance with previously approved practices. Line, terminal and gate post shall not be less than 95% of the nominal weight conforming to ASTM F 1043 Group 1 A.

G. Rail Size: 1.625 x 1.25 rails. Select brackets and tie wires for securing welded mesh to horizontal rails.

H. Fittings and Accessories

1. Post Tops: Pressed steel or malleable iron, designed as a weather tight enclosure for tubular terminal posts only.

2. Tension Bands: Tension bands shall be heavy - pressed steel, 3/4 in. (19 mm) x 1/10 in. (2.54 mm) nominal. Tension bands are used to secure fabric to end, corner and gate post with intervals of spacing not to exceed 15 in. (381 mm). Color to match fabric.

3. Preformed Power Twisted Ties:
    a. Fabric attachment to rails: 9 gauge (3.8 mm) ties for fabric wire sizes 10.5 gauge (3.3 mm) and larger.
    b. Fabric attachment to line post: 9 gauge (3.8 mm) ties for fabric sizes 11 gauge and larger.
    c. Ties shall be aluminized with a minimum coating of 0.40 oz. aluminum/ft2 (0.122 g/m2) and polymer coated.
4. Tie Spacing:
    a. Top rails are at intervals not exceeding 24 in. (610 mm).
    b. Bottom rail tie spacing intervals not to exceed 12 in. (305 mm)
5. Brackets: Spacing for line and terminal posts are at intervals not exceeding 18 in. (457 mm). See drawing for tie wire and bracket location.

3.00 EXECUTION

3.01 INSTALLATION

A. Installation of the Framework Components: installation shall be in accordance with ASTM F 567 when applicable and as specified herein. Larger corner posts not required for welded mesh installations.

B. Installation of Welded Wire Fabric components: follow the manufacturer's recommendations.

C. Site Preparation: Prior to the installation, all necessary grading and cleaning on both sides of fence shall be performed by the General Contractor or others responsible for site grading.
    1. Grading shall be done in such a manner as to provide a straight flat and level surface. Sloped angles shall be graded at the same angle to the next change of direction or grade change. Soil or stone fill shall be thoroughly compacted.
    2. All excavation shall be coordinated with respect to electrical and mechanical component installations. All existing utilities shall be located prior to starting excavation.
    3. Erect the fencing in straight lines between angle points. Erect framework in accordance with ASTM F 567 and as approved by show drawings.

D. Minimum Post Hole Diameters in concrete for 2.875 in. (73 mm) is 0.5 in. (127 mm) larger than the post. Alternatively, install sleeves during pouring operation. The space around the post shall be filled with grout.

POST HOLE DEPTH IN SOIL TABLE 1

EXPOSED HEIGHT OF FABRIC		LINE POST		CORNER/END PULL POST		SETTING DEPTH	
6ft.	1.8m	3.25x2.50in.	83x64mm	2.875in.	73mm	30in.	762mm
7ft.	2.1m	3.25x2.50in.	83x64mm	2.875in.	73mm	33in.	838mm
8ft.	2.4m	3.25x2.50in.	83x64mm	2.875in.	73mm	36in.	914mm
9ft.	2.7m	3.25x2.50in.	83x64mm	4.000in.	102mm	39in.	990mm

10 ft.	3.0m	3.25x2.50in.	83 x 64 mm	4.000 in.	102 mm	42in.	1066 mm
11 ft.	3.4m	3.25x2.50in.	83 x 64 mm	4.000 in.	102 mm	45in.	1143 mm
12 ft.	3.7m	3.25x2.50in.	83 x 64 mm	4.000 in.	102 mm	48in.	1219 mm
13 ft.	4.0m	3.25x2.50in.	83 x 64 mm	4.000 in.	102 mm	51in.	1295 mm
14 ft.	4.3m	3.25x2.50in.	83 x 64 mm	4.000 in.	102 mm	54in.	1372 mm
15 ft.	4.6m	3.25x2.50in.	83 x 64 mm	4.000 in.	102 mm	57in.	1447 mm
16 ft.	4.9m	3.25x2.50in.	83 x 64 mm	6.525 in.	168 mm	60in.	1524 mm

NOTE: The depth shall be a minimum of 24 in. (610 mm) plus 3 in. (76 mm) for each 1.0 ft. (0.305 m) increase in the fence height over 4 ft. (1.2 m) as per ASTM A 567.

E. Post Holes in Solid Rock or Concrete:

1. Drill holes into solid rock or concrete 1/2 in. (13 mm) wider than pipe diameter; 18 in. (457 mm) deep for end, corner and gate posts; and 12 in. (305 mm) deep for line post.
2. Half-fill the void with non-shrinkable grout and force the post to the bottom of the hole, leaving no voids. Crown the grout to shed water. Use sleeves in new concrete.

F. Concrete Mix: Shall be in accordance with ASTM C 94 with maximum 3/4 in. (19 mm) aggregate and having a minimum compression strength of 3000 PSI (20.69 MPa.) at 28 days. Concrete shall be thoroughly worked into the post holes leaving no voids.

G. Cure: Concrete to cure a minimum of 7 days before installing fence fabric or fittings. The top surface of the post footing shall have a crown water shed finish.

H. Post Spacing: Space post equal distance in the fence line to a maximum of 10 ft. (3 m).

I. Rails: Install rails as called for on the drawings and in these specifications. All rails shall be installed on the side of the fence least accessible to climbing from the outside. No corner bracing is required for welded wire fabric installations.

1. Top Rails: With the use of 7 in. (178 mm) sleeves, top rail shall run continuously through the top loop caps. Intermediate and bottom rails shall be connected to the line and terminal posts using boulevards or bands and rail ends. Attachment bolts for bands shall be 5/16 in. (7.9 mm) x 1-1/2 in (38 mm) carriage bolts with nuts.
2. Boulevard bolts shall be 3/8 in. (10 mm) minimum in diameter. Middle and bottom rails locations shall correspond with this specification and project drawings.
3. Tie wire twisted ends shall turn downward to prevent accidental contact causing injury.

J. Welded Wire Fabric General:

1. Welded wire panels are fabricated to correspond with the widths and heights specified.
2. Welded mesh panels are attached with a combination of brackets and tie wires in accordance with the drawing. Preformed 1 in. (25.4 mm) x 10 gauge (3.4 mm) thick two piece brackets, zinc/aluminum coated are secured to the line post and rails with 5/16 in. (7.9 mm) carriage bolts. Terminal post connections are comprised of tension bands.
3. Band spacing shall not exceed 18 in. (457 mm) for terminal post. See corner connection detail for securing tension bands. (Attach tension bands using the 5/16 in. bolts and nuts or other suitable means.)

K. Grounding to the Earth:

1. Grounding and bonding of the perimeter systems shall be in accordance with the N.E.C. (National Electric Code), N.E.S.C. (National Electric Safety Code) ASTM F 1916 and as specified herein and shown on the drawings. Contractor will employ a certified electrician to perform all grounding procedures.

2. Secure the grounding conductor to the post with 5/16 in. (7.9 mm) self-tapping galvanized or stainless steel bolts and approved copper compression terminal ends or clamps.

3. After grounding connections have been completed, perform a ground resistance test in the presence of the owner's representative. The ground resistance shall not exceed 25 OHMS under normal dry conditions or as specified elsewher. Where resistance requirements cannot be attained, install additional rods no closer than 6 ft. (1.8 m) on center. Install no more than two additional rods at each location.

3.02 CLEANING

A. Upon completion of the installation, clean up all waste material resulting from the fence construction.

END OF SECTION

32 91 19.13 TOPSOIL PLACEMENT AND GRADING

1.00 GENERAL

1.01 WORK INCLUDED

A. Furnish labor, materials, equipment and incidentals necessary to place topsoil, free from rock and foreign material in areas designated to receive sodding or seeding.

2.00 PRODUCTS

2.01 TOPSOIL

A. General: The topsoil shall be fertile loam, easily cultivated and free from objectionable material, and shall have a relatively high erosion resistance and be readily able to support the growth of the planting, seeding, or sodding specified on the plans.

B. Sources:

1. The topsoil may be obtained from the right-of-way at sites of proposed excavation, or it may be obtained from sources outside the right-of-way, secured by the Contractor, and meeting the approval of the Engineer.

2. Topsoil required in addition to salvaged topsoil from the project shall be secured from approved off-site borrow sources. Excavated material from construction which is suitable for topsoil shall be salvaged and used before any topsoil is obtained from borrow source.

3.00 EXECUTION

3.01 INSTALLATION

A. Stockpile topsoil material at locations approved by the Owner's Representative. Remove any trash, wood, brush, stumps or other objectionable materials prior to placement. The source and stockpile areas shall be kept drained and in a neat and presentable condition. Place and spread topsoil to a uniform depth to provide 6-inch compacted depth, while maintaining drainage in areas to be seeded or sodded.

END OF SECTION

DIVISION 33

UTILITIES

33 05 01.09 POLYVINYL CHLORIDE (PVC) PRESSURE PIPE AND FITTINGS

1.00 GENERAL

1.01 WORK INCLUDED

A. Furnish labor, materials, equipment and incidentals necessary to install polyvinyl chloride (PVC) pressure pipe, appurtenances, and fittings to the diameters indicated for water supply and wastewater pressure piping. Trenching, backfilling, and pipe embedment shall be in accordance with Section 31 23 33 “Trenching and Backfill [Utilities].”

1.02 QUALITY ASSURANCE

A. Certification: Domestic water piping shall be approved by the Underwriters Laboratory and shall be accepted by the State Fire Insurance Commission for use in water distribution systems. PVC water pipe shall bear the seal of approval (or “NSF” mark) of the National Sanitation Foundation Testing Laboratory for potable water pipe.

B. Design Criteria: The maximum allowable load for PVC pipe installations shall produce a maximum deflection of 4 percent.

1.03 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00 “Submittal Procedures” and shall include:

1. Certified Test Reports from the Manufacturer’s testing facility or an approved testing laboratory.

2. Shop Drawing including the following information:

a. Manufacturer.

b. Dimension ratio.

c. Joint types.

d. Gaskets material.

e. Means of restraint.

f. Manufacturer’s recommendation for maximum deflected joint angle and minimum longitudinal bending radius

g. Thrust restraint lengths and lay schedule as Shop Drawing. Lay schedule shall include the following:

1). Pipe class.

2). Joint type.

3). Fittings.

4). Stationing.

5). Transitions.

6). Joint deflection.

3. Shop Drawing of Detectable Warning Tape.

1.04 REFERENCE SPECIFICATIONS

A. Section 01 33 00 “Submittal Procedures.”

B. Section 01 40 00 “Quality Requirements.”

C. Section 33 10 13 “Disinfecting of Water Utility Distribution.”

D. Section 31 23 33 “Trenching and Backfill [Utilities].”

1.05 STANDARDS

A. The applicable provisions of the following standards shall apply as if written here in their entirety. PVC piping and fittings shall be in full compliance with the applicable standards and specifications for each type of plastic pipe involved. Pipe may be rejected for failure to comply with any requirement of this Section.

1. American Society for Testing and Materials (ASTM) Standards:

ASTM D1784	Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D1785	Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D2241	Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated PVC Pipe (SDR) Series
ASTM D2464	Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2466	Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings Schedule 40
ASTM D2467	Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2855	Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets
ASTM D3139	Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM F1674	Standard Test Method for Joint Restraint Products for Use with PVC Pipe

2. American Water Works Association (AWWA) Standards:

AWWA C104	Cement-Mortar Lining for Ductile Iron Pipe and Fittings
AWWA C105	Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110	Ductile-Iron and Gray-Iron Fittings
AWWA C153	Ductile-Iron Compact Fittings

AWWA C605	Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings
AWWA C900	Poly Vinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 through 60 Inches (100 mm Through 1,500 mm)
AWWA M23	PVC Pipe – Design and Installation.
AWWA M41	Ductile – Iron Pipe and Fittings

3. NSF International (NSF):

NSF 61	Drinking Water System Components – Health Effects

4. Underwriters Laboratories, Inc. (UL).

1.06 DELIVERY AND STORAGE

A. Store PVC material so that there is no exposure to sunlight.

2.00 PRODUCTS

2.01 MATERIALS

A. Pipe:

1. Four to 60 inches:

Class 165 (DR25) C900 with cast iron outside dimensions	PVC pressure drain lines, plant effluent lines, 165 psi pressure rating, wastewater force main
Class 235 (DR18) C900 with cast iron outside dimensions	Potable water lines, non-potable plant and reverse osmosis reuse lines, 235 psi rating
Class 305 (DR14) C900 with cast iron outside dimensions	Fire water lines, 305 psi rating

B. PVC Pressure Piping:

1. Smaller than 4 inches in size shall be Type 1, Grade 1, Polyvinyl Chloride, Schedule 40 pipe conforming to ASTM D1785.
2. For pipe 2 inches in diameter and smaller, joints shall be glued.
3. For pipe larger than 2 inches in diameter, joints shall be bell and spigot push-on type as specified in ASTM D3139.
4. PVC Pressure Pipe for potable water shall meet the requirements of NSF 61.
5. PVC Pressure Pipe for Sanitary Sewer shall conform to either C900 or ASTM D2241.

C. Fittings: 3- through 24-inch ductile iron and conforming to AWWA C110 or AWWA C153. Fittings for piping smaller than 3 inches shall be in accordance with ASTM D2466.

D. Thrust Restraint: Thrust restraint devices shall be Mega-lug or approved equal and shall be factory tested and pressure rated in accordance with ASTM F1674.

1. Joint restraint devices shall be designed specifically for use with PVC pipe of the joint type and pressure rating specified.

2. Restrained joints shall be used for a sufficient distance from each bend, tee, plug, valve or other fitting to resist thrust which will be developed at the design pressure of the pipe. For the purposes of thrust restraint, working pressure shall be 150 psi, design pressure shall be 1.5 times the working pressure or the pipe pressure class indicated.
3. The length of pipe with restrained joints to resist thrust forces shall be the sole responsibility of and determined by the Pipe Manufacturer using the following parameters:
    a. Laying condition equal to AWWA C605 Type 3 bedding.
    b. No thrust restraint contribution shall be allowed for pipe in casing**.**
    c. Soil density = 100 pcf.
    d. Concrete thrust blocking shall not be accounted for in joint restraint calculations.

E. Detectable Warning Tape:
1. Provide detectable warning tape as follows:
    a. Thickness: 5.0 mil overall thickness.
    b. Width: 3 inch minimum.
    c. Weight: 27.5 pounds per inch per 1000 square feet.
    d. Triple layer with:
        1). Minimum thickness 0.35 mils solid aluminum foil encased in a protective inert plastic jacket.
        2). 100 percent virgin low density polyethylene.
        3). Impervious to all known alkalis, acids, chemical reagents and solvents within soil.
        4). Aluminum foil visible to both sides.
    e. Locatable by conductive and inductive methods.
    f. Printing encased to avoid ink rub-off.
    g. Color and Legends:
        1). Potable Water Lines:
            a). Color: Blue (in accordance with APWA Uniform Color Code).
            b). Legend: Caution Potable Water Line Below (repeated every 24 inches).
        2). Reclaimed Water Lines:
            a). Color: Purple (in accordance with APWA Uniform Color Code).
            b). Legend: Caution Reclaimed Water Line Below (repeated every 24 inches).
        3). Sewer Line:
            a). Color: Green (in accordance with APWA Uniform Color Code).
            b). Legend: Caution Sewer Line Below (repeated every 24 inches).

2.02 MARKINGS

A. The Pipe Manufacturer shall mark the piping with the size and appropriate AWWA/ASTM Standard designations as applicable.

2.03 MATERIALS

A. Schedule 40 or 80 PVC Pipe: ASTM D1785, Type 1, Grade 1, rigid, unplasticized PVC, normal impact, bearing NSF seal. Fitting shall be in accordance with ASTM D2464, D 2465, or D 2467, or AWWA C110 or C153. Schedule 40 pipe shall not be threaded.

B. C 900 Pipe: Pipe shall meet the requirements of AWWA C900 with outside diameter equivalent to cast iron pipe, in accordance with AWWA C900, Table 2. Fittings shall be in accordance with AWWA C110 or C153.

C. SDR 26 Pipe: Pipe and fittings shall be in accordance with ASTM D2241.

3.00 EXECUTION

3.01 INSTALLATION

A. Install pipe, fittings, and specials to the lines and grades indicated. Install hangers, brackets, supports, etc., at spacings as recommended by pipe manufacturer. Flexible connections shall be required at locations where pipe passes through concrete walls. Begin installation at the main supply line valve and make connections where indicated.

B. Excavate trenches where required to alignment and depth specified or as required for proper installation of pipe. Carefully lower pipe, fittings, and specials into the trench to avoid damage to the pipe and/or fittings. Take necessary precautions to protect pipe during backfilling operations. Replace any damaged pipe before it is buried. Keep the pipe clean during laying operations, and seal the pipe against the entrance of objects at the close of each operating day.

C. Place thrust restraint fittings at bends, tees, crosses, valves, and plugs in the pipe line in accordance with approved Shop Drawing lay schedule and Paragraph 2.01.D.

D. Buried ductile iron fittings shall be double wrapped in 8mm high density polyethylene encasement in accordance with AWWA C105, repair or replace encasements which have tears, rips or punctures in the polyethylene wrap.

E. The minimum cover for 1- to 4-inch PVC piping shall be 36 inches. For 6-inch PVC piping and larger, the minimum cover shall be 48 inches.

F. For threaded joints not more than three threads at each pipe connection shall remain exposed after installation. Ream ends of pipe after threading and before assembly, to remove burrs. Threaded joints shall be made up with a suitable joint compound. Apply joint compound to male threads only.

G. Solvent weld joints shall be in accordance with ASTM D2855, and shall be made generally as follows: cut square and smooth the ends of the plastic pipe and wipe clean. Apply primer and solvent cement to the outside of the pipe and the inside of the fitting socket with a small brush. Immediately push the coated surfaces snugly together and rotate the pipe approximately one-half turn to insure uniform distribution of the cement. Remove the

excess cement by wiping. Cement shall be of type which welds plastic surfaces together. Cement shall be as recommended by the Pipe Manufacturer and shall be compatible with the chemical conveyed.

H. Push-on joints shall be in accordance with the manufacturer's instructions.

I. Use of deflected joints shall be at 75 percent of the manufacturer recommendation or longitudinal deflection shall be 133 percent of the manufacturer's minimum radius.

J. Joint lubricant shall be as recommended by the pipe manufacturer.

3.02 FREEZE PROTECTION SYSTEM

A. Heat tracing: Provide heat trace as directed on the Drawings and areas vulnerable to freezing. Heat trace shall be installed under the insulation.

B. Heat tracing shall be automatic self-regulating, UL listed, with tinned copper braid, able to crossover itself without overheating, parallel circuit design, able to be cut to length at job site, flat and flexible for easy installation, corrosion and chemical resistant, complete with power connection kits, splice kits, end seal kits and necessary accessories for a complete operating installation 120 VAC, 60 HZ, 5W/ft.

C. Cable shall be Raychem 5BTV1-CT or equal by Chromalox.

D. Thermostat Control: NEMA 4X enclosure. UL listed ambient-sensors thermostat with adjustable set point. Acceptable manufacturers and models: Tyco Digitrace AMC-1A-120V

E. Contractor to provide necessary J-Boxes. J Boxes shall be Raychem JBM-100 for multiple connections and Raychem JBS-100 for single connection.

F. Contractor to provide a minimum of end seal with LED per assembly, end seal shall be Raychem E100-L1A. LED shall be used to verify the system is on.

G. All other end seal shall be Raychem E150.

H. Tape shall be Raychem GT66.

I. Pipe strap shall be Raychem PS-10.

J. Labels shall be Raychem ETL.

K. Insulation shall be a minimum of 1.5" thick mineral wool.

L. Heat Trace to be installed by Raychem Trace Construction or manufacturer-approved installer.

M. Contractor to provide and install necessary conduits and circuit per Division 26.

3.03 FIELD CONTROL HYDROSTATIC TESTING

A. Test PVC pressure piping for leakage by a hydrostatic pressure test in accordance with Section 01 40 00 "Quality Requirements."

3.04 PURGING OF WATER LINES

A. Purge, sterilize, and test the constructed water lines in accordance with Section 33 10 13 "Disinfecting of Water Utility Distribution."

1. During construction operations, maintain the installed surfaces of the system, which come in contact with the City's water supply, in a sanitary condition.
2. Every effort must be made to keep the inside of the pipe, fittings, and valves free of loose foreign matter.
3. Should the Contractor's carrier be required to transport potable water to the job site for main testing, sterilize tankage and piping, including pumps used to transport or transfer potable water into the main.

B. When the entire pipeline or selected sections have been completed and are ready for use, disinfect the line or section according to the following procedures:

3.05 SERVICE CONNECTIONS

A. Make service connections in accordance with AWWA Manual M23 "PVC Pipe - Design and Installation" and the instructions from the Manufacturer. Use a service clamp or saddle to connect 2-inch and smaller services to PVC pipe sizes 4 to 12 inches. Use a ductile iron tapped tee to connect 3-inch service connections.

3.06 FIELD QUALITY CONTROL

A. Do not enclose or cover any Work until inspected.

B. Pressure and Leakage Tests of Pressure Piping: Perform hydrostatic pressure and leakage tests using methods, and per performance requirements of AWWA C605 Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.

END OF SECTION

33 05 05.31 HYDROSTATIC TESTING

1.00 GENERAL

1.01 WORK INCLUDED

A. Perform a hydrostatic pressure test on each valved or plugged section of newly laid pipe after the pipe has been backfilled. Perform hydrostatic pressure test by raising the pressure in the pipe section to the required test pressure for the duration defined in Paragraph 3.02.

B. Plugs may be installed in concrete cylinder or steel pipe at intermediate locations for the purpose of testing shorter lengths of pipe at the Contractor's option. No additional compensation will be paid to the Contractor for testing at intermediate locations if the Contractor uses this option.

C. Obtain water from the Owner for filling the pipeline for the hydrostatic test. Provide the necessary piping, connection, pressure reducing and backflow prevention equipment required to conduct the test. Fill the new pipeline through a backflow prevention device. Leave the pipeline full of water upon completion of the hydrostatic test, unless internal test plugs must be removed to allow construction to continue or where pipe will gravity drain.

D. Purchase water required for re-testing of the pipeline from the Owner. Water will be sold to the Contractor at published rates.

1.02 SUBMTTALS

A. Submit Hydrostatic Pipe Test Reports per Section 01 33 00 "Submittal Procedures."

1.03 STANDARDS

A. The applicable provisions of the following standards shall apply as if written here in their entirety:

American Water Works Association (AWWA)	
AWWA M9	Concrete Pressure Pipe
AWWA M11	Steel Pipe – A Guide for Design and Installation

2.00 PRODUCTS (NOT APPLICABLE)

3.00 EXECUTION

3.01 GENERAL

A. Perform hydrostatic test on bar-wrapped, concrete cylinder pipe in accordance with AWWA M9 and the Supplier's recommendations.

B. Perform hydrostatic test on steel pipe in accordance with AWWA M11 and the Supplier's recommendations.

3.02 TEST CONDITIONS

A. Test pipe at the test pressure for the duration as indicated below for the various pipe materials:

	Pipe Type	Duration (hours)	Test Pressure (psi)
A	Steel Pipe	8	150
B	PVC Pressure Pipe	8	150

3.03 PROCEDURE

A. Steel Pipe and PVC Pressure Pipe:

1. Hydrostatically test the pipe after backfill over the test section of pipe has been completed for 7 days. Slowly fill the line with water and vent all air from the pipeline during filling.
2. Allow the pipe to stand under a slight pressure for at least 48 hours to allow the mortar lining to become saturated and/or to allow the escape of remaining air trapped in the line. Examine bulkheads, valves, manholes, flanges, and connections for leaks during this period.
3. Stop leaks before continuing with the test.
4. Measure water volume during the test if existing valves in the main line leak during the test. Measure the water volume leaking from the valve through a meter or by other means approved by the Construction Manager. Furnish all necessary equipment and include the cost for this effort in the Contract Price.
5. Expel all air from the pipe before applying the specified test pressure. Provide taps in the line to expel air from high points where air valves are not provided. These taps must be made by the pipe manufacturer and approved by the Engineer. Tightly plug the tap after tests are complete. Include the cost for these taps in the Contract Price.

3.04 EXAMINATION UNDER PRESSURE

A. Inspect the pipe during the test to locate any leaks or breaks, defective joints, cracked or defective pipe, fittings, or valves. Correct defective Work identified during the pressure test.

B. Correct all identified leaks even if leakage is within the parameters for permissible make up water per Paragraph 3.05.

C. Test the pipe again after defective Work has been corrected. Repeat the test and correction of defective Work until satisfactory test results are obtained.

3.05 PERMISSIBLE MAKEUP WATER

A. Measure make up water required for the section of pipe being tested. Makeup water is the volume of water pumped into the test section of pipe necessary to maintain the specified test pressure after the pipe has been filled with water and the air expelled.

B. The maximum acceptable volume of makeup water for steel or bar-wrapped pipe installations is 10 gallons per inch of pipe diameter per mile of pipe tested per 24 hours. Calculate the maximum acceptable volume of makeup water using the following equation:

$$V_m = \frac{10DL}{5280}$$

Where:

V_m is the maximum acceptable volume of makeup water in gallons for 24 hours

D is the nominal pipe diameter in inches

L is the length of the pipe test section in feet

As an example the allowable amount of makeup water for a test section of 2500 feet of 60 inch diameter pipe would be: 10 x 60 x 2500 / 5280= 284 gallons

END OF SECTION

33 10 13 DISINFECTING OF WATER UTILITY DISTRIBUTION

1.00 GENERAL

1.01 WORK INCLUDED

A. Disinfect the facilities for pumping, storing, or conveying potable water to comply with the standards for potable water of the regulatory agency of jurisdiction. Potable water is defined as any water that has been filtered, disinfected or otherwise treated to the meet regulatory standards.

B. Disinfect piping systems that are used to convey water, solutions, or chemicals to the potable water facilities.

C. Test water from the disinfected system per regulatory standards to verify that water is acceptable. Repeat procedure if tests do not meet standards.

2.00 PRODUCTS

2.01 MATERIALS

A. Liquid Chlorine: Meeting the requirements of AWWA B301 - Liquid Chlorine.

B. Calcium Hypochlorite: Meeting the requirements of AWWA B300 - Hypochlorites.

3.00 EXECUTION

3.01 NEW FACILITIES

A. New facilities shall be thoroughly disinfected in accordance with AWWA C651 - Disinfecting Water Mains, AWWA C652 - Disinfection of Storage Facilities, and AWWA C653 - Disinfection of Water Treatment Plants, and then flushed and sampled before being placed in service. Samples shall be collected and tested in accordance with the TCEQ Rules and Regulations, Chapter 290.

B. During construction keep basins, pipe, fittings, equipment, and appurtenances free from dirt and debris.

1. Clean basins thoroughly before disinfection.
2. Seal the open ends of pipe with water-tight plugs when pipe is not being laid.
3. Pump water from trenches before removing the plug when water accumulates in the trench.

C. Complete hydrostatic test of the line prior to disinfection.

D. Wash the surfaces to be disinfected.

1. Flush pipelines. The minimum quantity of water used for flushing must exceed the capacity of the line to ensure that clean water has traversed the entire length of pipe.
2. Power wash the surfaces of basins and reservoirs using high pressure wash systems.

E. Disinfect facilities per the following procedures of AWWA:

1. Water Mains: AWWA C651 - latest revision.
2. Water Storage Facilities: AWWA C652 - latest revision.
3. Water Treatment Plants: AWWA C653 - latest revision.

F. Fill the system with potable water. Test the water to see that it meets the requirements of the regulatory agency of jurisdiction for potable water. Monitor the system for 2 days. If water test fails to meet the prescribed standards, repeat the disinfection process until water meets quality standards for disinfection.

3.02 REPAIRS OR CONNECTIONS TO EXISTING LINES

A. Clean and sterilize the interior surfaces of new piping, fittings, equipment, and appurtenances to be installed in an existing potable water system or connected to an existing system.

B. Clean and sterilize the existing pipe or facilities for a minimum distance of 3 pipe diameters back from the ends of the pipe. Plug the ends of the line when work is not being performed on the pipe.

C. Perform sterilization by swabbing each item with a concentrated chlorine solution.

1. Each piece is to be disinfected prior to being assembled for installation in the existing pipe.
2. Disinfect each piece just prior to assembly to help prevent re contamination.
3. Plug the ends of the assembly until a new item is to be added to the assembly.
4. Store disinfected materials on blocks to prevent contact with the ground.

3.03 DISPOSAL OF FLUSHING AND DISINFECTION WATER

A. Chlorinated water used in flushing and disinfecting pipelines, storage tanks, or vessels prior to connection to the distribution system shall be disposed of by the Contractor in an acceptable manner. Chlorinated water must be “de-chlorinated” prior to disposal to eliminate adverse impacts to the surrounding environment. Water released to the environment shall meet all AWWA, EPA, and TCEQ regulatory requirements.

1. The Contractor is responsible for complying with all of the applicable requirements of the TPDES General Permit TXG670000, issued by the TCEQ, regarding the discharge of hydrostatic test water. Maximum discharge chlorine concentration for compliance is 0.10 mg/l. Discharges within the Edwards Aquifer recharge area must meet special requirements under the terms of the General Permit. Contractor compliance is required.
2. Residual chlorine concentrations may be reduced using sulfur dioxide, sodium bisulfite, sodium sulfite, sodium thiosulfate, or ascorbic acid.
3. The discharge must be to a splash pad or paved area, and may not be located within 300 feet of the intake for a domestic drinking water supply or 500 feet of any public or private water well.

4. An effluent water sample must be taken during the first hour of discharge at a location immediately near the point of discharge, and collected prior to commingling with storm water, wastewater, or other flows.
5. For discharges that extend beyond an hour in duration, a second sample must be taken of the last 10 percent of the effluent.
6. Sampling protocol, sample containers, holding times, preservation methods, and analytical methods must follow the requirements set forth in the general permit.
7. The effluent grab sample(s) must be analyzed for total residual chlorine by an accredited and certified laboratory.
8. Any noncompliance that endangers human health or safety, or the environment must be reported to the TCEQ in accordance with the general permit.
9. Any effluent violation which deviates from the permitted effluent limitation by more than 40 percent must be reported to the TCEQ in accordance with the general permit.
10. The Contractor must record all hydrostatic test water sample results on an approved DMR (EPA Form 3320-1). These monitoring records shall be retained for a period of 3 years from the date of the record and be readily available for review by the TCEQ upon request. See attached form

B. With the written permission of the Owner of the system, chlorinated water may be disposed of in a sanitary sewer system if one is available. In the case of larger pipelines and the larger volumes of water involved, the Contractor will not be permitted to use the sanitary sewer system for disposal even if one is available.

END OF SECTION

PERMITTEE NAME/ADDRESS (Include Facility Name/Location if Different)
NAME

ADDRESS

FACILITY
LOCATION

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)
DISCHARGE MONITORING REPORT (DMR)

PERMIT NUMBER | DISCHARGE NUMBER

MONITORING PERIOD
FROM YEAR | MO | DAY TO YEAR | MO | DAY

☐ Check here if No Discharge
NOTE: Read instructions before completing this form

Form Approved.
OMB No. 2040-0004

PARAMETER		QUANTITY OR LOADING			QUALITY OR CONCENTRATION				NO. EX.	FREQUENCY OF ANALYSIS	SAMPLE TYPE
		VALUE	VALUE	UNITS	VALUE	VALUE	VALUE	UNITS			
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
	SAMPLE MEASUREMENT										
	PERMIT REQUIREMENT										
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	PERMIT REQUIREMENT										

NAME/TITLE PRINCIPAL EXECUTIVE OFFICER

TYPED OR PRINTED

SIGNATURE OF PRINCIPAL EXECUTIVE OFFICER OR AUTHORIZED AGENT

TELEPHONE: AREA CODE | NUMBER

DATE: YEAR | MO | DAY

COMMENTS AND EXPLANATION OF ANY VIOLATIONS (Reference all attachments here)

EPA Form 3320-1 PAGE OF

33 11 13.13 STEEL PIPE AND FITTINGS

1.00 GENERAL

1.01 WORK INCLUDED

A. Furnish labor, materials, equipment and incidentals necessary to install steel pipe, fittings, and specials as specified, including connections and appurtenances, as required for the proper installation and function of the pipe as indicated herein.

B. The pipeline coating shall be specified in Section 09 97 16 PIPELINE COATINGS AND LININGS. The pipe coating shall be polyurethane unless the use of mortar coated or epoxy coated steel pipe is indicated on the Drawings.

C. The pipeline shall be suited to carry potable water treated with chloramines and caustic.

1.02 QUALITY ASSURANCE

A. Experience Requirements:

1. Pipe shall be the product of one manufacturer who has had not less than five years' successful experience manufacturing pipe of the type and size indicated. Pipe manufacturing operations (fabrication of pipe and fittings, lining, and coating) shall be performed at one location unless otherwise approved by the Engineer. The lining and coating for the pipe or the fitting shall be done at the same location as the manufacture of the pipe or fittings. The pipe and fittings may be manufactured at different locations. The Engineer will waive the requirement for five years' experience in manufacturing of the pipe when, at the sole discretion of the Engineer, the manufacturer's experience and capabilities meet the intent of the experience requirement. All pipe shall be new and not supplied from inventory. All pipe and fittings shall be manufactured in the continental U.S.A., and shipping over salt waterways will not be allowed.

2. The lining for pipe diameters 108 inches and smaller shall be shop-applied, spun cement mortar lining per Section 09 97 16 "Pipeline Coatings and Linings."

3. The manufacturer shall be certified under Steel Pipe Fabricators Association (STI/SPFA) or ISO 9001 quality certification program for steel pipe and accessory manufacturing.

4. Approved manufacturers are:

a. Thompson Pipe Group

b. Northwest Pipe

c. American Spiralweld

B. Owner Testing and Inspection:

1. Pipe may be subject to inspection by an independent testing laboratory, which laboratory shall be selected and retained by the Owner. Representatives of the laboratory or the Engineer shall have access to the Work whenever it is in preparation or progress, and the pipe manufacturer shall provide proper facilities for access and for inspection. The pipe manufacturer shall notify the Owner in writing, a minimum of 2 weeks prior to the pipe fabrication so that the Owner may advise the manufacturer as to the Owner's decision regarding tests to be performed by an independent testing

laboratory. Material, fabricated parts, and pipe, which are discovered to be defective, or which do not conform to the requirements of this Section shall be subject to rejection at any time prior to Owner's final acceptance of the product. Pipe manufacturer shall be responsible for repairs to the coating system required as a result of Owner testing (polyurethane-coated pipe only) at no additional cost to the Owner.

2. The inspection and testing by the independent testing laboratory anticipates that production of pipe shall be done over a normal period of time and without "slow downs" or other abnormal delays. In the event that an abnormal production time is required, and the Owner is required to pay excessive costs for inspection, then the Contractor shall be required to reimburse the Owner for such laboratory costs over and above those which would have been incurred under a normal schedule of production as determined by the Engineer.

C. Factory Testing: The manufacturer shall perform all tests as required by the applicable AWWA standards and as listed herein.

D. Cement Mortar Lining: Shop-applied cement mortar linings shall be tested in accordance with AWWA C205.

E. Pipe Coatings: Pipe coatings shall be as specified in Section 09 97 16 “Pipeline Coatings and Linings.”

F. Hydrostatic Pressure Testing:

1. Each joint of pipe shall be hydrostatically tested prior to application of lining or coating. The internal test pressure shall be that which results in a fiber stress equal to 75 percent of the minimum yield strength of the steel used. Each joint of pipe tested shall be completely watertight under maximum test pressure. As a part of testing equipment, the pipe manufacturer shall maintain a recording pressure gauge, reference number of pipe tested, etc. The pipe shall be numbered in order that this information can be recorded.

2. Fittings shall be fabricated from hydrostatically tested pipe. Fittings shall be tested by hydrostatic test, air test or magnetic particle test. Air test shall be made by applying air to the welds at 10 pounds per square inch pressure and checking for leaks around and through welds with a soap solution. In addition, 10 percent of may shall be checked with x-ray or ultrasonic testing by a third party Certified Welding Inspector paid for by the Owner.

G. Elongation: For the tensile test specified in ASTM A370, 2-inch test specimens shall show elongations not less than 22 percent for each heat of steel. When 8-inch test specimens are used in lieu of 2-inch test specimens, the specimens shall show elongations not less than 18 percent for each heat of steel.

H. Mill Certification: The Owner will require the manufacturer to furnish mill test certificates on reinforcing steel or wire, steel plate, and cement. The manufacturer shall perform the tests described in AWWA C200, for all pipe, fittings, and specials.

I. Manufacturer's Technician for Pipe Installation:

1. During the construction period, the pipe manufacturer shall furnish the services of a factory trained, qualified, job experienced technician to advise and instruct as necessary in pipe laying and pipe jointing. The technician shall assist and advise the Contractor in

his pipe laying operations and shall instruct construction personnel in proper joint assembly and joint inspection procedures. The technician is not required to be on-site full time; however, the technician shall be on-site during the first 2 weeks of pipe laying and thereafter as requested by the Engineer, Owner, or Contractor.

2. The pipe manufacturer shall provide services of the polyurethane coating manufacturer's representative and a representative from the heat shrink joint manufacturer for a period of not less than 3 days at beginning of actual pipe laying operations to advise Contractor and Owner regarding installation, including but not limited to, handling and storage, cleaning and inspecting, coating repairs, field applied coating, heat shrink installation procedures and general construction methods and how they may affect the pipe coating.

3. The manufacturer's representative shall be required to return if, in the opinion of the Engineer, the polyurethane coating or the Contractor's construction methods do not comply with the Specifications. Cost for the manufacturer's representatives to return to the Site shall be at no additional cost to the Owner.

1.03 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00 "Submittal Procedures" and shall include:

B. SHOP DRAWINGS

1. Prior to the fabrication of the pipe, submit fabrication and laying drawings to the Engineer which shall include:

a. Schematic location; including a profile and a tabulated layout schedule, both of which shall reference the stationing shown on the plan and profile sheets.

b. Any deviation from the Drawings necessary to avoid conflicts with existing utilities and structures. The specific number of each pipe and fitting, location of each pipe, and direction of each fitting in the pipeline shall be depicted.

c. Full details of reinforcement and dimensions for pipe and fittings.

d. Location of all outlets as required by the Installation Contractor to install welds.

e. Location and details for the fabrication of all fittings and specials. The line layout shall include the pipe station and invert elevation at all changes in grade or horizontal alignment.

f. Provisions for thrust restraint, external loading, bedding, and vacuum collapse.

g. Welding requirements, welding procedures, provisions for thermal stress control, and provisions for control of coating damage for locations where welded joints are required.

h. Provide details and design calculations for fittings, specials, closures, outlets, joints, and special requirements for pipe in tunnels.

i. Provide certification for gasket joints, indicating it is designed to meet AWWA Standards and these documents.

j. Design calculations shall show methods and processes used to satisfy the pipe and fittings design criteria specified in the Contract Documents. All calculations shall be

prepared, signed, and sealed be a Professional Engineer licensed in the State of Texas.

k. Shop and Field Welding Data:

1). On a weld map, show the location, type, size, and extent of welds, with reference called out for Welding Procedure Specification (WPS) and non-destructive examination (NDE) numbers in tail of welding symbols, in accordance with AWS 2.4.

2). Submit welding terms and definitions in accordance with AWS 3.0.

3). Indicate by welding symbols or sketches, details of welded joints, and preparation of base metal.

4). Distinguish between shop and field welds.

5). Submit welding data together with Shop Drawings as a complete package.

l. Flanged Joints

1). For each flanged connection, provide: reference standard; dimensional data; bolt hole number, pattern, and diameter; bolt diameter and length; and face condition.

2). Gaskets and Bolting: Technical data sheets itemizing chemical composition, and technical and performance information that indicates compliance with this Specification.

C. CERTIFICATION OF COMPLIANCE WITH CONTRACT DOCUMENTS

1. Prior to shipment of the pipe, the Contractor/Pipe Manufacturer shall submit an affidavit certifying that the pipe, fittings, specials, and other products and materials furnished, comply with this Section, Drawings, NSF61, and the applicable requirements of the AWWA standards.

D. CERTIFIED TEST REPORTS

Submit the following Certified Test Reports:

1. Copies of results of factory hydrostatic tests and test of fittings shall be provided to the Engineer.

2. Mill certificates, including chemical and physical test results for each heat of steel, and elongation tests.

3. A Certified Test Report from the coating Manufacturer indicating that the coatings were applied in accordance with Manufacturer's requirements and in accordance with this Section on all pipe, fittings and joints made in the factory.

4. Welder Qualifications Records (WQR) in accordance with AWWA C206 and AWS D1.1 for both factory and field welders.

5. Certified test reports for cement mortar tests.

6. Gasket certification in accordance to AWWA C200 shall be provided where bell and spigot gasket joint pipe is specified.

7. Copies of all manufacturer’s factory quality control tests.

E. RECORD DATA

1. Submit the following:

   a. Manufacturer's Welding Procedure Specifications per AWS D1.1 or Section IX of the ANSI/ASME Boiler and Pressure Vessel Code, under ANSI/AWS B2.1.

   b. Submit inspection procedures to be used by Manufacturer and for quality control and assurance for materials and welding. Submit standard repair procedures that describe in detail shop and field work to be performed.

   c. Certification showing calibration within last 12 months for equipment such as scales, measuring devices, and calibration tools used in manufacture of pipe. Each device used in manufacture of pipe is required to have tag recording date of last calibration. Devices are subject to inspection by Owner.

2. Provide copies of "Release for Manufacture" layout sheets prior to pipe delivery.

3. Daily welding reports for field welding showing welder and joint welded shall be submitted monthly.

4. After construction, the Pipe Manufacturer shall provide AutoCad drawings of the pipe plan and profile layout sheets showing each joint of pipe and all appurtenances to the same coordinate system as used on the Drawings.

5. After construction, the installation Contractor shall provide ASCI electronic record data showing top-of-pipe survey every 50 feet along the pipeline and at horizontal and vertical deflections.

1.04 STANDARDS

A. Except as modified or supplemented herein, the steel pipe, coatings, fittings, and specials shall conform to the applicable requirements of the following standard specifications, latest edition:

1. American National Standards Institute (ANSI)/NSF:

   a. ANSI/NSF Standard 61.

2. American Society of Mechanical Engineers (ASME):

   a. ASME Shop Welding Certification.

3. American Society for Testing and Materials (ASTM):

American Society for Testing and Materials (ASTM)	
ASTM C33	Specifications for Concrete Aggregates
ASTM C35	Specifications for Inorganic Aggregates for Use in Gypsum Plaster
ASTM C150	Specifications for Portland Cement
ASTM D16	Paint, Varnish, Lacquer, and Related Products
ASTM D522	Mandrel Bend Test of Attached Organic Coatings
ASTM E165	Practice for Liquid Penetrant Inspection Method
ASTM E709	Practice for Magnetic Particle Examination

American Society for Testing and Materials (ASTM)	
ASTM E1444	Guide for Magnetic Particle Examination

4. American Water Works Associations (AWWA):

American Water Works Associations (AWWA)	
AWWA C200	Steel Water Pipe 6 Inches and Larger
AWWA C205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe 4 Inches and Larger – Shop-Applied
AWWA C206	Field Welding of Steel Water Pipe
AWWA C207	Steel Pipe Flanges for Waterworks Service – Sizes 4 Inches thru 144 Inches
AWWA C208	Dimensions for Steel Water Pipe Fittings
AWWA C210	Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
AWWA C216	Heat Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
AWWA C217	Petrolatum and Petroleum Wax Tape Coatings for the Exterior of Connections and Fittings to Steel Water Pipelines
AWWA C222	Polyurethane Coatings for the Interior and Exterior of Steel Water Pipelines and Fittings
AWWA C602	Cement-Mortar Lining of Water Pipelines – 4 Inches and Larger – In-Place
AWWA C604	Installation of Buried Steel Water Pipe 4-Inches and Larger
AWWA M11	Manual: Steel Pipe - A Guide for Design and Installation

5. American Welding Society (AWS):
    a. AWS D1.1 – Structural Welding Code.
6. Steel Structures Painting Council (SSPC):

Steel Structures Painting Council (SSPC)	
SSPC-SP-1	Steel Structures Painting Council - Solvent Cleaning
SSPC-SP-10	Steel Structures Painting Council - Near-White Blast Cleaning
SSPC-PA2	Steel Structures Painting Council - Measurement of Dry Paint Thickness with Magnetic Gages
SSPC-PA/Guide 3	Steel Structures Painting Council - A Guide to Safety in Paint Application
SSPC-PS/ Guide 17	Steel Structures Painting Council - A Guide for Selecting Urethane Painting Systems

1.05 DELIVERY AND STORAGE

A. Packing:

1. The pipe shall be prepared for shipment to afford maximum protection from normal hazard of transportation and allow pipe to reach the Site in an undamaged condition.

Pipe segments damaged in shipment that require more than two repairs per segment will not be accepted at the Site. No more than 10 percent of all segments shall have damage repairs or all damaged pipe segments will be rejected. Normal factory repair of lining and coating for fabrication of fittings and specials is acceptable.

2. Pipe sections shall be handled in accordance with Paragraph 3.01.C. In all instances deliver, handle, and store pipe in accordance with the Manufacturer's recommendations to protect coating systems. Upon delivery of the pipe, notify the Engineer so that inspection can be made.

3. For mortar-lined pipe, after the completed pipe and fittings have been removed from the final cure at the manufacturing plant, the pipe lining shall be protected from drying by means of plastic end covers banded to the pipe ends. Covers shall be maintained over the pipe ends at all times until ready to be placed in the trench. Moisture shall be maintained inside the pipe by periodic addition of water as necessary.

4. Pipes shall be carefully supported during shipment and storage. Pipe, fittings, and specials shall be separated so that they do not bear against each other, and the whole load shall be securely fastened to prevent movement in transit. Ship pipe on padded bunks with tie-down straps approximately over stulling. Store pipe on padded skids, sand or dirt berms, tires, or other suitable means to protect the pipe from damage. Each end and middle of each length of pipe, fitting, or special shall be internally supported and braced with stulls to maintain a true circular shape. Stulling shall meet the following requirements:

    a. Install stulling in 36 inch and larger pipe, specials, and fittings in accordance with approved submittal and as soon as practical after pipe is fabricated or for shop-lined pipe after lining has been applied. Six point stulls shall be equally spaced circumferentially (approximately 60 degree spacing) within the pipe. Additional stulls shall be included, as determined by the Pipe Manufacturer, to protect the pipe from damage. The Pipe Manufacturer's stulling shall meet or exceed the standards listed in ASCE MOP No. 79.

    b. Pipe shall be rotated so that one stull remains vertical during storage, shipment and installation.

    c. Stulls shall not be removed until pipe is laid, set to grade, and backfilled.

    d. Internal stulls shall consist of timber or steel, firmly wedged and secured so that stulls remain in place during storage, shipment, and installation. Timber stulls will be allowed in diameters above 84 inches, if it can be demonstrated that the timbers will stay in place until backfilling. All timber for stulls must be cured wood. Vertical stull shall be 4-inch by 6-inch timber (min.), Cross stulls shall be 4-inch by 4-inch timber (minimum). Connect stulls with bolts. Shim as needed to maintain tight fit and roundness of pipe.

    e. Install stulling in a manner that will not harm lining. Pipe and liner shall be protected from damage from stulls using wood pads, or similar devices, unless it can be demonstrated that the wood pads are not required to prevent damage to the pipe lining. Pad shall be shaped to conform to pipe diameter. Pad shall be 4-inch by 6-inch timber and a minimum of 18 inches in length.

f. Stulls shall not be welded directly to the pipe, except at the end of the pipe where the mortar is held back.

B. Marking for Identification:

1. Each joint of pipe, fitting, and special shall have plainly marked on one end of the exterior: the class for which it is designed, the date of manufacturer, and the identification number as shown on the Shop Drawings. Beveled pipe shall be marked with the amount of bevel. The top centerlines shall be marked on all fittings and specials.

2. Each joint of pipe, fitting, and special shall also be marked at each end on the interior lining, near but not inside the bell or spigot, with the section designation and pipe identification number as shown on the approved Shop Drawings. Markings should be visible from inside the pipe after installation, during and after field welding, joint grouting, and inspection. Markings should be applied a minimum of 3 inches in height with a waterproof paint or dye resistant to fading due to UV exposure.

C. Point of Delivery: Whenever possible, pipe shall be hauled directly from the manufacturing plant to the Site and strung along pipeline route, avoiding re-handling and the possibility of damage to the pipe. Where a fully loaded truck and trailer cannot operate along the pipeline route, pipe may be unloaded at access points along the route and brought to the trench side by approved methods; however, the Installation Contractor shall be responsible for pipe being undamaged at the time of installation.

2.00 PRODUCTS

2.01 MATERIALS

A. Flanges, Nuts, Bolts, and Gaskets: Furnish and install all bolts, nuts, flange gaskets, and insulation kits.

1. Flanges shall conform to the AWWA C207 class equal to or greater than the pipe class, unless otherwise specified, and shall match the class of valves or appurtenances which are attached.

2. All nuts, bolts, and washers exposed inside buildings or vaults shall be steel and coated in accordance with the specifications for adjacent pipe. All bolts shall be long enough that a minimum of three threads are exposed beyond the nut. Use an anti-seize compound during installation.

a. Bolts shall conform to ASTM A193, Grade B7. Nuts shall conform to ASTM A194, Grade 2H heavy hex nuts. Washers shall conform to ASTM F436.

3. All buried nuts, bolts, and washers shall be Type 316 stainless steel of suitable strength to meet the service requirements. Bolts shall conform to ASTM A193, Grade B8M. Nuts shall conform to ASTM A194, Grade 8M. Washers shall conform to ASTM A193. All bolts shall be long enough that a minimum of three threads are exposed beyond the nut. Use an anti-seize compound during installation.

4. Non-Insulated Flange Gaskets:

a. For working pressures up to 175 psi, gaskets shall be rubber.

b. For working pressures above 175 psi, gaskets shall be non-asbestos compressed fiber.

c. Gasket configuration shall be in accordance with AWWA C207. Gasket shall be NSF 61 certified. Acceptable manufacturers are Gasket Resources, Garlock, or approved equal.

5. Flange Insulating Kits:

a. Flange insulating kits shall be installed within six months of the date of manufacture of all components.

b. Do not store insulating flange gaskets, sleeves, or washers under direct sunlight or at temperatures exceeding 110 degrees F.

c. Insulating gaskets shall be full-face, Type E with an EPDM O-ring seal. Minimum total gasket thickness shall not be less than 1/8-inch. The gasket shall have the same outside diameter as the pipe flange. For steel pipe the gasket's inside diameter shall be equal to the inside diameter of the pipe's steel cylinder. The complete assembly shall have a pressure rating equal to or higher than that of the joint and pipeline. The gasket material shall be resistant to intended chemical exposure, operating temperatures, and pressures in the pipeline. Insulating sleeves shall be one-piece, full-length, Mylar or NEMA G10 fiberglass reinforced epoxy with a minimum thickness of 1/8-inch.

d. Insulating washers shall be NEMA G10 fiberglass reinforced epoxy.

e. Gasket configuration shall be in accordance with AWWA C207. Gasket shall be NSF 61 certified. Acceptable manufactures are GPT, Houston, TX; or Georg Fischer Central Plastics LLC, Shawnee, OK.

f. Flange bolt holes shall be oversized for bolt insulating sleeves.

B. Steel: Steel shall meet the requirements of AWWA C200 and shall be of continuous casting. Steel shall be homogeneous and shall be suitable for field welding, fully killed, and of a fine austenitic grain size. Steel shall have a minimum yield strength of 42,000 psi.

C. Bend Fittings: All bend fittings shall have a minimum radius of 2.5 times the pipe diameter to permit easy passage of pipeline pigs unless otherwise shown on the plans.

D. Threaded Outlets: No threaded outlets will be allowed

E. Outlets for Weld Leads: Installation Contractor may use factory manufactured outlets for access for weld leads. Outlets shall be welded after use. Outlet configuration shall be shown in the Shop Drawings. Spacing of outlets shall be no closer than 500 feet. Outlets for appurtenances shall be used in the calculation of outlet spacing. Outlet configuration shall be approved by the Engineer.

F. Joint Bonds for Steel Pipe with Rubber Gasket Joints: Bond shall be a solid copper strap, 1-1/4-inch wide by 1/16-inch thick (equivalent to 1/0 AWG wire). Strap bonds shall be manufactured by ERICO Products, Continental Industries, or approved equal. Connection of joint bond to pipe shall be with the thermite weld method using the cartridge and recommended by the bond manufacturer. Additional requirements based on the joint type include:

1. For Coated Steel Pipe: Provide two punched holes for thermite welding to the pipe. Strap bond shall be 12 inches long, maximum. Provide three joint bonds per pipe joint.

2. For Flexible Coupling, Flanged Coupling Adapter, and Other Non-Standard Joints: Provide five punched holes for thermite welding to the coupling and pipe. Strap bond shall be fabricated for the length of the coupling with sufficient additional length for 1 inch of joint movement. Provide two bonds per joints for pipe less than 60 inches in diameter and three bonds per joint for pipe 60 inches or greater in diameter.

3. For Insulated Flexible Coupling Joints: Provide four punched holes for thermite welding to the coupling and pipe. Strap bond shall be fabricated for the length of the coupling with sufficient additional length for one-inch of joint movement.

H. Flexible Joint Couplings: Shall be as specified in Section 33 12 16.13 “Miscellaneous Valves and Appurtenances.”

I. Cement Mortar Linings: Cement mortar linings shall be shop-applied (plant-spun) for pipe sizes 108 inches and smaller. Shop-applied cement mortar linings shall be provided in accordance with Section 09 97 16 “Pipeline Coatings and Linings.”

J. Epoxy Lining: Where indicated on the Drawings, at all insulating joints, and at all above grade piping provide epoxy lining in accordance with Section 09 96 00.01 “High Performance Coatings” and Section 09 97 16 “Pipeline Coatings and Linings.”

K. Epoxy Coating: Where indicated on the Drawings, and for exposed piping, pipe shall have an epoxy coating per Section 09 96 00.01 “High Performance Coatings” and Section 09 97 16 “Pipeline Coatings and Linings.”

L. Polyurethane Coating: Polyurethane coating shall be in accordance with Section 09 97 16 “Pipeline Coatings and Linings.”

M. Test Bulkheads: Furnish test bulkheads in accordance with the Drawings. Additional test bulkheads not shown in the Contract Drawings but requested by the Installation Contractor shall be paid for by the Installation Contractor.

1. Each test plug or bulkhead shall be designed to withstand the test pressure on either side with only atmospheric pressure on the opposite side. The manufacturer may use either one or two plugs to allow testing on each side.

2. Each test plug or bulkhead specified shall have a 30-inch flanged outlet on each side of the plug. The 30-inch outlets shall be supplied with a 30 inch by 16 inch reducing flange with a 16-inch blind flange. If pipeline diameter is less than 30-inch, the flanged outlet shall match the pipe diameter.

N. Special Coatings in Tunnels and Casings: Pipe to be laid in casing or tunnel shall have a full, continuous mortar coating over the polyurethane coating. The coating shall have at least two mortar bands at a minimum of 2 inches thick, or thick enough to be a larger outside diameter than the bell, including heat shrink sleeve. The mortar coating is to allow the pipe to be installed by skidding on pipe rings. The manufacturer shall design the mortar bands and reinforcement sufficiently to prevent damage to the coating from the installation process.

2.02 MIXES

A. Mortar for Interior and Exterior Joints: Mortar shall be 1 part cement to 3 parts sand. Cement shall be ASTM C150, Type I or II. Sand shall be of sharp silica base and shall not leach in water. Sand shall be plaster sand meeting ASTM C33 or C35. Exterior joint mortar shall be mixed to the consistency of thick cream. Interior joint mortar shall be mixed with as little water as possible so that the mortar is very stiff, but workable. Water for cement mortar shall be treated and suitable for drinking water.

B. Mortar for Pipe Patching for Shop-Applied Cement Mortar Lining: Mortar for patching shall be as per interior joints.

C. Bonding Agent: Bonding agent for cement mortar lining patching shall be Probond Epoxy Bonding Agent ET-150, parts A and B; Sikadur 32 Hi-Mod, or approved equal.

2.03 MANUFACTURED PRODUCTS

A. Pipe:

1. Pipe Design Criteria:

a. Steel pipe shall be designed, manufactured, and tested in conformance with AWWA C200, AWWA M11, and with the criteria specified herein. Sizes and pressure classes (working pressure) shall be as shown on the Drawings. For the purpose of pipe design, the transient pressure plus working pressure shall be 1.5 times the working pressure class specified. Fittings, specials, and connections shall be designed for the same pressures as the adjacent pipe. Pipe design shall be based on trench conditions and the design pressure in accordance with AWWA M11; using the following parameters:

Pipe Design Criteria	
Unit Weight of Fill (w)	130 pcf
Live Load	AASHTO HS 20 (at all locations except railroads)
	Coopers E 80 at railroad
Trench Depth	As indicated
Deflection Lag Factor (Dl)	1.1
Coefficient (K)	0.10
Maximum Calculated Deflection (Dy = Dx)	2 % (Polyurethane Coated Steel Pipe)
Soil Reaction Modulus (E')	1500 (typical trench section) or 3000 (where encased in CSLM or concrete)

b. The fittings and specials shall be designed in accordance with AWWA C208 and AWWA M11 except that crotch plates shall be used for outlet reinforcement for all Pressure Diameter Values, PDV, greater than 6000 unless otherwise specified. Where indicated on the Drawings, collars or wrappers shall be used in lieu of crotch plates to allow working space and supports.

c. Where the pipe requires additional external support to achieve the specified maximum deflection, the Contractor and the Supplier will be required to furnish alternate methods for pipe embedment. No additional compensation will be made to the Contractor by the Owner where this method is required.

d. Trench depths indicated shall be verified after existing utilities are located. Vertical alignment changes required because of existing utility or other conflicts shall be accommodated by an appropriate change in pipe and embedment design depth. In no case shall pipe be installed deeper than its design allows.

e. Pipe shall be designed for full vacuum conditions without buckling, damage to lining, damage to coating, or damage to pipe joints.

f. The pipe shall be designed for a maximum calculated deflection limit of 3 percent for polyurethane coated steel pipe and 2 percent for mortar/concrete coated steel pipe for any of the following future loadings:

   1). Additional fill of 8 feet above the finished grade over the pipeline.

   2). A fully loaded Link Belt Hylab 5 crane (150 ton capacity) or equivalent model. The crane will be parked over the pipeline for two days, maximum, during repair operations. The design shall assume the worst case scenario for the track orientation. For the purposes of design, the construction load will be considered a live load. This design vehicle translates to a design load in the following table:

Live Loads at the Top of Steel Pipe (lb/LF)

Pipe I.D. (inch)	**Soil Cover (ft.)**								
	4	5	6	8	10	12	14	16	18
60	5,000	4,300	3,700	3,000	2,500	2,100	1,900	1,700	1,500
66	5,500	4,700	4,100	3,300	2,800	2,400	2,100	1,900	1,700
72	6,000	5,200	4,600	3,700	3,000	2,600	2,300	2,000	1,800
78	6,600	5,700	5,000	4,000	3,300	2,900	2,500	2,200	2,000
84	7,200	6,200	5,400	4,300	3,600	3,100	2,700	2,400	2,200
90	7,800	6,700	5,900	4,700	3,900	3,400	3,000	2,600	2,400
96	8,400	7,200	6,300	5,100	4,200	3,600	3,200	2,800	2,500
102	9,000	7,800	6,800	5,500	4,600	3,900	3,400	3,000	2,700
108	9,700	8,300	7,300	5,800	4,900	4,200	3,700	3,300	2,900

2. Provisions for Thrust:

   a. Thrust at valves, bends, tees, or other fittings shall be resisted by restrained joints. Thrust at bends adjacent to casing shall be restrained by welding joints through the casing and a sufficient distance each side of the casing. No thrust restraint contribution shall be allowed for pipe in casing unless the annular space in the casing is filled with grout.

   b. Restrained joints shall be used a sufficient distance from each side of the bend, tee, plug, or other fitting to resist thrust which develops at the design pressure of the pipe. For the purposes of thrust restraint, design pressure shall be 1.5 times the working pressure class. Restrained joints shall consist of welded joints unless other joint types are specifically shown on the Drawings.

   c. Thrust restraint design shall be the complete responsibility of the pipe manufacturer. The length of pipe with restrained joints to resist thrust forces shall be determined by the pipe manufacturer in accordance with AWWA M11 and the following:

      1). The Weight of Earth shall be calculated as the weight of the projected soil prism above the pipe.

      2). Soil Density = 60 pcf (maximum value to be used).

      3). Coefficient of Friction = 0.15 (maximum value to be used for polyurethane coated steel pipe).

      4). Coefficient of Friction = 0.30 (maximum value to be used for mortar/concrete coated steel pipe).

      5). The above applies to unsaturated soil conditions. In locations where ground water is encountered, the soil density shall be reduced to its buoyant weight for all backfill below the water table, and the coefficient of friction shall be reduced to 0.15 for polyurethane coated steel pipe.

      6). For horizontal bends, the length of pipe to be restrained shall be calculated as follows:

         a). For Δ less than 60 degrees:

$$L = \frac{P\ A\ sin\ (\Delta/2)}{f(2We + Wp + Ww)}$$

         b). For Δ greater than 60 degrees:

$$L = \frac{P\ A\ (1 - cos\Delta)}{f(2We + Wp + Ww)}$$

         L = Length of pipe to be restrained

         P = 1.5 times working pressure

         A = Cross-sectional area of pipe steel cylinder I.D.

         Δ = Deflection angle

We = Weight of earth prism above the pipe

Wp = Weight of pipe

Ww = Weight of water

f = Coefficient of friction

7). For vertical bends, the length of pipe to be restrained shall be calculated in accordance with AWWA M11.

3. Inside Diameter: The inside diameter, including the cement mortar lining, shall be a minimum of the nominal diameter of the pipe specified, unless otherwise indicated on the Drawings.

4. Wall Thickness:

   a. The minimum pipe wall steel thickness shall be 0.183 inch or pipe ID/230, whichever is greater for pipe and fittings. All pipe, fittings and specials shall have a maximum or minus tolerance of .005 inches. Where indicated on the Drawings, pipe and fittings shall have thicker steel pipe wall. The minimum steel wall thickness shall also be such that the fiber stress shall not exceed 50 percent of the specified yield strength of the steel, nor the following, at the specified working pressure.

Pipe Type	Maximum Stress at Working Pressure
Polyurethane Coated Steel	23,000 psi
Mortar/Concrete Coated Steel Pipe	18,000 psi

   b. Pipe which is placed in casing or tunnel or exposed in vaults shall have a minimum pipe wall steel thickness of 0.35 inch or pipe ID/144, whichever is greater.

   c. Fittings and outlets shall be designed per AWWA M11 and AWWA C208:

5. Seams: Except for mill-type pipe, the piping shall be made from steel plates rolled into cylinders or sections thereof with the longitudinal and girth seams butt welded or shall be spirally formed and butt welded. There shall be not more than two longitudinal seams. Girth seams shall be butt welded and shall not be spaced closer than 6 feet except in specials and fittings.

6. Joint Length: Maximum joint length shall not exceed 50 feet. Maximum joint length of steel pipe installed in casing shall not exceed 25 feet.

B. Joint Bonds, Insulated Connections, and Flange Gaskets: See Section 2.01.F of this specification

C. Bend Fittings: All bend fittings shall be long radius (minimum of 2.5 times the pipe ID) to permit passage of pipeline pigs. Use 25 foot joints where shown on the drawings for curved alignments.

D. Pipe Ends: Pipe ends shall be lap-welded slip joint, butt-strap joint, flanged joint, or flexible-coupled joint.

   1. Lap-Welded Slip Joint:

a. Lap-welded slip joint shall be provided in all locations for pipe larger than 48 inches, for pressure class greater than 250 psi, and where joints are welded for thrust restraint. Ends of pipe, fittings, and specials for field-welded joints shall be prepared with one end expanded in order to receive a plain end, making a bell and plain end type of joint. Bells formed by rolling will not be allowed unless approved by the Engineer. Dimensional tolerance of bell and spigots shall be consistent, so that match marking of pipe ends will not be required, and joints are interchangeable in the field. Clearance between the surfaces of lap joints shall not exceed the requirements of AWWA C206.

b. The depth of bell shall be such as to provide for a minimum clear distance of 2 inches between the weld and the nearest tangent of the bell radius when welds are to be located on the inside of the pipe.

c. The depth of bell shall be such as to provide for a minimum lap of 2 inches or three times the thickness of the belled pipe, whichever is greater. Provide a deeper bell every 400 feet to accommodate thermal movement for which the minimum lap shall be 4 inches.

d. Lap-welded slip joints may be welded from the inside or outside for pipe diameters 42 inches and larger. All other sizes shall be welded from the outside.

e. Double welded lap joints and butt strap joints shall be tapped and drilled for testing from the outside in accordance with AWWA C206 and the Drawings.

f. For pipe 30-inches in diameter and larger, precisely paint a circumferential ¾-inch insertion band (leading edge of band indicating minimum insertion; trailing edge of band indicting maximum insertion; pulled joints to occur within the band around entire circumference). Bond shall be around the outside of spigot end to indicate location at which spigot end has reached required penetration into bell.

2. For Fittings with Flanges: Flanged joints shall be provided at connections to valves and where indicated. Ends to be fitted with slip-on flanges shall have the longitudinal or spiral welds ground flush to accommodate the type of flanges provided. Pipe flanges and welding of flanges to steel pipe shall conform to the requirements of AWWA C207 and AWWA C206. Pipe flanges shall be of rated pressure equal to or greater than the adjacent pipe class. Flanges shall match the fittings or appurtenances which are to be attached. Flanges shall be spot-faced or back-faced parallel to the front face.

3. Flexible Couplings: Flexible couplings shall be provided where shown on the Drawings. Ends to be joined by flexible couplings shall be of the plain-end type, prepared as stipulated in AWWA C200. Pipe ends shall be truly circular to within 1/4 inches or the coupling manufacturer's tolerance, whichever is smaller. In addition, the welds on the pipe ends that are to be joined by couplings shall be ground flush, to permit sliding the coupling in at least one direction to clear the pipe joint. Harness bolts and lugs shall comply with the Drawings.

4. Butt-strap Closure Joints: Where necessary to make closure to pipe previously installed, closure joints shall be installed using butt-strap joints in accordance with AWWA C206 and applicable provisions of this Section. Where butt-strap closure joints cannot be hydrostatically tested in the field with the main pipeline, the butt strap shall have an

inside and outside weld and shall be air tested. Air test shall be operated at 5 psi for a minimum of five minutes, from a threaded fitting between the welds.

3.00 EXECUTION

3.01 INSTALLATION

A. General:

1. Install steel pipe, fittings, specials, and appurtenances as specified and required for the proper functioning of the completed pipe line. Install pipe, fittings, and specials in accordance with the manufacturer's recommendations and AWWA M11 and AWWA C604. Pipe shall be laid to the lines and grade indicated. Just before each joint of polyurethane coated steel pipe is lowered into the ditch it is to be inspected and tested for holidays. All damaged areas and holidays are to be repaired before the pipe is lowered into the trench.
2. The requirements of Section 31 23 33 – TRENCHING AND BACKFILL govern for the excavation and backfilling of trenches for laying steel pipe, fittings, and specials. Conformance with pipe deflection requirements shall be as set forth below.
    a. Average allowable pipe deflection is limited to 2% for polyurethane coated steel pipe and 1% for mortar and shotcrete coated steel pipe. In no case shall a single measurement in any direction exceed 1.5 times the average allowable deflection. These measurements include the allowable tolerance for lining thickness. Percent deflection shall be calculated as:

$$Percent\ Deflection = \frac{\text{actual (plan) ID} - \text{installed (measured) ID}}{\text{actual (plan)ID}} \text{x}100$$

    b. Deflection measurements shall be made by the Contractor in the presence of the Owner. Method for taking measurements shall be agreed to by the Owner and Engineer in writing prior to installing the first joint of pipe.
    c. The contractor shall measure deflection approximately 7 days after backfill to final grade. The pipe shall be checked seven days after backfill and again 30 days after backfill. Payment for pipe installation will not be made until pipe deflection is measured, unless otherwise approved by the Owner.
    d. The Owner may, at his discretion, perform additional verification measurements on any area prior to substantial completion.
    e. Average deflection shall be determined by averaging the pipe's measured horizontal and vertical deflection as indicated below. Locations where measurements are taken shall be clearly marked on the interior of the pipe.
    f. For pipe joints 36 feet in length or less, measurements shall be taken at two locations, ¼-distance from each pipe end. Approximately 10 feet from each end.
    g. For pipe joints longer than 36 feet, measurements shall be taken at three locations including ¼-distance from each pipe end and at the pipe midpoint.
    h. If the average calculated deflections for any segment of pipe or any single measurement fails to meet specifications, the entire segment of pipe shall be reworked in accordance with the Manufacturer's recommendations and as directed

by the Engineer at no additional cost to the Owner. This may include uncovering the pipe and re-compaction of the pipe embedment, and repair of coating. A pipe segment shall be defined as a length of manufactured pipe between manufactured or field constructed joints.

i. Installed pipe joints will also be examined for flat spots and internal lining stress cracks by the Owner. Lining damage shall be repaired in accordance with the Manufacturer's recommendations and as directed by the Engineer at no additional cost to the Owner. Repair of flat spots may include uncovering the pipe and re-compaction of the pipe embedment, and repair of the coating.

j. Where pipe has been reworked to comply with the deflection requirements, Contractor shall re-measure for deflection no earlier than seven days after the repaired pipe is backfilled. Owner will re-inspect for flat spots at this time.

k. No pipe installation shall be accepted until the entire installation is in compliance with the above deflection requirements.

3. All costs associated with measuring for pipe deflection and any repairs or rework associated with meeting these requirements shall be borne by the Contractor.

4. Keep the pipe clean during the laying operation and free of sticks, dirt, animals, and trash, and at the close of each operating day, effectively seal the open end of the pipe against the entrance of water using a gasketed night cap. Do not lay pipe in water. The Contractor may install a vent at the top of the night cap to prevent flotation of the pipe in the event of heavy rain during the night.

5. Install bonds at all pipe joints, other than welded joints or insulated joints.

6. Pipe Deflection Reports:

a. A monthly report shall be submitted as Record Data showing the following for each joint of pipe:

1). Allowable deflection and 1.5 times allowable deflection for each pipe diameter installed.

2). Deflection measurements and calculated deflection for each location measured per joint.

3). It is the responsibility of the Contractor to verify that the nominal pipe diameter meets specifications at all measured locations. Contractor shall coordinate pipe replacement with the pipe manufacturer for any pipe not meeting the specified internal diameter.

B. Line, Grade and Cover over Top of Pipe

1. It is intended that the pipe be laid to the depth specified or shown on Drawings. Cover shall be defined as the distance from the top of the pipe barrel to the natural ground surface. The Installation Contractor shall be required to lay the pipe to conform to the profiles shown on the approved Shop Drawings within six-inches vertically and one-foot horizontally.

2. The grades shall be constructed to provide a uniform grade between low points and high points, and intermediate high and low points shall be eliminated. No additional compensation shall be made for extra trench depth required to meet these conditions.

3. Use survey equipment to indicate alignment and grade. Take at least one elevation reading every 50-feet along the pipeline and at horizontal and vertical deflections. Make periodic elevation measurements with surveying instruments to verify accuracy of grades.

C. Pipe Handling: Pipe shall be handled at all times with a minimum of two non-abrasive slings, belts or other equipment designed to prevent damage to the coating or lining. The equipment shall be kept in such repair that its continued use is not injurious to the coating. The spacing of pipe supports required to handle the pipe shall be adequate to prevent cracking or damage to the lining or coating.

D. Line Up and Bends:

1. Line up pipe for joining so as to prevent damage thereto. Thoroughly clean the bell and spigot ends of each joint of pipe of foreign matter, rust and scale before placing spigot into bell. Welded joints shall have an overlap of 2-inch minimum to 4- inch maximum.

2. All under-stabbed joints shall be butt strapped or re-stabbed. All over-stabbed joints shall not be acceptable. A joint shall be considered over-stabbed if the stabbed section is greater than 3-1/2 inches or the inside mortar gap is less than 1/4-inch. All over-stabbed joints shall be re-stabbed, butt strapped, or welded.

3. Where abrupt changes in grade and direction occur, the Contractor shall employ special shop fabricated fittings for the purpose. Field cutting the ends of the steel pipe to accomplish angular changes in grade or direction of the line shall not be permitted, unless approved by the Engineer.

4. Where pipe horizontal alignment is on a curve, contractor may pull joints to make a curved alignment. Pulled joints that are welded shall meet the overlap requirements mentioned above. Pulled rubber gasket joint deflection shall not exceed 75% of the Manufacturers' recommended allowable.

E. Pipe Laying – Welded Joints:

1. Weld joints in accordance with the AWWA C206 and AWS D1.1. Contractor shall provide adequate ventilation for welders and for Owner's representative to observe welds. Unless otherwise specified, welds shall be full circle fillet welds. Welding shall be completed before application of field applied joint coating. The Contractor may, at his option, weld pipe joints after the exterior joint coating and backfilling is complete. Contractor shall demonstrate that this procedure will not damage the exterior joint coating.

2. Contractor shall submit a welding procedure for approval according to paragraph 1.03. The welding procedure shall be approved by the Engineer before welding of joints begins. The procedure shall be in accordance with AWWA C206 and AWS D1.1. Contractor must follow approved welding procedure only.

3. Provide a deeper bell every 400 feet to accommodate thermal movement.

4. If the Contractor chooses to use weld after backfill, special techniques shall be used to limit damage to the exterior heat shrink sleeves. Contractor shall follow all Weld after Backfill Joint Requirements as dictated in Section 09 97 16 "Pipeline Coatings and Linings." After welding, the pipe shall be excavated to verify no unacceptable damage to the exterior heat shrink sleeve and coating protection. Each welder shall be required

to demonstrate that no unacceptable damage will occur to the heat shrink sleeve. Test shall be conducted on pipe with the minimum wall thickness for each type of sleeve used on the project. Should the inspection of the exterior coating reveal damage in the opinion of the Engineer, the test will be considered a failure and the coating will be removed and replaced at no additional cost to the Owner. The test for the failed welder may be repeated on another joint at the Contractor's option with the approval of the Engineer.

5. Adequate provisions for reducing temperature stresses shall be the responsibility of the Contractor.
6. After the pipe has been joined and properly aligned and prior to the start of the welding procedure, the spigot and bell shall be made essentially concentric by shimming or tacking to be within the maximum clearance tolerance around the periphery of the joint per AWWA C206. Tighter tolerance may be required to prevent damage to heat shrink sleeves for weld after backfill. In no case shall the clearance tolerance be permitted to accumulate.
7. Before welding, thoroughly clean pipe ends to bare metal. Joint shall be dry before welding. All welding shall be hand welded to minimize damage to heat shrink sleeves, unless it can be demonstrated that wire fed welding will not cause unacceptable damage to the heat shrink sleeve. Welding shall be performed so as not to damage lining or coating. Cover the polyurethane coating as necessary to protect from welding.
8. Furnish labor, equipment, tools and supplies, including shielded type welding rod to construct the work as required in the Contract Documents. Protect welding rod from any deterioration prior to its use. If any portion of a box or carton is damaged, reject the entire box or carton.
9. In all welding, the metal shall be deposited in successive passes. Not more than 1/8 inch of metal shall be deposited in each pass. Each pass except the final one, whether in butt or fillet welds, shall be thoroughly bobbed or peened to relieve shrinkage stresses and to remove dirt, slag, or flux before the succeeding bead is applied. Each pass shall be thoroughly fused into the plates at each side of the welding groove or fillet and shall not be permitted to pile up in the center of the weld. Undercutting along the side shall not be permitted.
10. Welds shall be free from pin holes, non-metallic inclusions, air pockets, undercutting and/or any other defects.
11. If the ends of the pipe are laminated, split or damaged to the extent that satisfactory welding contact cannot be obtained, the pipe will be replaced at no additional cost to the Owner and the defective joint removed from the Site.
12. Furnish each welder employed with a steel stencil for marking the welds, so that the work of each welder may be identified. Have each welder stencil the pipe adjacent to the weld with the stencil assigned to him. In the event any welder leaves the job, his stencil shall be voided and not duplicated if another welder is employed.
13. Keep daily welding reports which identify the welder's name and the joint welded. Joints must be shown on the daily welding reports with the identification number assigned in the lay drawings (ex. ID#1 – ID#2). Provide three copies of all daily welding reports to Owner's representative each month.

14. Use only competent, skilled and qualified workmen. Each welder employed by the Contractor shall be AWWA C206 and AWS D1.1 certified according to the Welding Procedure Qualification approved for the project. All welders shall have been certified within the last six months or shall provide a welding continuity log to be allowed to weld on the line. Field welding shall be provided by one of the following firms:
    a. Thompson Pipe Group, (972) 262-3600
    b. Fuller's Service Company, Barry Fuller, (817) 477-3841.
    c. Scott's Welding, Scott Fowler, (972) 978-7865.
    d. Fletcher's Welding, Darrell Fletcher.
    e. Eddie's Welding Service, Eddie Pierce, (817) 909-6089.
    f. National Welding Corporation, Nash Williams, (801) 255-5959.
    g. Others may be accepted pending approval by Owner or Engineer.
15. After each welder has qualified in the preliminary tests referred to above, inspections shall be made of joints in the line. Any welder making defective welds shall not be allowed to continue to weld.
16. Visual tests and magnetic particle tests in accordance with AWWA C206, ASTM E709, and E144 shall be performed by the Owner's independent testing laboratory on all welded joints. Welds that prove to be defective will be replaced or repaired, whichever is deemed necessary by the Engineer, at Installation Contractor's expense. The Installation Contractor shall provide adequate ventilation and a safe environment for welding inspector. Inspections will be made on a weekly or bi-weekly basis as determined by the Owner. The Installation Contractor shall cooperate with the welding inspector to allow efficient inspections.
17. If the Contractor disagrees with the Engineer's interpretation of welding tests, test sections may be cut from the joint for physical testing. The Contractor shall bear the expense of repairing the joint, regardless of the results of physical testing. The procedure for repairing the joint shall be approved by the Engineer before proceeding.

F. Inside Joint Grouting for Pipe with Plant-Applied Mortar Lining: Upon completion of backfilling of the pipe trench and inspection of interior welds, fill the inside joint recess with a stiff cement mortar. Prior to placing of mortar, clean out dirt or trash which has collected in the joint, and moisten the concrete surfaces of the joint space by spraying or brushing with a wet brush. Where the mortar joint opening is two inches or wider, apply a bonding agent to mortar and steel surface prior to placing joint mortar. Ram or pack the stiff mortar into the joint space and take extreme care to ensure that no voids remain in the joint space. After the joint has been filled, level the surfaces of the joint mortar with the interior surfaces of the pipe with a steel trowel so that the surface is smooth.

G. Flanged Joints: Flange bolt torque and sequence shall be determined by the pipe manufacturer in accordance with AWWA C604 and AWWA M11. Use lubricant for threads and washers. Before the joint is assembled, thoroughly clean the flange faces of foreign material. Center the gasket in the connecting flanges and draw-up watertight, without unnecessarily stressing the flanges. Tighten bolts in a progressive diametrically opposite sequence and torqued with a suitable, approved, and calibrated torque wrench. Torque

values shall be as recommended by the pipe manufacturer. Apply clamping torque to the nuts only.

H. Special Requirements for Weld-After-Backfill:

1. Quality Control:

a. If Installation Contractor elects to weld-after-backfill any joints, special techniques shall be used to limit damage to the exterior heat shrink sleeves. Weld procedures for weld-after-backfill shall meet the heat limitations of the proposed coating system.

b. Each welder shall be required to demonstrate that no unacceptable damage will occur to the heat shrink sleeve. Each welder shall demonstrate their ability to perform welding of the joints in compliance with the welding requirements, including weld profile, penetration depth, travel speed control, and temperature control. The following information shall be recorded for each joint tested:

1). Welder's name.

2). Weld procedure to be used.

3). Voltage setting of the welder.

4). Amperage setting of the welder.

5). Average electrode speed (inches per minute).

6). Calculation of the heat input to the weld, in Joules. Use the following equation:

a). Amperage (I) x Voltage (E) x 60 = Heat Input Travel Speed (V)

7). Record steel pipe can temperature measurements in 11.5-degree increments around the circumference of the joint. Read the temperature using heat stick methods or with a digital infrared thermometer. Record the temperature at the weld immediately following the completion of the weld. Record the temperature at locations 1-inch, 2-inches, and 3-inches from the weld, on either side of the weld, during the welding process.

8). Measure and record the highest interior weld temperature produced during successful weld-after-backfill testing. Measure the temperature at approximately 3-inches below the welding arc concurrent to the welding. Welders shall not exceed this temperature while using this welding procedure.

c. The test joint shall be backfilled and each welder proposed for the project shall be tested. Tests shall be conducted on prototype test joint with the minimum wall thickness for each type of sleeve used on the project.

d. Each welder shall provide a complete weld for a minimum of two feet of weld overhead and below head.

e. The test joint will be excavated after welding and destructively tested.

1). After welding, a visual inspection of the sleeve will be made to verify there is no unacceptable damage to the exterior heat shrink sleeve and coating protection. Sleeves shall have no visible burns, excessive wrinkles, or holidays. Sleeves shall

not have areas of dis-bonded coating or dis-bonding of the heat-shrink sleeve, except for limited carbonization zone.

2). The heat shrink sleeve shall be tested by an adhesion test in accordance with ASTM D1000, AWWA C216, and C222. Test shall meet an adhesion value of 15 lbs.-inch. Test shall be performed directly over the weld (parallel) and perpendicular to the weld. The sleeve backing shall not rip, tear, split or separate from the adhesive material. The test shall be done a minimum of 24 hours after welding.

3). Demonstration section shall be completely removed and legally disposed of after successful completion of the demonstration, or prior to final acceptance of the project.

f. Excavate the first two joints for evaluation of the joint coating condition. Engineer will randomly select up to three additional post-welded joints for excavation by Installation Contractor for evaluation of joint coating condition. Joint coating will be destructively evaluated by the Engineer. Should the inspection of the exterior coating reveal damage in the opinion of the Engineer, the test will be considered a failure and the coating will be removed and replaced at no additional cost to the Owner. The test for the failed welder may be repeated on another joint, with the approval of the Engineer.

g. If any excavated weld-after-backfill joint exhibits any heat related damage, Installation Contractor shall modify and test a new weld-after-backfill procedure prior to completing any additional welded joints. Installation Contractor shall demonstrate that the revised joint welding procedure will not significantly damage the coating by repeating the weld-after-backfill evaluation requirements, including excavation of the three additional joints randomly selected for destructive evaluation.

h. Installation Contractor will remove and replace joint heat shrink sleeve upon completion of the evaluation.

2. Materials:

a. “Weld-After-Backfill” or post-welded joints are defined as welded pipe joints that have been coated and backfilled prior to completing interior welds.

b. Weld-after-backfill joints shall be coated and protected as follows. Approved materials shall be in accordance with Section 09 97 16 “Pipeline Coatings and Linings”. Joint coatings shall be heat shrink joint sleeves only. Tape wrapped joints will not be acceptable.

c. Holdback primer shall be suitable for weld-after-backfill conditions. Primer shall not result in running or melting of the coating or cause toxic fumes when heated during weld-after-backfill joints. Primer shall not exhibit binder breakdown in the heat-affected zone. Binder breakdown causes loss of joint coating adhesion to the holdback primer. Tape primers are not allowed.

d. Filler mastic materials shall be high-temperature materials with 500 degrees F minimum melting point.

e. Filler mastic will be Denso North America or Trenton Corporation products.

3. Installation:

    a. Installation of heat shrink sleeves shall comply with the requirements of the Specifications and AWWA C216.

    b. Joints shall be buried prior to welding, with not less than 12 inches of soil or flowable fill material above the pipe, including side and bottom of trench.

    c. Prior to welding, remove hold-back primer from I.D. of bell and O.D. of spigot with a power steel brush to prevent contamination of welds.

    d. Welding of the joints:

        1). All welding shall be wire-fed or with stick electrodes. Provide two or more weld passes as required to meet the approved AWS welding procedures and maximum coating temperature limitations. Not more than 1/8 inch shall be deposited per weld pass. Weld-after-backfill procedures must be approved by the Engineer based on field testing demonstrating the welding procedures can comply with the requirements herein and Section 09 97 16 “Pipeline Coatings and Linings”.

        2). Welding speed, amperage, and voltage shall be as required to maintain a maximum heat input of 23,000 joules or a maximum surface temperature at the coating/steel interface of 500 degrees F, whichever is least.

        3). Maximum weld temperature and duration shall not result in significant carbonization of the joint coating adhesive or adversely affect the integrity of the sleeve. Significant carbonization is the loss of volatile organic compounds that results in substantial loss of tackiness, adhesion to the steel, and corrosion protection properties.

        4). Finished joint coating shall not have any visible creases or folds in more than 50 percent of the joint coating backing material or that extend through both the inner protective layer and outer joint sleeve. A slight surface deformation of the sleeve may be deemed acceptable if the underlying layers are not compromised beyond slight carbonization.

    e. The heat-shrink sleeve shall be electrically tested for holidays per Section 09 97 16 “Pipeline Coatings and Linings.”

3.02 PROTECTIVE COATINGS SYSTEM

A. Perform field coating of joints in accordance with Section 09 97 16 - PIPELINE COATING AND LINING. For weld after backfill, heat tolerant heat-shrink joint wrapping and special welding techniques will be used. At the start of the project, at least 3 joints of pipe shall be uncovered at no additional cost to the Owner to verify the exterior joint wrap is not damaged. Should a change of materials be required, or a new welder employed, additional test joints may be directed by the Engineer.

B. The Installation Contractor is responsible for ensuring his operations do not damage the factory or field applied coating system.

C. Protection of Buried Metal:

1. Buried ferrous metal such as flanges, bolts, nuts and couplings which cannot be protected with factory or field-applied polyurethane coatings or heat shrink sleeves shall be coated as specified in accordance with Section 09 97 16 “Pipeline Coatings and Linings” and encased in flowable fill.

D. Repair of Mortar Lining:

1. Repair lining cracks larger than 1/8" (in width) with approved methods. Pipes with loose and disbonded linings will be rejected. Excessive repair of lining shall not be permitted. Apply bonding agent to patch area. Patching of lining shall be allowed where area to be repaired does not exceed four square feet and has no dimension greater than 24 inches. In general, there shall be not more than one (1) patch in the lining of any joint of pipe. Patching for the manufacture of fittings and specials is acceptable, and not limited to the maximum square footage described above.

2. Wherever necessary to patch the pipe, make the patch with the mortar indicated. Do not install patched pipe until the patch has been properly and adequately cured and unless approved for laying by the Manufacturer's technician and by the Engineer.

3. Plant applied mortar lined pipe joints requiring patches that exceed the size in subparagraph 3.01.E above shall be rejected and replaced at no additional cost to the Owner. The opinion of the Engineer shall be the sole factor in determining the acceptability of the required repair.

E. Quality Control of Field Applied Polyurethane Coating: See Section 09 97 16 “Pipeline Coatings and Linings.”

F. Pipe Through Vaults - Where piping is to be inside a vault, such as meters or valves, the vault floor shall be cast, then the piping installed, then the vault walls constructed.

3.03 FIELD QUALITY CONTROL

A. Disinfect the piping system in accordance with Section 33 10 13 “Disinfecting Water Utility Distribution.”

B. Perform a field hydrostatic test in accordance with Section 33 05 05.31 “Hydrostatic Testing.”

END OF SECTION

33 12 16.13 MISCELLANEOUS VALVES

1.00 GENERAL

1.01 WORK INCLUDED

A. Furnish labor, materials, equipment and incidental necessary to install the equipment specified herein. See other specification sections for piping and appurtenances associated with heating, ventilation, air conditioning, and plumbing systems. Valves and accessories specified in this Section are to be installed only in the absence of product specifications in other Sections and must be approved by the Engineer. Review other Sections for specific requirements

1.02 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00 “Submittal Procedures” and shall include:

1. Shop Drawings.

2. Operation and Maintenance Manuals.

1.03 GUARANTEE AND WARRANTY

A. Manufacturer shall warrant the equipment and materials furnished under this Section against defects in materials and workmanship and operational failure for a period of 1 year from the date of project substantial completion.

B. In the event of failure of any part or parts of the equipment during the first year of service, provided that the equipment has been operated and maintained in accordance with good practice, the Manufacturer shall furnish and deliver a replacement for the defective part or parts at the Manufacturer’s own expense. Manufacturer is also responsible for equipment freight.

2.00 PRODUCTS

2.01 STEEL BOLTED (DRESSER) COUPLINGS FOR PLAIN-END PIPE

A. Where dresser couplings are indicated, furnish and install a gasketed sleeve-type coupling meeting AWWA C219, with a pressure rating as indicated on the drawings.

B. The pipe couplings shall be of a gasketed, sleeve-type with diameter to properly fit the pipe. Each coupling shall consist of one (1) steel middle ring, of two (2) steel followers, two (2) rubber-compounded wedge section gaskets and sufficient trackhead steel bolts to properly compress the gaskets. Field joints shall be made with this type of coupling. The middle ring and followers of the coupling shall be true circular sections free from irregularities, flat spots, or surface defects. They shall be formed from mill sections with the follower-ring section of such design as to provide confinement of the gasket. After welding, they shall be tested by cold expanding a minimum of 1% beyond the yield point.

C. The coupling bolts shall be of the elliptic-neck, track-head design with rolled threads. The manufacturer shall supply information as to the recommended torque to which the bolts shall be tightened. All bolt holes in the followers shall be oval for greater strength.

D. The gaskets of the coupling shall be composed of a crude or synthetic rubber base compounded with other products to produce a material which will not deteriorate from age, from heat, or exposure to air under normal storage conditions. It shall also possess the quality of resilience and ability to resist cold flow of the material so that the joint will remain sealed and tight indefinitely when subjected to shock, vibration, pulsation and temperature or other adjustments of the pipeline.

E. The couplings shall be assembled on the job in a manner to ensure permanently tight joints under all reasonable conditions of expansions, contraction, shifting and settlement. The coupling shall be Dresser Style 38, Smith Blair Style 411, or Baker Series 200.

2.02 ADJUSTABLE PIPE SUPPORTS

Galvanized pipe supports for floor mounted piping, where indicated, shall be Grinnell Figure 264 or approved equal, comprising a cast iron saddle, threaded nipple, and reducer assembly with extra strength steel pipe and floor flange. Where required, saddle shall be fabricated steel to fit valve or piping appurtenance. Entire unit shall be hot dipped galvanized after fabrication.

2.03 PVC BALL VALVES

A. PVC Ball Valves shall be furnished where indicated.

B. Valves shall be true union, of Type 1 PVC, with PTFE seats, EPDM/Viton/Neoprene “O” rings and with socket end connections.

C. Valves shall be:

1. Chemtrol TU Series Ball Valves,

2. GF Plastic Systems, Inc. Type 375, or

3. Approved equal.

2.04 CORPORATION STOPS

A. Corporation stops shall be bronze with tapered plug and flat key operator.

B. Unless otherwise indicated, stops shall have iron pipe thread on inlet and outlet, of the size indicated.

C. Corporation stops shall be:

1. Mueller H-10046 or

2. Approved equal.

2.05 GLOBE VALVES

A. Globe Valves, where indicated shall be Crane Figure 351 or approved equal with American Standard Class 125 flanges.

B. Globe valves for threaded piping shall be equal to Crane No. 1.

2.06 FLAP VALVES

A. Flap valves shall be circular flange framed, with machined back flange for attachment to a flanged wall thimble. Body and flap shall be cast iron, ASTM A126-B. Resilient seat shall be neoprene or Buna-N bonded in a groove machined in the body. Hinge arms shall be high-tensile bronze, ASTM B584-C865 with two pivot points, an adjustable lower pivot with limited rotation and a threaded upper hinge post to adjust flap valve sensitivity. A lubrication fitting shall be supplied for each pivot. Hinge pins shall be silicon bronze, ASTM B98-C655 or Type 304 Stainless Steel.

B. Flap valve shall be designed to open when differential head across the flap is 0.3 foot or less.

C. Flap valve shall be:

1. Rodney Hunt Series FV-AC or

2. Approved equal.

2.07 BACKFLOW PREVENTERS

A. Reduced pressure backflow preventers shall be designed to provide cross-connection protection of potable water supply.

B. Provide reduced pressure principle backflow preventers meeting requirements of ANSI/ASSE 1013, compliant with AWWA Standard C511, and approved by the Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California.

C. Units 2-1/2 inches and larger shall consist of two independently acting check valves together with an automatically operating pressure relief valve, two gate valves, and four test cocks, bronze or iron body with bronze internal parts. Acceptable manufacturers and models are:

1. Watts, 909

2. Wilkins, 375, and

3. Febco, 825YD

D. Units 2 inches and smaller shall consist of two independently acting check valves together with an automatically operating pressure relief valve, two ball valves, strainer, and four test cocks, bronze or iron body with bronze internal parts. Acceptable manufacturers and models are:

1. Watts, 009

2. Wilkins, 975XL

3. Febco, 825Y

E. Provide test kit consisting of gauge test valves, hoses, adaptors, securing strap, instruction guide and lightweight case. Acceptable manufacturers and models are:

1. Watts, TK-9A,

2. Wilkins, TG-5, and

3. Febco, TK-1.

2.08 SOLENOID VALVES

A. Solenoid valve shall be a two-position valve. Solenoid enclosure shall be water tight. The construction of the valve shall be brass with FPM seals. The valve shall be normally open, energize closed. Control voltage shall be coordinated with the control manufacturer. Valve shall be ASCO or approved equal.

3.00 EXECUTION

3.01 INSTALLATION

A. Carefully handle and install valves in a manner that prevents damage to any part of the valves. Install valves in accordance with the Manufacturer's instructions.

END OF SECTION

33 12 16.16 AIR RELEASE AND AIR AND VACUUM VALVES

1.00 GENERAL

1.01 WORK INCLUDED

A. Furnish labor, materials, equipment and incidentals necessary to install air release and air and vacuum valves of the sizes and types indicated. Furnish the necessary isolating valves and piping.

1.02 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00 “Submittal Procedures” and shall include:

1. Shop Drawings.
2. Operation and Maintenance Manuals

1.03 STANDARDS

A. The applicable provisions of the following standards shall apply as if written in their entirety:

1. AWWA C-512 “Standards for Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service.”

2.00 PRODUCTS

2.01 MANUFACTURED PRODUCTS

A. General:

1. Each air valve shall have a cast iron body, bronze, or stainless steel trim and stainless steel float. Float shall be baffled to prevent air from blowing valve closed until air is exhausted.
2. Valve body, float, etc., shall be designed for a working pressure and shall seat at a minimum pressure shown in the valve schedule, Paragraph 3.02.
3. Air valves shall be manufactured by DeZurik (APCO), Val-Matic Manufacturing Corp., or Crispin Valves.
4. Top of valve assembly shall be fitted to attach discharge pipe as indicated. Valve inlet shall be N.P.T. for 2-inch and smaller valves. Valve inlet shall be ANSI flange for 3-inch and larger valves. Flange rating shall equal or exceed the maximum working pressure.

B. Air Release Valves (AR): Air release valves shall be designed to automatically release accumulated air pockets within the pipeline while in operation and under pressure. Air release valves shall be APCO Model 200, Val-Matic Model 38, or Crispin Model P.

C. Air and Vacuum Valves (AV): Air and vacuum valves shall be designed to allow large volumes of air to escape through the valve orifice when filling a pipeline and to close water tight once the air has been expelled. Air and vacuum valves shall also permit large volumes of air to enter through the valve orifice when the pipeline is being drained to break the

vacuum. Air and vacuum valves shall be APCO Model 140, Val-Matic Model 100, or Crispin Model AL.

C. COMBINATION AIR VALVES (CAV)

1. Combination air valves shall be heavy duty air and vacuum valves with air release.
2. Combination air valves shall be designed to release accumulations of air at high points within a pipeline by exhausting large volumes of air as the pipeline is being filled and by releasing accumulated pockets of air while the pipeline is in operation and under pressure. Combination air valves shall also be designed to permit large volumes of air to enter the pipeline during pipeline drainage.
3. Combination air valves shall be of “custom built” duplex body style with standard air and vacuum valve piped to a separate standard air release valve with a shutoff valve in between. The standard air and vacuum valve shall be tapped with 1” drain pipe with gate valve and turned-down elbow.
4. Combination air valves shall be Vent-o-Mat Model RBX 1631, APCO Model 1800 with air release valve model 200, Val-Matic Model 100 with air release valve model 38, or Crispin Model AL/PL-NT.

E. COMBINATION AIR AND VACUUM VALVE WITH SURGE CHECK (CAVSC)

Each CAVSC shall have a combination air valve as described above which is mounted on top of a surge check. The surge check shall provide anti-slam slow closing operation of the air and vacuum valve. The surge check shall be spring loaded and have orifices drilled in the plug to throttle water flow. The surge check shall have an exterior bypass with flow control to bypass the plug. CAVSC shall be APCO Model 1700 with a 2" Air Release Valve Model 200 or Valmatic Model 1200S/100/38 with 2" air release valve.

3.00 EXECUTION

3.01 INSTALLATION

A. Carefully handle and install valves vertically in such a manner as to prevent damage to any part of the valves. Installation shall be in accordance with the Manufacturer’s instructions. Provide nuts, bolts, and gaskets where applicable.

3.02 SCHEDULES

A. Provide Air Release and Air Vacuum valves as shown in the plans

END OF SECTION

33 12 16.23 GATE VALVES

1.00 GENERAL

1.01 WORK INCLUDED

A. Furnish labor, materials, equipment and incidentals necessary to install gate valves and appurtenances, including valve boxes, operators, bolts, nuts and gaskets.

1.02 QUALITY ASSURANCE

A. Acceptable Manufacturers:

1. American-Flow Control.
2. M&H.
3. Mueller.
4. Clow.

1.03 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00 “Submittal Procedures” and shall include:

1. Operation and Maintenance Manuals.
2. Shop Drawings

1.04 STANDARDS

A. The applicable provisions of the following standards shall apply as if written here in their entirety:

1. American National Standards Institute (ANSI) Standards:

ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings

2. American Society for Testing and Materials (ASTM) Standards:

ASTM A126	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A536	Standard Specification for Ductile Iron Castings

3. American Water Works Association (AWWA) Standards:

AWWA C111	Rubber-Gasket Joints
AWWA C500	Gate Valves for Water and Sewage Systems
AWWA C509	Resilient Seated Gate Valves for Water and Sewage Systems

2.00 PRODUCTS

2.01 GATE VALVES

A. General:

1. Unless otherwise specified, gate valves 3 through 24 inches in size shall be in accordance with AWWA C509, Resilient Wedge.

2. Gate valves 2-1/2 inches and smaller shall be bronze, non-rising stem with wedge disc and screwed ends for 300-psi W.O.G. working pressure. Bronze gate valves shall be Crane No. 437, Mueller No. H 10914, or approved equal.

3. Gate valves 30 inches and larger shall be equipped with non-rising stem bypass valve and with spur-gears in enclosed oil or grease lubricated gear cases. Gear boxes shall be factory lubricated. Flanges shall conform to ANSI, Class 125 or 250.

B. Gate: Gate for resilient seated valves shall be cast iron with rubber-seat compound bonded to the valve gate.

C. Operators: Operators shall turn counterclockwise to open the valve. Exposed valves shall have handwheel operators unless otherwise designated. A directional arrow and the word "open" shall be cast on the handwheel. Valves for buried service shall have a 2-inch square nut operator and shall be installed with extension stems where required to extend operating nut to within 12 inches of the finished grade. Provide a cast iron valve box to enclose the operating stem. Valve box shall be three-piece extension type equal to Mueller No. 10380 or Clow F2450.

D. Stem and Seal: The non-rising stem shall be bronze with inside screw. Shaft seal shall employ O-rings or V-type packing.

E. Bell Ends: Where designated, valves shall be mechanical joint or rubber gasketed push on joints in accordance with the applicable requirements of AWWA C111.

3.00 EXECUTION

3.01 INSTALLATION

A. Carefully handle and lower buried valves into position to prevent damage to any part of the valves. Place the valve in the proper position with stem truly vertical and securely hold until connections have been made. Furnish bolts, nuts, and gaskets. The Contractor shall be responsible for adjusting the valve boxes to the proper length to conform with the ground surface.

3.02 BLOCKING UNDER GATE VALVE

A. Gate valves 18 inches and larger which are buried shall rest on a concrete pad. Pad shall extend for the full width of the trench and from back of hub to back of hub (or flange). Care shall be taken to not interfere with the jointing. Concrete shall be minimum 1500-psi compressive strength.

3.03 FIELD QUALITY CONTROL

A. Upon completion of installation of the equipment, an acceptance test to verify the satisfactory operation of each unit shall be conducted. The test shall be conducted in a manner approved by and in the presence of the Engineer. The unit shall be checked for

general operation and leakage. The unit must perform in a manner acceptable to the Engineer before final acceptance will be made by the Owner.

END OF SECTION

33 12 16.26 BUTTERFLY VALVES

1.00 GENERAL

1.01 WORK INCLUDED

A. Furnish labor, materials, equipment and incidentals necessary to install butterfly valves and appurtenances, including valve boxes, operators, bolts, nuts and gaskets.

B. Potable water pumped at the Re-Pump Station is treated with chloramines and caustic.

1.02 QUALITY ASSURANCE

A. Acceptable Manufacturers:

1. Acceptable Valves Manufacturers:

a. DeZurik.

b. M&H.

c. K-Flo.

d. Rodney Hunt.

e. Golden Anderson.

f. Val-Matic.

g. Pratt.

2. Acceptable Motor Operator Manufacturers:

a. AUMA-Aumatic.

b. Rotork IQ.

c. Limitorque.

d. EIM.

B. Experience Requirements: The manufacturer shall have had successful experience in manufacturing tight-closing, rubber-seated butterfly valves for this type service in the sizes indicated. The manufacturer shall have at least 10 years' experience in the manufacture of valves.

C. Manufacturer's Representative for Startup and Testing: The valve manufacturer shall furnish the services of a competent service technician for the duration of time necessary to assist in the installation and adjustment of the equipment and making field acceptance tests. The Technician shall instruct the Owner's personnel in the proper care, maintenance, adjustment, and operation of the equipment and shall issue a written certification that the equipment has been properly installed. The Technician shall also be on-Site during field pipe pressure testing and startup of motor operated valves and shall adjust the limit switches as required. The Technician shall be factory trained and have a minimum of 5 years' experience in the installation and adjustment of valves.

D. Factory Testing:

1. Valve shall be completely assembled at the factory. Valve shall be adjusted for correct seating, and tested in accordance with AWWA C504. Factory operational tests and adjustment shall be performed on each valve, with the valve in the same orientation (valve shaft horizontal or vertical) as the field installation. Correct seating of each valve disc shall be certified with five fully open-close cycles. The valve will be opened 10 percent, closed, and tested in the position the valve will be installed. This test is to be repeated five times, and one opening test must be with the maximum pressure differential in order to test the actuator. The maximum differential pressure shall be equal to the pressure class of the valve unless noted otherwise.
2. Limit switches, seat adjustments, stops and functions shall be set and checked at the factory. Provide Certified Test Reports.
3. The manufacturer shall make thorough visual inspection and perform ultra-sound tests on all castings before assembly.
4. The manufacturer shall conduct ultrasound testing of each valve disc and valve body and certify there are no defects within the ductile iron material in accordance with the following test procedures.
    a. The testing will be performed using a hand-held ultrasonic velocity/thickness gage that uses pulse-echo techniques to measure material thickness and velocity. The gage will be used as a velocimeter by coupling the transducer to a ductile iron Sample of known thickness and performing a velocity calibration. The ductile iron Sample will conform to ASTM A536 Gr. 65/45/12.
    b. A minimum of sixteen readings per body and disc will be taken for valve sizes 42 through 96 inches. A minimum of eight readings shall be taken for valves sizes 24 through 36 inches. Valves less than 24 inches do not require testing. The points of measurement should be equally spaced and represent the entire body and disc casting and not limited to one specific area.
    c. Velocity will be read off the gage display, recorded and included as a Certified Test Report. Components with measured velocities of less than .21 in/µS (5300 m/S) will be rejected. The gage will also be used as an ultrasonic thickness gage to confirm the minimum body shell thickness meets the requirements listed in Table 1 of the latest revision of ANSI/AWWA C504 and the requirements of Section 4.3.1.5. Although AWWA C504 establishes minimum requirements for rubber seated butterfly valves through 72 inches, all requirements for AWWA C504 will also apply to larger valves.

1.03 PROVIDE CERTIFIED TEST REPORTS FOR FACTORY TESTING.SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00 “Submittal Procedures” and shall include:
    1. Shop Drawings:
        a. Shop Drawings showing standard cut sheets, seat orientation, operator and extension stem orientation, and materials of construction. The Shop Drawings for the valves with extension stems shall indicate the provisions for supporting the valve, gearing, and extension stem.

b. Weight of valves and operators

c. Description of valve body seats and disc seats with appropriate ASTM, AWWA, or ANSI material specification.

d. Valve flange pressure rating, flange bolt diameter, and flange bolt orientation.

e. A description of the components that will be shipped separately, thus requiring field assembly.

f. Project specific motor operator control schematic / wiring diagrams.

g. Motor operator motor data sheet showing voltage horsepower, full load amps, locked rotor amps, etc.

h. Valve torque calculations.

i. Motor operator torque.

j. Provide torque calculations through the full range of operations for all motor operated valves.

2. Operation and Maintenance Manuals: Manuals shall be prepared by the equipment manufacturer and shall also incorporate appropriate final certified Shop Drawings and final wiring diagrams. Manuals may be the manufacturer's standard instructions, but shall be supplemented as necessary to cover any special feature not included in standard material. O&M manuals shall include storage instructions, valve installation and adjustment procedures and troubleshooting procedures.

3. Certified Test Reports indicating compliance with factory hydrostatic tests, operational tests, seat test, and ultra-sound tests.

4. Equipment Installation Report for all valves.

1.04 STANDARDS

A. The applicable provisions of the following standards shall apply as if written here in their entirety:

1. American National Standards Institute (ANSI)/NSF:

a. ANSI B16.1 – Cast Iron Pipe Flanges and Fittings.

b. ANSI/NSF Standard 60/61.

2. American Society for Testing and Materials (ASTM):

American Society for Testing and Materials (ASTM)	
ASTM A48	Standard Specification for Gray Iron Castings
ASTM A126	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A276	Standard Specifications for Stainless Steel Bars
ASTM A536	Standard Specification for Ductile Iron Castings
ASTM B148	Standard Specifications for Aluminum Bronze Coatings

3. American Water Works Associations (AWWA):

American Water Works Associations (AWWA)	
AWWA C504	Standard for Rubber-seated Butterfly Valves
AWWA C540	Standard Specification for Power Actuating Devices for Valves and Sluice Gates
AWWA C542	Standard Specification for Electric Motor Actuators for Valves and Slide Gates
AWWA C550	Standard for Protective Interior Coatings for Valves and Hydrants

4. National Electric Manufacturers Association (NEMA).

1.05 GUARANTEES

A. Vendor shall warrant the equipment furnished under this Section for a period of 2 years against defects in materials and workmanship and operational failure.

B. In the event of failure of any part or parts of the equipment during the 2 years of service, provided that the equipment has been operated and maintained in accordance with good practice, the vendor shall furnish, deliver, and install the defective part or parts at his own expense.

C. The first 2 years of service shall be interpreted as the 24-month period following the installation, adjusting, and acceptance testing, and the start of actual operation of the equipment.

2.00 PRODUCTS

2.01 VALVE CONSTRUCTION

A. General: Butterfly valves supplied under this Contract shall be of the tight-closing, rubber seated type with rubber seats that are securely attached to the valve disc or body. Valves which are used for modulating. Valves shall be bubble tight at rated pressures with flow in either direction and shall be satisfactory for applications involving valve operation after long periods of inactivity. Butterfly valves shall conform to the applicable requirements of AWWA C504, AWWA C542, and AWWA C550. All valves for potable water service shall comply with NSF61 standards.

B. Motor Control Operation:

1. For normal start, engage the RUN (OPEN) contactor at the valve or remotely.

2. For normal stop, engage the STOP (CLOSE) contactor at the valve or remotely.

3. Valve operator motor shall move the valve from full closed to full open or from full open to full closed in approximately 300 seconds. Valve speed shall be controlled by gearing and not by step timing of valve motor operator.

4. Provide two limit switches on the valve for remote indication of valve limits. Valve closed limit switch shall close when valve lifts from its seat and Valve open limit switch shall open when valve is fully open. Switches will turn-off remote lights and indicate valve is in the fully closed or open position.

5. Limit switches shall be set per the Limit Switch Positions Table shown in the electrical drawings.

C. Butterfly Valves:

1. Valve Bodies: Valve bodies shall be constructed of ductile iron in accordance with ASTM A536, Grade 65/45/12. Valve class shall be suitable for the pressure class of the adjacent pipe or as shown in the valve list herein. Valve shall have flanged ends with ANSI B16.1 drilling. Two trunnions for shaft bearings shall be integral with each valve body. Pressure class of valve shall be permanently marked on the valve.

2. Valve Discs: Valve discs shall be ductile iron conforming to ASTM A536, Grade 65/45/12. There shall be no external ribs transverse to the flow path.

3. Valve Shafts: Valve shafts shall be turned, ground and polished, constructed of stainless steel conforming to ASTM A276. Valve shafts may consist of a one piece unit extending completely through the valve disc, or may be of the "stub shaft" type, which comprises two separate shafts inserted into the valve disc hubs. If of the "stub shaft" construction, each stub shaft shall be inserted into the valve disc hubs for a distance of at least 1-1/2 shaft diameters. The shaft shall be tightly connected to the disc using tapered or wedged keying devices.

4. Valve Seats: Valves shall have EPDM resilient seats to provide tight shut off at the pressure specified. The mating seat surface shall be ASTM A276, 18 8 stainless steel or a 95 percent pure nickel overlay. All valves shall have mechanically retained, replaceable, adjustable seats for valves larger than 48 inches. Seats retained using epoxy or similar system are not acceptable for valves larger than 48-inches. Valves 30 inches and larger shall have in-line replaceable seats.

5. Valve Bearings: Valve shall be fitted with sleeve type bearings. Bearings shall be of corrosion-resistant and "self-lubricated" materials that will not deteriorate natural or synthetic rubber.

6. Valve Shaft Seals: Where shafts project through the valve bodies for operator connection, a split-V or O-ring type shaft seal shall be provided.

7. Valve Operators, General: The valve operator shall be designed and manufactured in accordance with the applicable requirements of AWWA C504 and AWWA C542 and shall be arranged for horizontal or vertical valve shaft installation as shown.

8. Valve Position Indicator: Above ground or valves in vaults shall have an indicator which will indicate the valve position. The indicator shall be permanently match-marked at the factor to indicate full open and full closed position. Valve position indicator is not required for buried valves.

D. Manual Operators:

1. Manual operators shall have all gearing totally enclosed and shall be pre-lubricated or grease packed. Operators shall be of the enclosed worm gear type with a non-rising stem. Worm gear shall be grease lubricated. The direction of the manual rotation shall be clockwise to close.

2. Operators for exposed valves shall be provided with a valve position indicator.

3. Operators shall have a 2-inch square operating nut. Provide bevel gear for vertical operation of the operating nut. Provide a handwheel where indicated.

4. Provide a cast iron valve box to enclose the operating stem. Valve box shall be three-piece extension type, Mueller No. 10380 or Clow F2450. For valves installed with the shaft vertical, provide a bevel gear for vertical operation of the operating nut.

E. Valve Extension Stems and Stem Guides: Worm gear actuator shall be designed for submerged service with operating nut pinned to shaft with a solid round pin. Extension stem shall be 1-inch carbon steel solid shaft. Valves in manholes shall include two (minimum) adjustable Trumbull 367 stem guides, one at each end of extension stem. Supports shall be provided at 10 foot maximum spacing.

F. Electric Motor Operators:

1. General:

a. Actuator sizes shall be developed and verified by the valve manufacturer as appropriate selections.

b. Both valve and motor operator manufacturer shall submit torque calculations for engineer approval. The motor operator shall have a seating torque 50 percent greater than the maximum torque required to operate the valve. The torque requirements listed above are the minimum requirements.

c. The electric motor valve operators shall be of the reversible motor type. The rated torque capability of each operator shall be sufficient to seat, unseat and rigidly hold in any position the valve disc under the operating conditions specified herein.

d. Operators shall be self-contained units comprising housing, motor, reversing contactor, limit switches, torque switches, relays, control transformer, gear train, and auxiliary handwheel. Operators shall comply with the applicable requirements of AWWA C542.

e. Operator for the valve shall move the valve from fully open to closed position or the reverse, in the time specified in schedule below. Operator shall allow full gear travel for opening and closing. Repeat cycle timers will not be allowed.

f. Provide remote handheld programmer for Operator.

2. Construction:

a. Operators shall be equipped with an auxiliary handwheel to provide for manual actuation of the valve in the event of power failure. The handwheel shall not turn during normal operation of the valve.

b. Each operator shall have an integral three-phase, full-voltage, reversing contactor with electrical and mechanical interlocks and three overload sensing relays. The contactor shall operate on 120 VAC and shall have a control transformer to transform 480 VAC to 120 VAC. The control transformer shall be sized with sufficient capacity to operate the contactor, relays, and the motor switch compartment heaters.

c. Limit switches shall be furnished for valve control, for remote and local OPEN-CLOSE indications. Limit switches shall be dry contacts and shall be independently adjustable at the open and closed limits. Auxiliary limit switches shall have isolated

Form A or B contacts rated 10 amps at 120 VAC. See Drawings for limit switch requirements.

d. The operator enclosure shall be NEMA 4. Space heaters with thermostat shall be provided in the enclosure of wattage suitable for keeping the compartment dry at all times. There shall be installed also a suitable breather and drain. A schematic wiring diagram shall be attached and protected from the environment for maintenance use. Controls shall be shop wired to terminal strip, complete and ready for field installation. Wires to terminal strip shall be identified with heat shrinkable wire tags.

e. Motor shall be designed for 30-minute duty and rated for 460 volts, 60 hertz, 3-phase service. Motor shall have an extra 50 percent service factor of torque. Motors shall have thermal switch wired to 120 VAC control circuit on operator. Control voltage shall be 120 volts AC. Bearings shall be permanently lubricated ball bearings.

f. Operator shall have a selector switch, LOCAL-OFF-REMOTE and CLOSE-STOP-OPEN pushbuttons mounted on the operator with watertight boots. Operators shall have local position indicator.

g. Operator shall have contact to indicate analog output 4-20mA valve position, discrete output contacts for OPEN, CLOSED and REMOTE ENABLE indication signals to SCADA and discrete input contacts for OPEN and CLOSE commands from SCADA Operators.

3.00 EXECUTION

3.01 INSTALLATION

A. Pipeline:

1. Install valves in piping with valve shaft horizontal and with the disc seat adjustment facing the thrust harness, unless otherwise indicated.

B. General:

1. Valve operators shall be stored in an environmentally protected area until installed. Space heaters shall be energized during storage as materials on hand, and upon installation of the valve.

2. Installation shall be in accordance with the manufacturer's instructions. Carefully handle and lower valves into position to prevent damage to any part of the valves. Place the valve in the proper position with the stem aligned as specified and securely hold until connections have been made. Furnish stainless steel bolts, nuts, and gaskets.

3. For buried valves, adjust valve boxes to the proper length to conform to the surrounding ground surface and construct a 30-by-30-inch concrete pad around the valve box at the ground surface.

4. Atmospherically exposed valves shall be painted per System No. 2, in Section 09 96 00.01 “High-Performance Coatings.”

3.02 FIELD QUALITY CONTROL

A. Upon completion of installation of the equipment, an acceptance test to verify the satisfactory operation of each valve shall be conducted. The test shall be conducted in a manner approved by and in the presence of the Engineer. The unit must perform in a manner acceptable to the Engineer before final acceptance will be made by the Owner.

3.03 CLEAN AND ADJUST

A. Adjustments shall be in accordance with the valve manufacturer's instructions.

3.04 SCHEDULES; VALVES

VALVE I.D.	VALVE TYPE	VALVE LOCATION	ACTUATOR	VALVE SIZE (IN)	VALVE PRESSURE CLASS (PSI)	VALVE CONNECTION
RPS-P1-BFV1	BUTTERFLY	PUMP SUCTION	MANUAL HANDWHEEL	48	150	FLANGED
RPS-P2-BFV1	BUTTERFLY	PUMP SUCTION	MANUAL HANDWHEEL	48	150	FLANGED
RPS-P3-BFV1	BUTTERFLY	PUMP SUCTION	MANUAL HANDWHEEL	48	150	FLANGED
RPS-P4-BFV1	BUTTERFLY	PUMP SUCTION	MANUAL HANDWHEEL	48	150	FLANGED
RPS-P5-BFV1	BUTTERFLY	PUMP SUCTION	MANUAL HANDWHEEL	48	150	FLANGED
RPS-P1-BFV2	BUTTERFLY	PUMP DISCHARGE	MANUAL HANDWHEEL	36	150	FLANGED
RPS-P2-BFV2	BUTTERFLY	PUMP DISCHARGE	MANUAL HANDWHEEL	36	150	FLANGED
RPS-P3-BFV2	BUTTERFLY	PUMP DISCHARGE	MANUAL HANDWHEEL	36	150	FLANGED
RPS-P4-BFV2	BUTTERFLY	PUMP DISCHARGE	MANUAL HANDWHEEL	36	150	FLANGED
RPS-P5-BFV2	BUTTERFLY	PUMP DISCHARGE	MANUAL HANDWHEEL	36	150	FLANGED
RPS-YP1-BFV1	BUTTERFLY	YARD PIPING YP1	MANUAL, 2-INCH NUT	60	150	FLANGED
RPS-YP2-BFV1	BUTTERFLY	YARD PIPING YP2	MANUAL, 2-INCH NUT	60	150	FLANGED
RPS-YP3-BFV1	BUTTERFLY	YARD PIPING YP3	MOTOR OPERATED	84	150	FLANGED
RPS-YP4-BFV1	BUTTERFLY	YARD PIPING YP4	MOTOR OPERATED	84	150	FLANGED
RPS-YP5-BFV1	BUTTERFLY	YARD PIPING YP5	MOTOR OPERATED	84	150	FLANGED
RPS-YP6-BFV1	BUTTERFLY	YARD PIPING YP6	MANUAL, 2-INCH NUT	60	150	FLANGED
RPS-YP7-BFV1	BUTTERFLY	YARD PIPING YP7	MANUAL, 2-INCH NUT	60	150	FLANGED

3.05 SCHEDULES; MOTOR OPERATORS

VALVE I.D.	ACTUATOR	VALVE SIZE (IN)	MAXIMUM FLOW (MGD)	MAXIMUM PRESSURE DIFFERENTIAL (PSI)
RPS-YP3-BFV1	MOTOR OPERATED	84	160	90
RPS-YP4-BFV1	MOTOR OPERATED	84	160	90
RPS-YP5-BFV1	MOTOR OPERATED	84	160	90

END OF SECTION

33 16 13.18 PRECAST WIRE WOUND PRESTRESSED CONCRETE TANK

1.00 GENERAL

1.01 WORK INCLUDED

A. This Section describes the design and construction of two 10 million gallon circular precast, wire-wound, prestressed concrete tanks complete with steel diaphragm in accordance with AWWA D110, Type III. The acceptance of the prestressed concrete tanks is predicated upon the design criteria and construction methods specified. In the case of conflict between this and other Sections of the Specifications, the requirements of this Section shall govern.

B. The minimum acceptable site preparation shall be as indicated on the Drawings and as specified in Section 31 23 10 “Structural Excavation and Backfill.” The tank manufacturer shall increase site preparation as necessary to be compatible with the foundation design.

C. The tank, appurtenances, and all material exposed on the interior of the tank or in contact with stored water shall be resistant to degradation from the use of chlorine and chloramines.

D. The tank shall be built as early in the project as possible. After the tank is complete, the pipes will be plugged approximately 10 feet beyond the footer and the tank will be filled full to cause the foundation to consolidate. The tank must be filled at a conservative rate that is approved by the Engineer. Install survey monuments and record elevations at the frequency specified. Submit the data to the Engineer for review. The tanks are to remain full for a minimum of six months, but the Engineer may extend this duration based upon the trend of the consolidation data. After the tanks are drained, connect the tank piping to the other yard piping.

1.02 QUALITY ASSURANCE

A. Qualifications: The tank manufacturer shall be a specialist in the design and construction of circular, precast, wire wound prestressed, AWWA D110 Type III concrete tanks and shall have constructed a minimum of thirty such structures of the same size tank as specified in this Project or larger, which have been in successful service for a minimum of 5 years.

B. Acceptable Tank Manufacturers:

1. DN Tanks, Inc.

2. Preload, LLC.

C. Singular Responsibility: It is the express intent of this Specification to create a singular point of responsibility for the design and construction of the precast wire wound prestressed concrete tank(s). The design indicated within the Drawings and Specifications for the floor slab and subgrade are the minimum requirements. The design and construction of all aspects, including but not limited to the floor slab, wall, wall penetration, subgrade, granular subbase, drainage layers, prestressing, concrete dome, and architectural treatments and shotcrete of the prestressed concrete tank is the sole responsibility of the tank manufacturer. Tank manufacturer shall supervise and have a representative on-site at all times during excavation and backfill of the tank foundation to ensure Work is performed in compliance with the Drawings, Specifications and geotechnical report.

D. The tank manufacturer shall have in its employment a design engineer with a minimum of 10 years' experience in the design of AWWA D110 Type III tanks. The design engineer shall have been the engineer of record for a minimum of ten AWWA D110 Type III tanks.

E. The tank manufacturer shall have in its employ for this Project a team consisting of a tank superintendent, project manager, shotcrete foreman, wire-winding foreman, and precast erection foreman, each of whom shall have constructed a minimum of five AWWA D110 Type III tanks of the same size as specified in the plans or larger.

F. The tank manufacturer's construction superintendent shall have a minimum of 4 years' experience with prestressed concrete tanks of similar design. The tank manufacturer shall furnish a superintendent on the Site at all times during construction of the tank work. Tank manufacturer may designate a subcontractor's superintendent during the Work described in Paragraph 1.02.G.1 Tank manufacturer shall submit proposed designated superintendent to the Engineer in writing with a resume indicating experience in excavation and foundation work.

G. The tank work is defined as the water containment portion of the tank, including the walls and floor slab, roof, floor slab penetrations, foundation, base, subgrade, waterstops, joints, bearing pads, cables, and all other items penetrating or attaching to the floor or walls of the tank. Only the following Work may be subcontracted to qualified subcontractors experienced in the type of work to be subcontracted, and under the supervision of the prestressed tank manufacturer:

    1. Earthwork including excavation, backfilling, foundation preparation and final grading.

    2. Reinforcing steel installation and the concrete slab placement labor.

    3. Coating of the exterior walls and exterior dome roof.

    4. Miscellaneous work exterior of the tank, including under floor piping and encasements.

H. The tank manufacturer is fully responsible for the water-tightness of the tank.

I. The tank manufacturer shall obtain and review all the geotechnical information pertaining to this Work.

J. Tank manufacturer shall conduct one pre-placement meeting with Owner and Engineer prior to placing the foundation.

K. The tank manufacturer shall retain and pay for the services of an Independent Testing Laboratory, subject to the approval by the Owner, to perform soil compaction tests and compressive tests of concrete and shotcrete for all Work associated with the tank, including foundation, and as indicated in this Section. All other testing responsibilities shall be as indicated in the Specifications.

L. Field Measurements:

    1. Verify elevations by field measurements. Submit the following elevations as Record Data prior to proceeding with subsequent Work.

    2. Provide surveyed elevations on a 10-foot grid for the top of the granular subbase prior to placement of the floor slab.

    3. Provide surveyed elevations on a 10-foot grid for the top of the finished concrete floor slab.

4. Elevations every 45º around the perimeter of the slab prior to filling, after filling, and each day for the first month. Elevations will be taken for at least six months. The Engineer may reduce the frequency after the first month based on the results of the data.

1.03 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00 “Submittal Procedures.”

1. Contractor shall provide a single Shop Drawing submittal for the tank design calculations and drawings. Partial submittals will not be accepted and will be returned without review.

2. Submittals for materials may be combined to reduce the total number of submittals required.

3. The Engineer’s general review and approval shall not relieve the tank manufacturer of its design responsibility.

4. Provide the following Shop Drawings:

a. After Contract award, and prior to the start of construction, the tank manufacturer shall submit Shop Drawings to the Engineer for review and approval which include design calculations, proposed tank/dome roof connections, wall penetrations, drawings, certification that the tank has been designed to support the concrete dome and construction procedures for the tank and all appurtenances. Include design calculations for tank design, and capacities for vent, overflow, and overflow weir. Design calculations and record drawings shall be sealed by a licensed professional engineer registered in the State of Texas.

b. Concrete and shotcrete, include:

1) Mix designs for all concrete and shotcrete used for the tank construction.

2) Admixtures to be used in the concrete and/or shotcrete, their purpose and MSDS’s.

c. Reinforcing Steel shall include manufacturer’s information and ASTM certifications.

d. Mortar fill and non-shrink grout submittal shall include manufacturer’s information, compressive strength and ASTM certifications.

e. Steel diaphragm submittal shall include cut sheets indicating dimensions, gauge and form, certified copy of mill test, and ASTM certifications.

f. Prestressing steel submittal shall include:

1) Manufacturer’s information, tensile strength and ASTM certifications.

2) Certified copy of mill test on each heat or reel of prestressing wire showing physical and chemical analysis shall be submitted at the time of shipment of prestressing wire.

3) Methods and procedures for prestressing prior to operation.

g. Elastomeric materials submittal shall include manufacturer's information, ASTM certifications, indication if product will be in contact with potable water and NSF certification if in contact with potable water.

h. Sealants and joint fillers submittal shall include manufacturer's information, ASTM certifications, indication if product will be in contact with potable water and NSF certification if in contact with potable water.

i. Tank appurtenances submittal shall include manufacturer's information, ASTM certifications, drawings, materials utilized, etc.

j. Coatings and architectural treatments submittal shall include manufacturer's information, application data for coatings, MSDS's for coatings, color, selection charts for coatings.

5. Provide the following Certified Test Reports:

   a. Performance data for approved concrete and shotcrete mix designs.

   b. Performance data for concrete, flowable fill and shotcrete placed during construction. Compressive strength test reports shall be provided to Owner within 7 days of test.

6. Provide the following Samples:

   a. Color Samples for coatings.

   b. Color samples for all architectural items.

7. Provide the following Record Data:

   a. Documentation of experience as required in Paragraph 1.02 "Quality Assurance." Submit prior to start of construction.

   b. Disinfection and testing plan.

   c. Field measurements per Paragraph 1.02 "Quality Assurance."

   d. After construction is complete, Contractor shall submit a full set of sealed tank drawings in PDF format with all changes during construction identified and incorporated.

8. Results from watertightness testing and post construction foundation survey.

9. Provide the following Schedules:

   a. Daily schedule during concrete placement operations with updates if changes are required.

   b. Daily schedule during disinfection and watertightness testing.

   c. Construction Schedule showing at a minimum the following items:

      - Shop Drawings submittals
      - Procurement
      - Foundation Preparation
      - Tank Construction

- Completion
- Filling and Testing

1.04 STANDARDS

A. Comply with the provisions of the following standards as if written here in their entirety.

B. In the event of a conflict between the published standards, codes, and this Section, the provisions of this Section shall govern.

1. American Concrete Institute (ACI):

ACI 301	Specifications for Structural Concrete
ACI 304 R	Guide for Measuring, Mixing, Transporting and Placing Concrete
ACI 305 R	Hot Weather Concreting
ACI 306 R	Cold Weather Concreting
ACI 309 R	Guide for Consolidation of Concrete
ACI 347 R	Guide to Formwork for Concrete
ACI 350 R	Code Requirements for Environmental Engineering Concrete Structures and Commentary
ACI 372 R	Design and Construction of Circular Wire- and Strand- Wrapped Prestressed Concrete Structures
ACI 506 R	Guide to Shotcrete

2. American Society for Testing and Materials (ASTM):

ASTM A185	Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A366	Specification for Steel, Sheet, Carbon, Cold Rolled, Commercial Quality
ASTM A416	Specification for Steel Strand, Uncoated Seven Wire for Prestressed Concrete
ASTM D471	Test Method for Rubber Property-Effect of Liquids
ASTM A475	Specification for Zinc Coated Steel Wire Strand
ASTM A615	Standard Specifications for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement
ASTM A821	Specification for Steel Wire, Hard Drawn for Prestressing Concrete Tanks
ASTM A996	Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
ASTM A1008	Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
ASTM A1011	Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength

ASTM C42	Test Method for Obtaining Drilled Cores and Sawed Beam of Concrete
ASTM C143	Test Method for Slump of Hydraulic Cement Concrete
ASTM C172	Practice for Sampling Freshly Mixed Concrete
ASTM C173	Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C231	Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C881	Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C920	Elastomeric Joint Sealants
ASTM C1218	Standard Test Method for Water-Soluble Chloride in Mortar and Concrete
ASTM D1056	Specification for Flexible Cellular Materials Sponge or Expanded Rubber
ASTM D6938-10	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM D1752	Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Placing and Structural Construction
ASTM D2000	Classification System for Rubber Products in Automotive Applications
ASTM D395	Test Methods for Rubber Property Compression Set
ASTM D698	Test Methods for Laboratory Compaction Characteristics of Soil using Standard Effort 12,400 ft.-lb./ft^3
ASTM D1557	Test Methods for Laboratory Compaction Characteristics of Soil using Modified Effort 56,000 ft.-lb./ft^3
ASTM D2240	Test Methods for Rubber Property Durometer Hardness

3. American Water Works Association (AWWA):

AWWA D110	Standard for Wire-and-Strand-Wound, Circular, Prestressed Concrete Water Tanks
AWWA C152	Standard for Ductile Iron Pipe, Centrifugally Cast
AWWA C200	Standard for Steel Water Pipe – 6 in. and Larger
AWWA C220	Standard for Stainless-Steel Pipe
AWWA C652	Standard for Disinfection of Water Storage Facilities

4. American Welding Society (AWS) Standards

AWS D1.1	Structural Welding Code – Steel
AWS D1.2	Structural Welding Code - Aluminum
AWS D1.6	Structural Welding Code – Stainless Steel

5. Miscellaneous Standards:

ASCE/SEI 7	Minimum Design Loads for Buildings and Other Structures

MIL R 219 31(A) OS	Military Specification Resin, Epoxy
NSF/ANSI Standard 61	Drinking Water System Components – Health Effects
TAC Title 30, Part 1, Chapter 290, Subchapter D	Rules and Regulations for Public Water Systems

1.05 DESIGN CRITERIA

A. Design Requirements: The tank shall be designed in accordance with the requirements of ANSI/AWWA D110 Standard for Wire Wound Circular Prestressed Concrete Tanks, Type III: Precast Concrete with Steel Diaphragm. No alternate designs will be considered.

B. Tank Dimensions and Capacity Criteria: The tank manufacturer shall use the following loadings and requirements in the design calculation:

Tank Name	**RPS -TNK1**	**RPS-TNK2**
Minimum Storage Capacity	**10.0 million gallons**	**10.0 million gallons**
Inside Diameter	**206 feet**	**206 feet**
Wall Height	T.B.D. by tank manufacturer and approved by the Engineer	T.B.D. by tank manufacturer and approved by the Engineer
Side Water Depth	**40.0 feet**	**40.0 feet**
Liquid Unit Weight	**62.4 lb/ft^3**	**62.4 lb/ft^3**
Maximum Fill Rate	**160 MGD**	**160 MGD**
Maximum Drawdown Rate (normal operation)	**160 MGD**	**160 MGD**

C. Loads to be considered in the tank design shall include internal liquid pressure, backfill, pressure, seismic effects, construction procedures, prestressing, end restraints, temperature and moisture gradients, dead loads, live loads, wind loads, and loads due to the concrete dome roof.

D. Seismic design shall be in accordance with the requirements of the ASCE 7-16 and AWWA D110 with the most stringent requirements controlling with the following design loads. Tank manufacturer shall provide calculations for both criteria and indicate the most stringent requirements.

1. Ultimate Design Wind Speed: 145 MPH
2. Occupancy Risk Category: III.
3. Site Class: D.
4. Spectral Response Coefficients: S_{DS} = 0.077, S_{D1} = 0.062.
5. Seismic Design Category: A.

E. Structural Design Requirements:

1. Allowable Stresses:
   a. Compressive stresses in concrete and shotcrete shall not exceed 0.55 f'c initial (immediately after prestressing) and 0.45 f'c final (after all losses have taken place)

where f'c is the 28-day compressive strength of concrete or shotcrete. Vertical tensile stresses shall be taken fully by reinforcing steel and/or the diaphragm.

b. Maximum permissible initial stress f'_{si} in any prestressing wire on the wall shall not exceed 0.75 f_{pu}, where f_{pu} equals the ultimate tensile strength of the wire. Stress losses due to shrinkage, plastic and elastic shortening of concrete or shotcrete, and relaxation in steel shall be assumed as 25,000 psi.

2. Strength Design: Reinforcing steel shall be designed in accordance with the requirements of ACI 350. Load combinations shall be per ACI 350 and shall include the environmental durability factor (Sd).

F. Tank Wall Design:

1. The tank wall shall be designed as a composite concrete wall with an embedded mechanically bonded steel diaphragm in combination with vertical mild steel reinforcement.

2. The prestressed tank wall shall be considered as an elastic cylindrical shell, with no reduction in hoop tension or compression taken due to edge restraint at the wall base.

3. The wall shall be precast, incorporating a continuous watertight and mechanically-bonded steel diaphragm. Shotcrete or cast-in-place walls are not permitted. Minimum core wall thickness shall be 4.5 inches, which includes a minimum shotcrete cover of 0.5 inches, which shall be applied to the exterior of the steel diaphragm prior to wire winding.

4. Circumferential prestressing steel shall be furnished to resist all forces due to internal loads, after accounting for stress losses and residual compression. Minimum residual compression in the core wall under tank full condition shall be 200 psi.

5. Mild steel reinforcement shall be used to resist vertical bending stresses. The horizontal cross-sectional area of the steel diaphragm may be included as part of the vertical reinforcing. A minimum vertical reinforcement ratio of 0.0025 on each face of the wall section shall be provided. The minimum concrete or shotcrete cover over steel reinforcement or diaphragm shall be 1 inch or 1.5 times the diameter of the reinforcement, whichever is greater. Shotcrete coats over circumferential prestressing shall be considered as part of the minimum diaphragm cover.

6. A suitable stress plate shall be required at all locations where prestress wires are displaced by wall openings of 12 inches or greater. The stress plate shall be designed to transfer stress across the opening.

G. Concrete Dome Roof Design:

1. The roof shall have a dome, and not be flat. The dome roof shall have a rise to span ratio within the range of 1:8 to 1:14. The dome shall be fixed to the tank wall. Columns or interior supports will not be allowed.

2. The underside of the dome ring shall be provided with a continuous 3/4-inch perimeter drip groove or equivalent to prevent water from running off the dome and down the side of the tank.

3. The dome design shall be based on elastic spherical shell analysis and shall include a circumferentially prestressed dome ring.

4. Minimum shell thickness shall be proportioned for bucking, but shall not be less than thickness that provides 2 inches minimum cover over rebard for precast or cast-in-place domes. All joints between precast dome panels shall be the full thickness of the precast dome panel. There shall be no discoloration or change in texture at the joints between the dome panels as compared to the adjacent dome panels.
5. Mild steel reinforcement in each of two perpendicular directions shall be placed at the mid-depth of the shell, except in the edge region where two layers of reinforcement are required. The minimum concrete cover over steel reinforcement shall be 2 inch.

H. Floor Design:

1. The foundation design shall be per ACI 350.
2. The floor shall be a concrete slab designed to transfer loads directly to the subbase. It must be able to deflect to the settlement shape of the underlying soil without excessive stresses.
3. The floor shall be a structural type foundation. The floor design shall be in accordance with ACI 350R with special attention to crack control and designed to support the tank contents and to resist the maximum hydrostatic uplift forces when tank is empty, to resist expansive soils, and/or to take into account any other unusual foundation conditions warranted.
4. Temporary foundation “block-outs” to relieve hydrostatic uplift forces during construction will not be allowed.
5. The floor shall be placed monolithically.
6. Minimum floor thickness shall be 8 inches. The wall footing shall be proportioned to resist imposed loads.
7. Reinforce the floor slab with a minimum of two mats of reinforcing steel in each direction and a minimum area of reinforcing steel per foot in accordance with ACI 350. The reinforcing minimum clear cover shall be per ACI 350 and shall not be less than 2 inches.
8. Wall footings may be above or below floor grade, but shall be placed monolithically with the floor.
9. Piping placed under the floor slab:
    a. Piping placed under the floor slab shall be encased in reinforced concrete for support and added corrosion protection and to ensure against leakage during the useful life of the structure.
    b. Base materials shall be placed under any inlet/outlet pipe(s) and compacted to the same specifications as the tank foundation granular base. The remainder of the excavation for inlet/outlet pipe(s) shall be backfilled with lean concrete to the bottom of the granular subbase. Concrete encasement of pipe below the floor and pipe penetrations through the floor slab shall be designed by the manufacturer and floor slab thickened if required.
10. A 6-mil polyethylene vapor barrier shall be placed under the bottom of the slab. Joints in the polyethylene shall be overlapped a minimum of 6-inches.

11. Floor shall be sloped near the outlet pipe as shown on the Drawings.

I. Concrete mix designs to be in direct contact with soil shall be designed to resist severe sulfate attack risk category utilizing appropriate cement type, compressive strength, water-cement ratio, and pozzolans. Final mix designs to resist sulfate attack shall be submitted by tank manufacturer and approved by the Engineer prior to construction.

J. Lightning Protection: Lightning protection shall be as specified in Section 26 41 13 "Lightning Protection for Structures." The tank manufacturer shall coordinate with the Lightning Protection Subcontractor and coordinate all connections and hangers. The hangers and accessories for the lightning protection system shall be discontinuous with the prestressing wires, reinforcing, or other metal components of the tank.

K. The tank manufacturer may make minor adjustments to the tank details indicated on the Drawings as required to facilitate the tank manufacturer's proprietary design and construction methods. All adjustments or deviations from the Drawings or Specifications shall be submitted to the Engineer for review and approval prior to construction.

1.06 GUARANTEES AND WARRANTIES

A. Workmanship and Material Guarantee: The tank manufacturer shall guarantee the tank structure against defects in workmanship and material for a period of 2 years. If within 1 year from final completion of the entire Project, workmanship or material is proven defective, the tank manufacturer shall repair such defects at his own expense.

B. Design Warranty: The tank manufacturer shall warrant its design of the proposed facility to be structurally and functionally applicable to serve the intended use of the Project. Such intended use is exemplified by the criteria of design, workmanship, and material expressed by the requirements of the Contract Documents prepared by the Engineer. The Owner's or Engineer's review of the tank manufacturer's design, or the Owner's acceptance and final payment for the Work shall not relieve the tank manufacturer of design responsibility. The Owner shall be the direct beneficiary of the warranty.

1.07 PROJECT CONDITIONS

A. Subsurface and Physical Conditions:

1. The following are reports of explorations and tests of subsurface conditions at or contiguous to the Site of the Work:

   a. Report dated July 16th, 2018: Phase 2 Geotechnical Investigation Summary, WHCRWA Re-Pump Station, consisting of 212 pages. Contractor recognizes that the technical data listed reflects only the conditions for the day the data was collected and reflects only conditions existing at the exact location of Samples.

   b. Copies of these reports and drawings that are not included with Bidding Documents may be examined at the offices of Freese and Nichols, Inc. in Houston, Texas during regular business hours. These reports and drawings are not part of the Contract Documents. Tank manufacturer is not entitled to rely upon other information and data utilized by Engineer and Engineer's Consultants in preparation of the Contract Documents.

c. No additional geotechnical information will be provided by the Owner. It shall be the complete responsibility of the tank manufacturer to satisfy himself of the geotechnical conditions at the proposed tank site. If the tank manufacturer deems it necessary for additional geotechnical investigations and analysis, such investigations and analysis shall be provided by the tank manufacturer at no additional cost to the Owner. The structural foundation design shall be provided by the tank manufacturer.

B. Field Measurements:

1. Verify layout information for tank shown on the Drawings in relation to property survey and existing structures. Verify dimensions by field measurements. Submit the following elevations as Record Data, survey shall be completed by licensed surveyor:

a. Bottom slab elevation of the existing ground storage tank.

b. Overflow elevation of the existing ground storage tank.

2.00 MATERIALS

2.01 MATERIALS IN CONTACT WITH POTABLE WATER

All materials in contact with potable water with the exception of concrete and metals shall comply with the requirements of the Safe Drinking Water Act, NSF 61 and other federal, state, local, and provincial requirements. Any constituents in the concrete shall not be toxic or release toxicity into the water or impart any changes of color, taste or odor into the water.

2.02 CONCRETE

A. Concrete materials shall meet the requirements of ACI 301 and ACI 372R. Cement shall be Portland Type I/II or II.

B. Concrete or shotcrete in direct contact with prestressed reinforcement shall not contain chloride ions in excess of 0.06 percent of the weight of the cement in the mix.

C. Concrete for floor and footing construction, pipe encasements, and other Work shall have a minimum 28-day strength of 3500 psi. Concrete for wall and roof construction shall have a minimum 28-day strength of 4000 psi.

D. Concrete for tank wall construction shall be placed at a slump of 3 inches plus or minus 1 inch, not to exceed 4 inches. Concrete for floor and dome shall be placed at a slump not to exceed 4 inches plus or minus 1 inch. If a high range water reducer is used, concrete shall be placed at a slump not to exceed 7 inches. Samples for concrete testing shall be taken near the place of final deposit of the material.

E. Admixtures shall comply with the requirements of ACI 301 and shall not contain chlorides, (except as heretofore stipulated) fluorides, sulfides or nitrates. Concrete for tank wall, dome, and other concrete subjected to freeze-thaw cycling shall be air entrained.

F. Curing compounds shall be compliant with NSF Standard 61.

G. Concrete for floor and footing shall contain polypropylene fibers, Grace Microfiber, or equal. The amount of polypropylene fibers added to the concrete mix shall conform to the manufacturer's recommendations.

2.03 FLOWABLE FILL

Flowable fill shall be provided per Section 31 23 23.34 “Flowable Fill.”

2.04 SHOTCRETE

A. Shotcrete materials shall meet the requirements of ACI 506. Cement shall be Portland Type I/II or II.

B. Shotcrete mix designs to be in direct contact with soil shall be designed to resist severe sulfate attack risk category utilizing appropriate cement type, compressive strength, water-cement ratio, and pozzolans. Final mix designs to resist sulfate attack shall be submitted by tank manufacturer and approved by the Engineer prior to construction.

C. Shotcrete for tank construction shall not contain chloride ions in excess of 0.06 percent of the weight of the cement in the mix.

D. Shotcrete wire coat used for covering intermediate layers of prestressing wire shall consist of not more than 3 parts sand to 1 part portland cement by weight; additional coats of shotcrete shall consist of not more than 4 parts sand to 1 part portland cement by weight. The wet mix process referred to in ACI 506 for shotcreting shall be employed.

E. Shotcrete shall have a minimum 28-day strength equal to that for which the core wall is designed but not less than 4,500 psi.

F. Wet mix shotcrete for dome roofs in areas subject to freeze-thaw shall be air entrained with an air content of 5 to 8 percent at the pump. Dry mix shotcrete shall not be used in domes subject to freezing cycles.

G. Admixtures shall comply with the requirements of ACI 301 or ACI 506.2 and shall not contain more than trace amounts of chlorides, fluorides, sulfides, or nitrates because of their possible corrosive effect on the prestressed reinforcement. Materials in contact with potable water shall not impart taste, odor, or toxic chemicals to the water. All admixtures used in the concrete shall be compatible.

H. Polypropylene fibers shall be included in the shotcrete used for the finish covercoat. Fibers shall be Harbourite by Synthetics Industries, or equal. Fiber length shall be 1/4 inch. The amount of fibers added to the shotcrete used for the finish covercoat shall conform to the manufacturer’s recommendations. Fly ash may be incorporated into the finish overcoat. Fly ash shall conform to ASTM C618, Type C.

I. Testing:

1. Testing of shotcrete shall be in accordance with ACI 506, except as specified herein. One test panel shall be made for each of the following operations: corewall, cove, wire cover, and covercoat. Test panels shall be made from the shotcrete as it is being placed, and shall, as nearly as possible, represent the material being applied. The method of making a test Sample shall be as follows: A frame of wire fabric (1-foot square, 3 inches in depth) shall be secured to a plywood panel and hung or placed in the location where shotcrete is being placed. This form shall be filled in layers simultaneously with the nearby application. After 24 hours, the fabric and plywood backup shall be removed and the Sample slab placed in a safe location at the Site.

2. The Sample slab shall be moist cured in a manner identical with the regular surface application. The Sample slab shall be sent to an approved testing laboratory and tested at the age of 7 days and 28 days. Nine 3-inch cubes shall be cut from the Sample slab and subjected to compression tests in accordance with current ASTM Standards. Three cubes shall be tested at the age of 7 days, three shall be tested at the age of 28 days, and three shall be retained as spares.

2.05 REINFORCING STEEL

Nonprestressed reinforcement shall be new deformed billet-steel bars that conform to the requirements of ACI 350, Grade 60, meeting the requirements of ASTM A615. Strand for seismic cables shall be galvanized and shall conform to the requirements of ASTM A416 prior to galvanizing. Welded wire fabric conforming to ASTM A185 shall not be used.

2.06 MORTAR FILL AND NON-SHRINK GROUT

A. Mortar fill shall have a minimum compressive strength of 4,000 psi at 28 days, and non-shrink grout shall have a minimum compressive strength of 5000 psi at 28 days.

B. ACI 301 for mortar, ASTM C1107 grade A or C for nonshrink grout. Nonshrink grout is not to be used for bonding of prestressed tendons or to come into contact with the wire or strand prestressed reinforcement.

2.07 STEEL DIAPHRAGM

A. Steel sheet diaphragms shall be vertically ribbed with adjacent and opposing channels that provide the mechanical bond to the concrete. The base of the channels shall be wider than the throat. Uncoated steel sheet shall comply with ASTM A366 and ASTM A1008. Diaphragm steel thickness shall be a minimum of 26 gauge/0.016-inches.

B. The steel diaphragm shall extend within 2 inches of the full height of the wall panel with no horizontal joints; moreover, the steel diaphragm shall be continuous for the full height of the tank. Vertical joints within a wall panel shall be roll seamed or otherwise fastened in a fashion which results in a firm mechanical lock. Joints between wall panels that are not roll seamed shall be edge sealed with polysulfide sealant. All vertical diaphragm joints shall be sealed to be fully and completely watertight under full tank load.

C. No punctures will be permitted in the diaphragm except those required for pipe sleeves, temporary construction openings, or special appurtenances. Details of such openings, as are necessary, shall be approved by the Engineer. All such openings shall be completely edge sealed with polysulfide sealant.

D. Diaphragm joints between precast wall panels shall be sealed with polysulfide sealant.

2.08 PRESTRESSING STEEL

A. Steel for prestressing shall be cold-drawn, high carbon wire meeting the requirements of ASTM A821 having a minimum ultimate tensile strength of 210,000 psi.

B. Splices for horizontal prestressed reinforcement shall be ferrous material compatible with the prestressing wire, and shall develop the full strength of the prestressing wire. Wire splice and anchorage accessories shall not nick or otherwise damage the prestressing.

C. Circumferential prestressing wire shall conform to the requirements of ASTM A648 or ASTM A821. Splices and anchor clamps for prestressing wire shall be ferrous material compatible with the wire and shall develop the full strength of the wire.

2.09 ELASTOMERIC MATERIALS

A. Waterstops:

1. Thermoplastic Elastomeric Rubber (TPE) waterstops: Waterstops shall have a center bulb and be NSF 61 approved. Splices shall be made in accordance with the manufacturer's recommendations.

a. Approved Manufacturer(s):

1) JP Specialties, Inc., Earth Shield Waterstop.

2) Sika Greensteak, WESTEC Envirostop TPE-R.

3) Approved Equal.

2. Polyvinylchloride (PVC) waterstops: Waterstops shall have a center bulb and be NSF 61 approved. Splices shall be made in accordance with the manufacturer's recommendations.

a. Approved Manufacturer(s):

1) JP Specialties, Inc.

2) Sika Greensteak.

3) Approved Equal.

B. Bearing pads shall consist of neoprene or natural rubber.

1. Neoprene bearing pads shall have a minimum elongation of 500 percent and a maximum compressive set of 50 percent, and shall comply with ASTM D2000, Line Call Out M 2 BC 410 A14 B14 for 40 durometer material.

2. Natural rubber bearing pads shall contain only virgin natural polyisoprene as the raw polymer, and the physical properties shall comply with ASTM D2000, Line Call Out M 4 AA 414 A13. The tank manufacturer shall verify that bearing pads shall be resistant to damage caused by chlorine or chloramines.

2.10 SEALANTS AND JOINT FILLERS

A. Sponge filler shall be closed cell neoprene or rubber conforming to the requirements of ASTM D1056, Type 2A1 through 2A4, and shall be resistant to damage by chlorine or chloramines. Contractor may provide Type 2C1, with a letter from the product manufacturer certifying that the sponge filler meets or exceeds all of the requirements of ASTM D1056, Type 2A1. Compression deflection limited to 25 percent at 2 to 5 psi. The sponge filler pad may be removed after construction in lieu of being NSF 61 approved.

B. Polysulfide sealant will be a two component elastomeric compound meeting the requirements of ASTM C920, Type M. Sealants and joint material must have permanent characteristics of bond metal surfaces, flexibility, and resistance to extrusion due to hydrostatic pressure and resistant to damage from chlorine or chloramines. Air-cured sealants shall not be used. Sealant shall provide watertightness under the full tank head.

C. Epoxy coatings for inserts and temporary openings shall be of a high-build flexible coating for concrete. It should be 100 percent solids epoxy system coat or equal. Epoxy coatings shall only be used upon the recommendation and approval of the tank manufacturer and the approval of the Owner. All epoxy fillers in contact with potable water shall be compliant with NSF Standard 61.

2.11 APPURTENANCES

A. The Contractor shall provide and install all appurtenances shown on the Drawings and as indicated below. All hardware furnished with interior tank appurtenances shall be 316 stainless steel.

B. Inlet/Outlet Piping: All piping on the interior of the tank shall be concrete encased. 316 stainless steel piping may be provided in lieu of concrete encasement. Piping material shall be similar from floor connection to its terminus. Provide isolation kits for connections at differing material piping. All hardware shall be 316 stainless steel.

1. Inlet piping shall be:

    a. AWWA C200 – Steel pipe (D/t=230 or 0.250-inch min. wall thickness). All steel piping shall be lined with a NSF 61 certified epoxy coating in accordance with AWWA C222.

    b. AWWA C220 – Schedule 10S 316L - stainless steel pipe.

2. Outlet piping shall be:

    a. AWWA C200 – Steel pipe (D/t=230 or 0.250-inch min. wall thickness). All steel piping shall be lined with a NSF 61 certified epoxy coating in accordance with AWWA C222.

    b. AWWA C220 – Schedule 10S 316L - stainless steel pipe.

    c. Silt stop shall be made of Class 250 ductile iron. Coat and line as specified in Section 09 96 00.01 “High Performance Coatings.”

3. Piping encased in concrete is not required to be coated. All encased piping shall be clean and free of rust and other foreign matter.

4. Buried piping shall be as specified in 33 11 13.13 “Steel Pipe and Fittings”.

5. All above grade or exposed piping shall be coated per Section 09 96 00.01 “High Performance Coatings.” Stainless steel piping is not required to be painted.

6. Outlet piping shall have a steel baffle plate as shown in the plans.

7. All pipe to concrete anchors and connections shall be designed by tank manufacturer. Interior supports and hardware shall be 316 stainless steel. Exterior supports and hardware shall be 316 stainless steel.

C. Overflow weir(s), piping, flap valve(s), and splash pad shall be as indicated on the Drawings. Flap valve shall have a gravity-hinge and the cover shall fit tight with no gap over 1/16-inch per TCEQ requirements. Refer to Section 33 12 16.12 “Miscellaneous Valves” for flap valve requirements. The tank manufacturer shall be responsible for sizing the overflow weir and associated piping for the maximum fill rate indicated in Paragraph 1.05.B at the maximum static water surface permitted in the wall and roof design. Maximum static water surface

permitted shall be at least one inch below the joint between the wall and dome. Pipe supports shall be 316 stainless steel. Contractor shall include detailed calculations for sizing overflow pipe and weir with design calculations and Shop Drawings.

D. Vent(s) shall be as indicated on the Drawings. The tank manufacturer to size roof ventilator to pass air so that the maximum fill/draw rate shall not develop pressure within the tank as stated in Paragraph 1.05.B and a broken pipe analysis assuming a broken pipe immediately outside of the tank's foundation. Broken pipe analysis shall be based on largest diameter inlet/outlet pipe.

1. Vent shall be constructed of 316 Stainless Steel and shall be sized by the tank manufacturer, meeting current AWWA and TCEQ standards.
2. Vent shall be screened with #16 316 stainless steel insect screen with openings not greater than 1/16 inch. Vent shall be securely fastened using 316 stainless steel hardware.
3. Contractor shall include detailed calculations of vent sizing and broken pipe analysis with design calculations and Shop Drawings.
4. Vent shall be of sturdy construction with design and materials approved by the Engineer.

E. Tank Access:

1. Install tank access as indicated:

Hatch Location	Quantity (per tank)	Clear Opening Size
Dome Access Hatch to Interior Shell Ladder	1	42" x 42"
Wall Manway	2	36" Diameter

2. Dome Hatches:

a. Hatch shall be single leaf and constructed of aluminum with 316 stainless steel hardware. Hatch shall be rated for a minimum live load of 150 psf.

b. The access door shall be equipped with a 316 stainless steel slamlock with fixed exterior and interior handles and interior and exterior padlock staples. The door shall have stainless steel gas shocks to assist in opening the door and reducing the force during closing. A 316 stainless steel hold open arm with push/pull handle shall automatically keep the cover in its upright, open position.

c. Hatch shall be installed on a minimum 4-inch concrete curb. Hatch lid shall have a minimum 2-inch overhang as required by TCEQ Chapter 290. Provide a neoprene gasket between concrete curb and hatch.

d. An EPDM rubber gasket shall be used to make a positive seal when the hatch is closed.

e. Aluminum shall have a clear anodic finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

f. Installation shall be in accordance with the manufacturer's written instructions.

g. Manufacturer shall guarantee hatch against defects in materials and workmanship for a minimum of 10 years.

h. Approved Manufacturers:

1) Babcock-Davis.

2) Bilco Company.

3) Milcor, Inc.

4) U.S.F. Fabrication

5) Approved Equal

i. Provide confined space label on roof hatches, Seton Item No. 5185C or approved equal.

F. Ladders/Stairs:

1. Install ladders with appurtenances as indicated:

Location	Material	Ladder Safety Post Req'd	Fall Prevention System Req'd	Cage Req'd
Interior Shell (Tank Floor to Dome)	316 Stainless Steel	Yes	Yes	No
Exterior (Ground to Dome)	316 Stainless Steel, Galvanized Steel, or Aluminum	Yes	Yes	Yes

2. All ladders shall be designed and installed per OSHA standards.

3. All stainless steel connections shall be welded.

4. All ladder to tank connections shall be by anchors designed by tank manufacturer. Anchors shall be 316 stainless steel. Shotcrete pads shall be provided on the exterior of the tank at ladder connections.

G. Ladder Safety Post

1. Post shall be constructed of 316 stainless steel and mounted with 316 stainless steel hardware.

2. Post shall be mounted to it does not obstruct access to the fall prevention system, if provided on ladder.

3. Install safety post per the manufacturer's written recommendations.

4. Approved Manufacturers:

a. Halliday.

b. Bilco.

c. Approved Equal.

H. Fall Prevention System:

The complete system shall allow the worker to operate freely in a normal climbing position during ascent or descent. The device is to be installed in accordance with the manufacturer's instructions in such a manner to enable the worker to be attached to the device at all times during the climb without having to remove his hands from the ladder to operate the system effectively and to be able to easily pivot onto and off of work platforms or landings while safely attached to the device.

1. The system shall meet the following requirements:
    a. Approved fall prevention systems:
        1) DBI/Sala - Lad-Saf Flexible Cable Ladder Safety System with cable, components, and hardware with guide rails spaced at 20-feet max.
        2) FrenchCreek Production – TS Products Rigid Rail Climbing System
    b. Provide 2 sleeves or trolleys:
        1) DBI/Sala Model 6116502 sleeve for 3/8-inch cable.
        2) French Creek climbing trolley for Rigid Rail system.
    c. Provide two full body safety harnesses:
        1) FrenchCreek Model 850B-TS, coordinate with Owner for sizing prior to ordering.
        2) Approved equal.
    d. Provide two lanyards:
        1) DBI/Sala Model AE57831.
        2) Approved Equal.
    e. Provide One weatherproof Saf-T-Climb Storage Box by North Safety or Approved Equal, to be located and installed as directed by Owner.
2. Materials:
    a. Interior Ladder: The cable/rail, hardware and all system components shall be of Type 316 stainless steel.
3. All cables, components, brackets, etc. shall be on-site to complete installation.
4. All cables/rails and components designated for in-tank use shall be 316 stainless steel.
5. The fall prevention system shall be installed in accordance with the manufacturer's installation instructions by a competent person.
6. Fall prevention system shall not be installed until all painting and/or construction has been completed on the tank.

I. Handrail:

1. Handrail may be of Aluminum, Galvanized steel, or 316 Stainless steel
2. handrail shall be constructed on top of tank as shown on the Drawings. All handrail to tank connections shall be by anchors designed by the tank manufacturer. Anchors shall be 316 stainless steel.

3. Handrail shall be 1-1/2-inch diameter schedule 80 pipe.
4. Isolate handrail from tank with 1/8-inch neoprene pads.
5. Base plates shall be square and secured to dome using 316 stainless steel wedge anchors. 4 minimum per base plate.
6. Beveled toe-board shall be attached to railing along the circumference of the tank.
7. All hardware shall be 316 stainless steel.
8. Provide supports for handrail as recommended by the handrail manufacturer and per the tank manufacturer's design.
9. Approved Manufacturers:
    a. Hollander, Inc. – Speed Rail.
    b. Approved Equal.

J. Provide two (2) 6-inch dome sleeves for level sensors

K. Concrete Tank Interior Coating System:
1. Interior concrete surfaces do not require a coating.

L. Concrete Tank Exterior Coating System:
1. Provide the following exterior coating system.
2. Decorative coating for precast dome surfaces:
    a. Coat 1: Cementitious based damp-proofing product. "Tamoseal" by Euclid or approved equal.
    b. Coat 2: Non-cementitious, high build, 100 percent acrylic resin polymer. "Tammscoat Smooth" textured protective coating by Euclid or approved equal.
3. Decorative coating for cast-in-place dome surfaces:
    a. Coat 1: Non-cementitious, high build, 100 percent acrylic resin polymer. "Tammscoat Smooth" textured protective coating by Euclid or approved equal.
    b. Coat 2: Non-cementitious, high build, 100 percent acrylic resin polymer. "Tammscoat Smooth" textured protective coating by Euclid or approved equal.
4. Decorative coating for exterior wall surfaces:
    a. Coat 1: Non-cementitious, high build, 100 percent acrylic resin polymer. "Tammscoat Smooth" textured protective coating by Euclid or approved equal.
    b. Coat 2: Non-cementitious, high build, 100 percent acrylic resin polymer. "Tammscoat Smooth" textured protective coating by Euclid or approved equal.
5. Mix and apply the coating in strict accordance with the manufacturer's directions. Do not apply coating when the temperature is below 45 F, or when the temperature is expected to fall below 45 F within 24 hours after completing application.
6. See Section 09 91 13 "Exterior Painting" for general painting requirements.

M. Procedure for approval of exterior coating colors and architectural treatment colors:

1. Preliminary Color Selections:

   a. Tank Coating Color Samples: Owner will select up to six colors from the manufacturer's color chart. Contractor shall provide six 24-inch-by-24-inch color Samples on boards with texture matching that of the proposed tank.

2. Owner will choose up to five color combinations from the Samples provided. Contractor shall provide computer generated renderings detailing the view of the tank and pilaster**s** from the adjacent road with selected color combinations. Renderings shall accurately depict colors selected. Owner may request renderings to be resubmitted if renderings do not match selected coating colors.

3. Owner will select two renderings for mock walls.

4. Contractor shall construct mock walls consisting of:

   a. 4-foot-by-8-foot sheet of plywood with finish color and texture of proposed tank, including efface, dome ring and arch color and texture.

5. Owner selects colors from mock walls.

6. Contractor submits final rendering of the selected colors.

3.00 EXECUTION

3.01 CLEARING, GRUBBING, AND STRIPPING

A. All trees, shrubs, brush, stumps, roots, and other objectionable material shall be removed to a minimum distance of 12 feet outside the edge of the tank floor, plus additional areas as necessary. In addition, all vegetation shall be removed from areas designated for precast panel casting beds, material storage, and construction trailers. Refer to Section 31 11 00 "Clearing and Grubbing."

3.02 EXCAVATION AND BACKFILL

A. The Contractor shall excavate to such depths and widths as will provide adequate room for tank construction with a minimum working area of 10 feet beyond the exterior of the tank footing plus additional area as required by the tank manufacturer.

B. The excavation shall be dewatered during all construction operations. The dewatering method used shall prevent disturbance of the earth below grade.

C. Unsuitable material and compacted select fill shall be measured separately and paid for by the unit price indicated in the Bid.

D. The area outside of the tank foundation shall be backfilled and graded to the contours shown on the Drawings as indicated in Section 31 23 10 "Structural Excavation and Backfill."

E. Frozen material shall not be used for backfill or embankments, nor shall fill material be placed on snow, ice, or frozen material. Rock or spoils (greater than 6 inches in diameter) shall not be used in backfilling or embankment construction within 3 feet of the tank structure.

F. Surplus excavated material remaining after backfill or embankments are completed shall be removed from the Site and/or properly disposed of as directed by the Owner.

G. Tank Contractor shall provide geotechnical engineer to inspect and confirm/approve that the subgrade is consistent with the original geotechnical or report provided by the tank manufacturer and the subgrade is suitable for the contact loads anticipated. Confirmation shall be documented and approved by the Engineer prior to continuing with granular subbase and foundation construction.

3.03 GRANULAR SUBBASE

A. A minimum 12-inch thick layer of granular material shall be provided on top of the proposed subgrade foundation prior to tank floor construction, to a tolerance of within plus or minus 1/2 inch of the bottom of the floor and footing elevation.

B. The granular material shall be Class 1, 3 or 7 aggregate fill, or well graded crushed rock as required by tank manufacturer's foundation design provided the material is suitably sized for use with the perforated drainage pipe. Refer to Section 31 05 16 "Aggregates for Earthwork".

C. Refer to Section 31 23 10 "Structural Excavation and Backfill" for placement and compaction requirements.

D. Test granular sub-base for density and moisture using ASTM D6938-10.

3.04 CONCRETE

A. Concrete placement, finishing and curing shall generally meet the requirements of ACI 301.

B. Weather Limitations: Hot and/or cold weather concreting conditions shall be determined, as outlined in Chapter 7, Section 7.6 of ACI 301-99 and requirements of that Section shall govern. Protection shall be in accordance with Chapter 12, Section 12.3 of ACI 301-99.

The maximum temperature of concrete shall not exceed 90 F at the time the concrete is placed. The temperatures of the mixing water shall be reduced by the use of chilled water or ice.

The maximum temperature of concrete with high range water reducing admixture shall not exceed 100 F at the time concrete is placed.

Concrete shall not be placed when temperature is 40 F and falling.

C. Curing shall be by membrane-forming curing compound, by covering exposed surfaces with polyethylene sheets, or by keeping surfaces continuously moist. Curing floor by flooding is an acceptable alternative to providing curing compound.

D. Testing:

1. General:

a. Tests shall be required throughout the Work to monitor the quality of concrete per ACI 301. Samples shall be taken in accordance with ASTM C172.

b. The Engineer may waive these requirements on concrete placements of 10 cubic yards or less. However, evidence shall be furnished showing a design mix which meets the Specifications.

c. Testing of the materials, ready mix, transit mix or central plant concrete will be by a testing laboratory. A summary of all tests performed will be available within 7 days of 7-day and 28-day breaks. No concrete shall be placed without a representative of the tank manufacturer present at either the plant or at the Site.

2. Slump Test: Slump tests, in accordance with ASTM C143, shall be used to indicate the workability and consistency of the concrete mix from batch to batch. Slump tests shall be taken on each delivery prior to placement.

3. Air Content Test: Tests for the concrete's air content shall be made in accordance with ASTM C231 or ASTM C173 at the point of delivery of concrete prior to placing in forms. The test shall be made frequently to monitor a proper air content uniform from batch to batch.

4. Temperature Test: The temperature of the concrete to be placed shall be taken with a thermometer immediately before placement, with the point of measurement being the chute or bucket. Temperature test shall be performed for each truck. Record temperatures on batch ticket.

5. Compression Test:

   a. Compression test specimens shall be 6-by-12-inch concrete cylinders (4-inch cylinders may be used and tested per ACI 301) made and cured under laboratory conditions in accordance with ASTM C31. Additional concrete cylinders may be required for curing on the job under actual job curing conditions. These Samples could be required when:

      1) There is a possibility of the air temperature surrounding the concrete falling below 40 F, or rising above 90 F.

      2) The curing procedure may need to be improved and/or lengthened.

      3) It is necessary to determine when the structure may be put into service.

   b. Compression strength tests shall be made on the laboratory-cured and job-cured concrete cylinders at 7 and 28 days, in accordance with ASTM C39. One cylinder shall be tested at 7 days, two at 28 days, and one held as a spare. The tests made at 7 days shall show strengths of not less than two-thirds of the design strength. For the 28-day cylinders, the strength level shall be satisfactory if the averages of all sets of consecutive strength test results exceed the required design compressive strength, and no individual strength test result falls below the required compressive strength by more than 500 psi. Additional cylinders may be required by ACI 301 if 4-inch cylinders are used.

   c. Testing Frequency:

      1) No fewer than three specimens shall be made for each test at each age (7 and 28 days).

      2) Samples shall be taken at a minimum of every 150 cubic yards of concrete of each class placed.

      3) At least one set of test specimens per day shall be made of each class of concrete used that day.

4) High Early Strength Concrete Test: When Type "III" High Early Strength Portland Cement is used instead of Type "I" Portland Cement, the minimum allowable 28-day strength for Type "I" Portland Cement concrete shall be at 7 days. The ages at time of test for Type "III" shall be 3 days and 7 days, instead of 7 days and 28 days, respectively, for Type "I."

5) For concrete placed in precast panels or wall slots, a set of three cylinders shall be made for each truck load of concrete placed.

6) For concrete placed in the floor, dome ring, or dome slots, two sets of three cylinders for the first 50 cubic yards, and one set of three cylinders for every 100 cubic yards thereafter placed in the same day.

6. Failure to Meet Requirements:

a. Should the 7-day strengths shown by the test specimens fall below the required values, additional curing shall be performed on those portions of the structures represented by the test specimens at the Contractor's expense. If the 28-day strength tests fall below the specified limits, test cores shall be obtained from the extended cure structure and tested in accordance with ASTM Method of Obtaining and Testing Specimens from Hardened Cores and Beams of Concrete, Designation C42. If additional cure strength tests are below the specified limits, the Owner reserves the right to require strengthening, replacement of those substandard portions of the structure, or additional testing, at the Contractor's expense.

b. Upon receipt of the Contractor's written request, substandard concrete Work may be reexamined in place by nondestructive testing methods or core Samples, in accordance with ACI 301. The services of an independent testing laboratory shall be retained and all expenses paid by the Contractor without compensation from the Owner. Laboratory results shall be evaluated by the Engineer, who shall make the final decision on acceptability of the concrete in question. Core Sample holes shall be repaired by the Contractor without additional compensation from the Owner.

E. The Owner may withhold payment for any section of concrete which does not meet the requirements of the Specifications. Withheld payment shall be based upon the unit prices established for concrete and reinforcing steel. Payment shall be withheld until the unacceptable concrete has been refinished, removed and replaced, or otherwise brought into conformance with the Specifications.

3.05 NONPRESTRESSED STEEL REINFORCEMENT

A. Steel reinforcement shall be placed to proper tolerances.

B. The minimum concrete or shotcrete cover over steel diaphragm and non prestressed steel reinforcement shall be 1 inch. Shotcrete cover over prestressing wires shall be counted as part of cover.

C. If wall base cables are required, they shall be installed between base of wall and footing. Sleeves of rubber or other suitable material shall surround the strands at the joint to permit radial wall movements.

D. Reinforcing steel shall be accurately fabricated and shall be free from loose rust, scale, and contaminants, which reduce bond.

E. Reinforcing steel shall be accurately positioned on supports, spacers, hangers, or other reinforcements, and shall be secured in place with wire ties or suitable clips. Concrete block bar supports are not allowed. Rebar chair supports may be either steel or plastic.

3.06 FLOOR

A. The floor and wall footings shall be constructed to the dimensions shown on the approved Shop Drawings.

B. Concrete floors or floor sections shall be cast monolithically with no cold joints.

C. Waterstops:

1. Vertical waterstops shall be located to a tolerance of plus or minus 1/4-inch vertically and plus or minus 1/2 inch radially, and secured to ensure positive positioning.

2. Horizontal waterstops shall be secured in a manner allowing them to be bent up while concrete is placed and compacted underneath, thereby facilitating proper embedment.

3. All waterstops shall be spliced in a manner which provides complete continuity as a water barrier, and each splice shall be electronically spark tested prior to concrete encasement. Punctures in the waterstop shall not be permitted.

4. Waterstops shall be observed by the Owner's representative prior to concrete placement.

5. Unacceptable splicing defects include:

a. Misalignment of center bulb, ribs, and end bulbs greater than 1/16 inch.

b. Bond failure at joint deeper than 1/16 inch.

c. Misalignment which reduces waterstop cross-section more than 15 percent.

d. Bubble or visible porosity in the weld.

e. Visible signs of splice separation when a cooled splice is bent by hand at a sharp angle.

f. Charred or burnt material.

D. Finish: The floor slab shall be given a mechanical steel float or Fresno finish.

E. As soon as possible after final finishing operations, the floor concrete shall receive a coat of non-toxic curing compound and shall be kept moist for a minimum period of 7 days.

3.07 PRECAST CORE WALL

A. The core wall shall be constructed of precast panels and vertical joints filled with shotcrete or cast in place concrete.

B. A continuous waterproof steel diaphragm shall be provided throughout and within the tank wall, located between the stored tank contents and the prestressing wires. The steel diaphragm shall be full length without horizontal joints. Vertical diaphragm joints shall be mechanically seamed except where located between wall panels, where either mechanical seaming or sealing with polysulfide may be employed. All vertical diaphragm joints shall be sealed to be fully watertight. Piercing of the diaphragm shall not be permitted except by design. Form ties shall not be permitted to pierce the diaphragm.

C. Precast panels shall be fabricated to the curvature of the tank radius. The tolerance in panel wall thickness shall be 0 to 1/4 inch. Concrete for each panel shall be placed in one continuous operation.

D. After each precast panel has firmed sufficiently, it shall be covered with polyethylene film for curing.

E. The maximum out-of-round tolerance for precast-concrete panel walls shall be based on the ratio of plus 1/2 inch, minus 0 per 100 feet diameter circle, and the circumference shall be a smooth curve. Tolerance in wall thickness shall be plus 1/2 inch, minus 0. Wall thickness shall not be less than specified. All transitions shall be gradual and smooth. Walls shall be plumb within a tolerance not exceeding 3/8 inch per 10 feet of vertical dimension.

F. Bearing pads shall be located and held in their proper position prior to erection of wall panels. Nailing of pads shall not be permitted.

G. Sponge filler pads shall be properly secured. All voids around bearing pads and sponge shall be caulked with an approved nontoxic sealant to prevent mortar seepage. The sponge filler located under the cove on the interior side of the waterstop shall have a 1/2-inch wide by 1/2-inch deep grove at the center to key the sponge filler to the cove to prevent it from coming dislodged. Alternatively, if the groove is not utilized on the sponge filler on the interior side of the waterstop it shall be removed by the tank manufacturer after the tank is prestressed but prior to the tank being watertightness tested. If the sponge filler is not NSF 61 approved it shall be removed after the curb is poured, but prior to the tank being watertightness tested.

H. Finish:

1. The interior or precast wall panels shall be given a light broom finish.

2. The exterior of precast dome panels, dome slots, and cast-in-place dome shall be given a light broom finish.

3.08 DOME ROOF

A. The dome roof shall be constructed to proper spherical curvature. Construction joints shall be located and configured to maintain an adequate strength for cast-in-place concrete.

B. Dome forms shall be designed to resist all forces acting with respect to its sloped surface. No portion of formwork for domes shall be removed until the concrete has attained sufficient strength, and until the full circumferential prestressing force has been applied to the dome ring.

C. Finish:

1. The exterior dome surface shall be given a light broom finish.

2. The dome soffit shall be a form finish. The exterior dome surface shall receive a coat of membrane-forming curing compound immediately after completion of the final finishing operation.

3.09 PRESTRESSING

A. Circumferential prestressing shall be accomplished by the application of high tensile steel wire. An essential feature of the wire wound stressing system is the proper application of tension to the prestressing element before it is placed on the wall.

B. The stressing system shall be capable of consistently producing a stress at any point around the wall, falling within plus or minus 7 percent tolerance of the specified initial stress fsi. A calibrated stress measuring device which can be easily recalibrated shall be used to determine wire stress levels frequently throughout the wrapping process. At least one stress reading for every coil or foot of wall height shall be taken immediately after application on the wall, and all such readings shall be on straight lengths of wire. A written record of stress readings shall be maintained and submitted as Record Data.

C. If measured wire stress falls below design fsi, additional prestress wire shall be applied. If the applied stress of the wire exceeds 1.07 fsi, the wrapping operation shall be discontinued immediately upon discovery and satisfactory adjustment made to the stressing equipment before proceeding. The total prestress force measured on the wall per vertical foot of height shall not be less than the specified force, nor more than 5 percent greater.

D. Each coil of prestressing wire shall be temporarily anchored. Ends of the individual coils shall be joined by suitable steel splicing devices capable of developing the full strength of the wire.

E. The force diagram shall be prepared for minimum spacing between the prestressing elements of 3/8 inch and the average minimum clear space between wires on the wall shall be 1/4 inch or 1-1/2 wire diameters, whichever is greater. Wires in areas adjacent to openings or inserts shall be uniformly spaced in accordance with the above. Any wires not meeting the spacing requirements shall be respaced. Prestressing shall be placed no closer than 2 inches from the top of the wall, edges of openings, or inserts, nor closer than 3 inches from the base of walls or floors where radial movement may occur.

F. A properly designed stress plate shall be used at all permanent wall penetrations greater than 12 inches in height. The stress plate shall accommodate a portion of the prestressing wires normally required over the height of the penetration. The remaining prestressing wires normally required shall be displaced into circumferential bands immediately above and below the penetration. The effect of banded prestressing shall be taken into account in the design. Bundling of wires is prohibited.

G. The Contractor shall furnish a calibrated stress recording device, which can be recalibrated, to be used in determining wire stress levels on the wall during and after the prestressing process. At least one stress reading per vertical foot or one stress reading for every roll of wire, whichever is greater, shall be taken immediately after the wire has been applied on the wall. Readings shall be recorded and shall refer to the applicable height and layer of wire for which the stress is being taken. A written record of stress readings shall be kept by the Contractor and a copy thereof shall be provided to the Engineer prior Owner's acceptance of the Project. All stress readings shall be made on straight lengths of wire. If applied stresses fall below the design stress in the steel, additional wire will be provided to bring the force on the corewall up to the required design force. If the stress in the steel is more than 7 percent over the required design stress, the wrapping operation shall be

discontinued and satisfactory adjustment shall be made to the stressing equipment before proceeding.

3.10 SHOTCRETE

A. Placement of Shotcrete:

1. Shotcrete placement shall meet the requirements of ACI 506.

2. Shotcrete shall be applied with the nozzle held at a small upward angle not exceeding 5 degrees, and constantly moving during application in a smooth motion with the nozzle pointing in a radial direction toward the center of the tank. The nozzle distance from the prestressing shall be such that shotcrete does not build up or cover the front face of the wire until the spaces behind and between the prestressing elements are filled.

3. Total cover coat thickness shall be controlled by shooting guide wires. Vertical shooting wires shall be installed under tension and spaced no more than 2 feet apart to establish uniform and correct coating thickness. Wires of 18 or 20 gauge high tensile strength steel or a minimum 100-pound monofilament line shall be used. Wires shall be removed after placement of the cover coat and prior to finishing.

B. Weather Limitations:

1. Shotcrete shall not be placed in freezing weather. Shotcrete placement can start without special protection when the ambient temperature is 40 F and rising, and must be suspended when the ambient temperature is 40 F and falling. The surface to which the shotcrete is applied must be free from frost. Cold weather shotcreting shall be in accordance with ACI 301 and ACI 306, and only when approved by the Engineer.

2. Hot weather shotcreting shall be in accordance with the requirements of ACI 301 and ACI 305.

C. Coating of Steel Diaphragm:

1. The steel diaphragm shall be covered with a layer of shotcrete at least 1/2-inch thick prior to prestressing.

2. Total minimum coating over the steel diaphragm shall be 1-1/2 inches, including diaphragm cover, wire cover, and finish overcoat.

D. Each layer of circumferential prestressing shall be protected by a shotcrete wire coat of not less than 1/4 inch. Each prestressing wire shall be individually encased in mortar. The outer layer of wire shall be protected by the wire coat plus two or more additional coats of shotcrete, totaling at least 1 inch in thickness over the outer layer of wire.

E. Dust, efflorescence, oil and other foreign material shall be removed from surfaces to be shotcreted. The nozzle distance from the prestressing shall be such that shotcrete does not build up or cover the front face of the wire until the spaces between the prestressing elements are filled.

F. Minimum shotcrete cover on the outside face of the steel diaphragm shall be 1 inch.

G. All exposed shotcrete coatings shall be kept moist for at least 3 days. Moist curing shall be started as soon as possible without damaging the shotcrete. Curing shall be by fog spraying

or sprinkling. Curing may be interrupted for subsequent application of prestressing and shotcreting.

H. Finish: Exterior shotcrete shall have a natural gun finish.

3.11 DISINFECTION AND TESTING

A. Contractor shall submit disinfection, filling and testing plan to the Engineer as Record Data prior to completion of activities. Plans shall detail the disinfection method, application, filling rates, etc.

B. Disinfection:

1. Disinfect the tank in accordance with AWWA C652, latest edition, Disinfection of Water Storage Facilities. Unless directed by the Engineer, use Chlorination Method No. 2 or 3. After the specified drying time has passed, sweep the tank and wash down with water. The Owner will pay for the water to fill the tank once and the Contractor shall pay for any subsequent water required.

2. Equip personnel working inside the tank during the disinfection procedure with suitable air masks and safety lines leading through a manway to personnel outside the tank. Observe all safety precautions.

3. Upon completion of the disinfection procedure, the Contractor shall provide bacteriological testing of water Samples from the tank. The tank shall not be put in service until safe test results are obtained.

C. Watertightness Testing:

1. Upon completion of the tank, and prior to backfilling at the footing, it shall be filled to overflowing with water furnished by the Contractor. The tank shall remain filled for a period of at least 24 hours to allow for absorption and initial settlement. After the initial period, makeup water shall be added as required and the tank shall be allowed to stand for a minimum of 24 hours to allow swell and slosh to abate.

2. Measure the drop in liquid level over the next 72 hours. The net liquid loss for a period of 72 hours shall not exceed 1/20th of 1 percent of the tank capacity (0.0005 x tank volume) after allowance for evaporation.

3. If the measured liquid loss exceeds the specified limits, the liquid level test shall be extended to a total of 5 days. If at the end of 5 days the average daily leakage does not exceed the maximum allowable, the test shall be considered satisfactory. If the allowable leakage is exceeded, the test shall be considered unsuccessful, the source of leakage shall be corrected, and the tank shall be retested.

4. Damp spots will not be permitted at any location on the tank wall. Damp spots are defined as spots where moisture can be picked up on a dry hand. The source of water movement through the wall shall be located and permanently sealed in a manner acceptable to the Engineer.

5. Leakage through the wall base joint or footing shall be located and permanently sealed in a manner acceptable to the Engineer. Dampness on the top of the footing will not be construed as leakage as this is generally to be expected and permissible.

6. Survey the edge of the tank dome ring and obtain the elevations at 10-foot intervals around the perimeter of the tank before and after the tank is filled.
7. Contractor shall have the tank inspected by divers.
8. The Contractor shall provide all equipment, labor, and materials necessary to conduct the watertightness test. Additionally, the Contractor shall provide the Engineer with documentation certifying the calibration accuracy of all equipment used in this test.
9. The leakage test, at the Owner's option, may be repeated just prior to the end of the warranty period. If any changes in leakage from the initial test are found, the tank manufacturer shall determine the cause of this change and make corrective repairs. If leakage exceeds the maximum allowable leakage as specified above, the Contractor shall be responsible for all repair costs, including excavation and backfill.
10. All leaks shall be repaired to the satisfaction of the Owner and repairs shall be warranted for a period of **[2]**-year from the date of acceptance of the repairs.

3.12 CLEAN UP

A. The premises shall be kept clean and orderly at all times during the Work. Upon completion of construction, the Contractor shall remove or otherwise dispose of all rubbish and other unsightly material caused by the construction operation. The Contractor shall leave the premises in as good a condition as it was found.

3.13 **[TWO]** -YEAR WARRANTY INSPECTION

A. The Contractor shall observe all surfaces of the tank with the Owner within 23 months after the reservoir Work has been accepted for Substantial Completion and placed in service. If an observation date has not been established within 23 months after the reservoir has been placed in service, the anniversary observation shall be considered waved, except in the event the Owner is unable to remove the reservoir from service due to extremely long dry climate conditions or otherwise adverse weather conditions or due to unexpected breakdowns in the distribution system. The date of anniversary observation may be extended for a period of time not to exceed 18 months beyond the date of Final Completion and acceptance of the Work.

B. The Owner will isolate the tank from the distribution system and drain the tank. The Contractor shall open, clean out, high-pressure water wash and rinse the tank prior to the anniversary observation. After observation of the tank is complete and repair work accepted by Owner, the Contractor shall follow disinfection procedures specified in Paragraph 3.11.A. Disinfection of the tank, after anniversary observation, shall be by Owner as described above should Contractor meet cleanliness requirements.

C. The Contractor shall provide suitable and adequate equipment including, lighting, ventilation, rigging, cable climbers, mirrors, inspection equipment, and sufficient man-power to clean, disinfect and move equipment and tools around the tank, etc., as may be necessary to facilitate complete observation of all interior surfaces. The Contractor shall bear all costs of the anniversary observation and shall incorporate such costs into his Bid. Contractor shall provide digital copies of all photos taken by the Contractor during the warranty inspections within 14 days after the inspection date. The Owner will pay for the water to fill the tank once and the Contractor shall pay for any subsequent water required.

END OF SECTION

DIVISION 40

PROCESS INTEGRATION

40 05 53 IDENTIFICATION FOR PROCESS PIPING AND EQUIPMENT

1.00 GENERAL

1.01 WORK INCLUDED

A. Provide identifying devices for the following:

1. Piping.
2. Equipment.
3. Electrical Equipment.
4. Valves.
5. HVAC equipment.
6. Fire sprinkler and piping.
7. Control devices.

1.02 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00 “Submittal Procedures” and shall include:

1. Product data sheets for identifying devices.
2. A list of where devices are to be installed, and the data to be included on each identifying device.

1.03 STANDARDS

A. The applicable provisions of the following standards shall apply as if written here in their entirety:

1. American National Standards Institute (ANSI) Standards:

ANSI A13.1	Pipe Marking Specifications

1.04 DELIVERY AND STORAGE

A. Store products inside storage sheds until installed.

1.05 GUARANTEES

A. Guarantee Identifying devices installed in wet locations or areas subject to moisture to be weather resistant for a period of 3 years after installation.

2.00 PRODUCTS

2.01 MATERIALS

A. Piping Identification: Pressure sensitive, adhesive-backed vinyl plastic label having the lettering indicated on background color as scheduled. Provide labels manufactured by the

Seton Name Plate Corp. or Brady “Perma Code”. Provide labels having an arrow to indicate the direction of flow. Provide 1-1/4-inch high letters.

B. Outdoor Pipe Markers: Seton “Weather Code” Fade resistant, vinyl markers, 2-1/4 by 9 inches.

C. Valve Identification: Provide Seton Style 2961, 1-1/2-inch round, plastic tag or Style 250-BL Black Filled, 1-1/2-inch round, brass tag with proper identification stamped or incised into plastic on tag. Tag shall have the proper prefix followed by a code number that is unique and identifies the valve from all others in the project. Provide hole in top of tag for mounting chain. Provide brass jack chain, copper metal meter seals, or brass “S” hooks as appropriate.

D. Equipment Nameplate: Seton Style 2060 “Seton-ply” engraved plastic plaque, approximately 3/4 by 2-1/2 inches in size. Plaque shall be 1/16 inch thick having beveled edges and drilled with two mounting holes when attached by screws. Mounting screws shall be stainless steel. Lettering shall be approximately 3/16 inch high. Text to include equipment mark and equipment description (Example: EXHAUST FAN EF-5). Identification label on nameplate shall correspond to a typewritten legend included in the O & M Manual which includes the following:

1. Equipment identifier.
2. Location inside building (or on project site).
3. Manufacturer’s model number.
4. Brief description of function.
5. Reference to shop drawings, parts lists, or other data included in the O & M Manual.

E. Fire Sprinkler System Signs: Signs for fire protection system shall conform to NFPA-13 and shall be equal to Seton Style SFB, furnished in porcelain with “white on red” color.

3.00 EXECUTION

3.01 PREPARATION

A. Install piping complete with insulation and valves in place prior to installing identification devices. Mount electrical components, including electrical control devices. Piping shall be dry and free of oil, grease, or other contaminants. Insulation shall be completely dry.

3.02 INSTALLATION

A. Install pipe labels on piping exposed to view, in any location inside buildings or structures, or in underground vaults, pump stations, basements, or other exposed locations.

B. Install a minimum of one label in each area or room and additional labels at spacings not to exceed 5 feet. Position labels so that lettering is visible from the front of piping at floor level. Provide labels of a size that is legible from floor level. Install labels in rows with uniform spacings where several pipes run parallel to each other.

C. Name the fluid flowing inside the pipe on color coded labels with text per the schedule below. Labels shall also include an arrow indicating the direction of flow.

3.03 VALVE IDENTIFICATION

A. Install a valve tag on all valves. Attach the tag to hand wheel of valve stem so that it does not interfere with operation of valve tag brass link chains or copper meter seals furnished by the Tag Manufacturer.

B. Number valves to correspond to a typewritten list included in the Operational and Maintenance Manual and include the following information:

1. Valve Number.
2. Description of piping fluid or purpose.
3. Normal position of valve (Open or Closed).
4. Manufacturer's catalog number.
5. Brief description of valve specification.
6. Brief description of valve's function in the system.

C. Valve identification shall be based on the following example:

Valve Number	Function	Location	Normal Position	Mfg's Cat No.	Valve Type	Description
P-1	Domestic Water	Rm. 103	Open	Crane Fig. 315C	Gate rising stem	Shut off to heater

3.04 EQUIPMENT IDENTIFICATION

A. Provide an equipment identifier on each separate piece of equipment, including process equipment, HVAC equipment, plumbing equipment (other than plumbing fixtures), and electrical equipment. Provide a nameplate for each separate piece of electrical equipment, including but not limited to panelboards, switchgear, starters, disconnects, control devices and control panels. Provide name tags for each separate switch, starter, contactor, or other compartment on electrical switchgear.

B. Engrave lettering on nameplates corresponding to the identification marks. Install nameplates prominently on equipment not occurring in occupied spaces. Install nameplates on the inside covers of lighting panelboards. Install nameplates on all other equipment centered and at top of equipment. Nameplates shall not be installed in a location that interferes with the equipment's ability to operate.

C. Attach nameplates to exterior equipment with two 3/8-inch stainless steel screws. Interior plaque may be attached by screws, or by the adhesion method when approved by the Engineer.

3.05 ELECTRICAL OUTLET

A. Provide a nameplate for electrical outlet listed below. The nameplate shall be white letters on red background, and shall specify the outlet's voltage and ampere rating. The nameplate on special outlets shall have an appropriate warning. Lettering shall be 1/8 inch high. Overall plate size shall be approximately 3/4 by 2-1/2 inches.

B. Provide nameplates on the following:

1. 208/240 outlet: voltage and ampere rating.

2. Special outlet: voltage, ampere rating and intended function (Example: Welder Outlet 240 V – 40 A).

3.06 POTABLE AND NON-POTABLE WATER

A. Provide name tags at every water hydrant or outlet. Fabricate name tags of 3/4-by-1-1/2-by-1/8-inch aluminum with a medium, duranodic finish and plexiglas face panel. The face panel shall have 1-inch high, white, helvetica medium lettering on blue background stating "Potable Water", or white lettering on green background stating "Non-Potable Water". Place signs on walls above the hydrant locations and attach to backplates. Yard hydrants shall have concrete piers which are 6 inches in diameter by 36 inches with signs attached to the face of the concrete directly in front of the hydrants. Extend the piers 4 inches minimum above finish grade. Signs shall be manufactured by Vomer Products, Inc., equal to Vocator Exterior sign series E9/12.

3.07 SCHEDULES

A. Prepare a typed schedule showing piping label requirements, valve tag identification, and equipment tags. Include each valve or piping type and the appropriate identification on the schedule. Submit the schedule to the Engineer for approval.

B. Mark valve tags and pipe labels to conform with the following legend, or with requirements of standards noted. Include the full name, as appearing under the column heading "Description", and the abbreviation under the column heading "Abbrev. Legend."

Description	Valve Prefix	Abbrev. Legend	Label Color (Letter on Background)
Plumbing			
Sewer, Sanitary	W	SW	Black on Green
Sewer, Storm	SS	SS	Black on Green
Waste, Drain	W	DP	Black on Green
Waste, Acid	W	AW	Black on Yellow
Water, Domestic, Cold	P	CW	Black on Green
Water, Domestic, Hot	P	HW	Black on Yellow
Water, Domestic, Ret.	P	HWR	Black on Yellow
Water, Distilled	P	DW	Black on Green
Water, Non-potable	N	NPW	Black on Green
Fire Protection			
Fire Protection, Mains	F	FM	White on Red
Fire Protection, Sprinkler	F	FS	White on Red

Description	Valve Prefix	Abbrev. Legend	Label Color (Letter on Background)
Gas Piping			
Natural Gas	G	NG	Black on Yellow
Fuel Gas	G	NG	Black on Yellow
Acetylene	G	AC	Black on Yellow
Argon	G	AG	White on Blue
Hydrogen	G	HG	Black on Yellow
Nitrogen	G	NI	Black on Green
Nitrous Oxide	G	NO	White on Blue
Methane	G	MT	Black on Yellow
Oxygen	G	OX	Black on Yellow
Compressed Air	G	CA	White on Blue
Instrument Air	G	IA	White on Blue
Vapor	G	VG	Black on Yellow
Vacuum	G	VP	White on Blue
HVAC			
Refrigerant, Suction	H	RS	Black on Green
Refrigerant, Liquid	H	RL	Black on Green
Chilled Water	H	CW	Black on Green
Chilled Water Ret.	H	CWR	Black on Green
Hot Water	H	HW	Black on Yellow
Hot Water, Ret.	H	HWR	Black on Yellow
Condensate	H	CD	Black on Green
Process Piping			
Lime	PP	LI	White on Green
Chlorine	PP	CH	Black on Yellow
Ammonia	PP	AM	Black on Yellow
Primary Effluent	PP	PE	White on Green
Primary Sludge	PP	PS	White on Green
Raw Sewage	PP	SR	White on Green
Recir. Sewage	PP	RS	White on Green
Recir. Sludge	PP	RR	White on Green
Thickened Sludge	PP	TS	White on Green
Activated Sludge	PP	AS	White on Green

Description	Valve Prefix	Abbrev. Legend	Label Color (Letter on Background)
Electrical			
Panelboards	LP-1		White on Black
Starters for Exhaust Fan	S/EF-1		White on Black
Control Panels for Exhaust Fan	CP/EF-1		White on Black
Disconnects for Exhaust Fan	DS/EF-1		White on Black
Junction Boxes	JB/101		White on Black
Controllers for Exhaust Fan	CI/EF-1		White on Black

C. Piping Color Schedule:

Description	Pipe Color
Potable Water	Light Blue
Compressed Air	Light Green
Instrument Air	Light Green with Dark Green Bands
Chlorine (gas, liquid, or vent)	Yellow
Chlorine (solution)	Yellow with Red Bands
Liquid Alum	Yellow with Orange Bands
Alum (solution)	Yellow with Green Bands
Ammonia	Yellow with Brown Bands
Chlorine Dioxide (solution)	Yellow with Blue Bands
Ferric Chloride	Brown with Red Bands
Ferric Sulfate	Brown with Yellow Bands
Polymers	White with Green Bands
Liquid Caustic	White with Red Bands
Caustic (solution)	White with Orange Bands
Fluoride	White with Yellow Bands
Ozone	Stainless Steel with White Bands
Settled Water	Green
Filter Effluent	Light Blue
Backwash Supply	Light Blue
Drain	Dark Grey
Raw Water	Tan

END OF SECTION

40 05 56 PROCESS VALVES FOUR-INCH AND SMALLER

1.00 GENERAL

1.01 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install valves smaller than four-inch diameter, and appurtenances, complete and operational.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before valves Work.

C. Related Sections:

1. Section 09 91 00, Painting.

2. Section 33 05 01.09 Polyvinyl Chloride (PVC) Pressure Pipe and Fittings

1.02 REFERENCES

A. Standards referenced in this Section are listed below:

1. American Bearing Manufacturers Association (ABMA).

2. ANSI B16.1, Cast-Iron Pipe Flanges and Flanged Fittings.

3. ANSI B16.34, Valves-Flanged, Threaded and Welding end. (ASME B16.34).

4. ANSI/NSF 61 Drinking Water Components – Health Effects.

5. API STD 594, Check Valves, Flanged Lug, Wafer and Butt-Welding.

6. API STD 598, Valve Inspection and Testing.

7. API STD 609, Butterfly Valves: Double Flanged, Lug-Type and Wafer-Type.

8. ASTM A126, Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.

9. ASTM A193/A193M, Specification for Alloy-Steel and Stainless-Steel Bolting Materials for High-Temperature Service.

10. ASTM A194/A194M, Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service, or Both.

11. ASTM A240/A240M, Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
12. ASTM A276, Specification for Stainless Steel Bars and Shapes.
13. ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
14. ASTM A351/A351M, Specification for Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts.
15. ASTM A380, Practice for Cleaning, Descaling and Passivation of Stainless-Steel Parts, Equipment and Systems.
16. ASTM A536, Specification for Ductile Iron Castings.
17. ASTM A564/A564M, Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless-Steel Bars and Shapes.
18. ASTM A743/A743 M, Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.
19. ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.
20. ASTM B98/B98M, Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.
21. ASTM B138/B138M, Specification for Manganese Bronze Rod, Bar and Shapes.
22. ASTM B265, Specification for Titanium and Titanium Alloy Strip, Sheet and Plate.
23. ASTM B584, Specification for Copper Alloy Sand Castings for General Applications.
24. ASTM D429, Test Methods for Rubber Property - Adhesion to Rigid Substrates.
25. AWWA C500, Metal-Seated Gate Valves for Water Supply Service.
26. AWWA C501, Cast-Iron Sluice Gates.
27. AWWA C502, Dry-Barrel Fire Hydrants.
28. AWWA C504, Rubber-Seated Butterfly Valves.
29. AWWA C507, Ball Valves, 6-inch through 48-inch.
30. AWWA C508, Swing-Check Valves for Waterworks Service, 2-inch through 24-inch NPS.
31. AWWA C509, Resilient-Seated Gate Valves for Water Supply Service.
32. AWWA C540, Power-Actuating Devices for Valve and Slide Gates.

33. AWWA C550, Protective Interior Coatings for Valves and Hydrants.

34. AWWA Manual M49, Butterfly Valves: Torque, Head Loss, and Cavitation Analysis.

35. FS TT-C-494, Coating Compound, Bituminous, Solvent Type, Acid-Resistant.

36. NEMA MG 1, Motors and Generators.

1.03 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Manufacturer shall have minimum of five years of experience producing substantially similar materials and equipment to that required and be able to provide evidence of at least five installations in satisfactory operation for at least five years.

2. Each type of valve shall be the product of one manufacturer.

B. Component Supply and Compatibility:

1. Obtain each type of equipment and appurtenances included in this Section, regardless of the component manufacturer, from a single manufacturer of the type of valve. For each type of valve, do not furnish valves of more than one manufacturer.

2. Supplier of each type of equipment specified shall review and approve or prepare all Shop Drawings and other submittals for all components associated with the type of valve Supplier is furnishing.

3. Components shall be suitable for use in the specified service conditions. Components shall be integrated into the overall assembly by the valve manufacturer.

1.04 SUBMITTALS

A. Contractor shall submit working drawings, shop drawings and material specifications for the approval of the Engineer in accordance with the requirements of the General Conditions, Article 4 – Contractor's Working Drawings, Design and Shop Drawings. Working drawings and shop drawings shall include, but not be limited to:

B. Working Drawings:

1. Product data sheets for make and model.

2. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.

3. Power and control wiring diagrams, including terminals and numbers.

4. Manufacturer's qualifications.

5. Confirmation of suitability of the valve materials for the application.

6. Complete motor nameplate data.

7. Certificates of compliance with AWWA Standards where applicable.

8. Spare Parts List.

9. Special Tools List.

10. Valve manufacturer(s) certified test results of shop testing specified in the Detailed Specification shall be submitted for all valves.

C. Operation and Maintenance Data: Submit complete manuals including:

1. Copies of all Shop Drawings, test reports, maintenance data and schedules, description of operation, and spare parts information.

1.05 SPARE PARTS

A. Provide one spare valve for every five valves installed for each different type and size of valve.

1.06 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling, and Unloading:

1. Deliver materials and equipment to Site to ensure uninterrupted progress of the Work. Deliver anchorage products that are to be embedded in concrete in ample time to prevent delaying the Work.

2. Inspect boxes, crates, and packages upon delivery to the Site and notify ENGINEER in writing of loss or damage to materials and equipment. Promptly remedy loss and damage to new condition in accordance with manufacturer’s instructions.

B. Storage and Protection:

1. Keep products off ground using pallets, platforms, or other supports. Store equipment in covered storage and prevent condensation and damage by extreme temperatures. Store in accordance with manufacturer's recommendations. Protect steel, packaged materials, and electronics from corrosion and deterioration.

2.00 PRODUCTS

2.01 GENERAL

A. Valve Materials:

1. Valve materials shall be suitable for the associated valve's service or application, as shown. Chemical services include:

    a. Liquid Ammonium Sulfate – 38 – 40% Concentration

    b. Sodium Hydroxide – 25% Concentration

    c. Sodium Hypochlorite – 12.5% Concentration

2. Protect wetted parts from galvanic corrosion caused by contact of different metals.

3. Wetted components and wetted surfaces of valves used with potable water or water that will be treated to become potable shall conform to ANSI/NSF 61.

4. Clean and descale fabricated stainless-steel items in accordance with ASTM A380 and the following:

    a. Passivate all stainless steel welded fabricated items after manufacture by immersing in pickling solution of six percent nitric acid and three percent hydrofluoric acid. Temperature and detention time shall be sufficient for removing oxidation and ferrous contamination without etching surface. Perform complete neutralizing operation by immersing in trisodium phosphate rinse followed by clean water wash.

    b. Scrub welds with same pickling solution or pickling paste and clean with stainless steel wire brushes or by grinding with non-metallic abrasive tools to remove weld discoloration, and then neutralize and wash clean.

B. Non-ferrous Materials:

1. Non-ferrous materials are materials consisting of mixtures of copper, tin, zinc, lead, or other metals in which iron does not predominate.

2. Non-ferrous materials shall have standard composition and physical properties conforming to ASTM standards except as otherwise indicated.

C. Ferrous Materials:

1. Cast iron valves shall conform to ASTM A126, Class A.

2. Type 316 stainless steel bolts and studs shall conform to ASTM A193, Grade B.

3. Carbon steel bolts shall conform to ASTM A307, Grade A.

D. Valve Joints:

1. Exposed Valves: Unless otherwise specified, provide with flanged ends conforming to ANSI B16.1. Pressure class of flanges shall be equal to or greater than specified pressure rating of the associated valve.

2. Buried Valves: Unless otherwise specified, provide with mechanical or push-on joints, restrained or unrestrained, as required by piping with which valve is installed.

3. For stainless steel bolting, except where nitrided nuts are required, use graphite-free anti-seize compound to prevent galling. Strength of joint shall not be affected by using anti-seize compound.

2.02 MANUFACTURERS

A. The following manufacturers are acceptable. Equivalent products of other manufacturers may be submitted for approval.

B. Solenoid Valves:

1. Plastomatic.

C. Thermoplastic Ball Valves:

1. Spears Manufacturing Co.

2. Hayward Industries, Inc.

3. Asahi/America, Inc.

D. Thermoplastic Check Valves:

1. Spears Manufacturing Company.

2. Hayward Industries, Inc.

3. Asahi/America, Inc.

E. Needle Valves:

1. Stockham Valves and Fitting Company.

2. Lunkenheimer Company.

F. Pressure Reducing Valves:

1. Cla-Val Company.

2. Watts Regulator Company.

G. Pressure Relief Valves:

1. GF Piping Systems,

2. Or equal.

H. Degassing Valves:

1. Plastomatic.

I. Corporation Stops:

1. Mueller Company.

2. A.Y. McDonald Manufacturing Company.

J. Strainers:

1. Hayward Industries, Inc.

2. Or equal.

2.03 VALVES

A. Solenoid Valves:

1. Type: Packless construction with screwed end connections and threaded conduit connection.

2. Materials: PVDF body and wetted parts.

3. Coil: Continuous duty, epoxy encapsulated.

4. Failure Mode: as shown.

5. Electrical Power: 120 volt, 60 Hz, single phase.

B. Thermoplastic Ball Valves:

1. Type: Full port. Vented for sodium hypochlorite service.

2. Joint/Connection Type: True union

3. Body and Ball: Polyvinyl chloride (PVC) compounds, ASTM D 1784.

4. Stem: Type 316 stainless steel.

5. Seats: Teflon.

6. Seals: Teflon.

a. For caustic soda, use Ethylene Propylene Dienne Terpolymer (EPDM) for seals.

7. O-Rings: Teflon.

8. End Connections: Unions or flanged as required.

9. Rating: 150 psig at 73°F.

C. Thermoplastic Check Valves:

1. Type: Ball.
2. Joint/Connection Type: True union
3. Body and Ball: Polyvinyl chloride (PVC) compounds , ASTM D 1784.
4. Seats: Teflon.
5. Seals: Teflon.
    a. For caustic soda, use EPDM for seals.
6. O-rings: Teflon.
7. End Connections: Unions or flanged as required.
8. Rating: 150 psig at 73°F.

D. Needle Valves:

1. Type: Long tapered plug for fine flow regulation.
2. Body and Wetted Parts: Bronze.
3. Handwheel: Malleable iron.
4. Hardware: Type 316 stainless steel.
5. End Connections: Screwed.
6. Rating: 150 psig.

E. Pressure Reducing Valves:

1. Type: Balanced, soft closing, single seat. Constant downstream pressure regardless of upstream pressure or flowrate. Drop tight shutoff when downstream pressure greater than spring setting.
2. Strainer: Integral with the valve, Type 316 stainless steel.
3. Body and Cover: Bronze with pressure gauge taps.
4. Trim: Type 316 stainless steel.
5. End Connections: Screwed.

6. Diaphragm: EPDM, fully guided at top and bottom.

7. Pressures and Flows: As specified in the Detailed Specifications.

F. Pressure Relief Valves:

1. Body: PVC.

2. Seats: Teflon.

3. Seals: Teflon.

4. Spring: Stainless Steel.

5. Pressure: set to 100 psi maximum pressure.

G. Degassing Valves:

1. Body: CPVC.

2. Joint/Connection Type: NPT

3. Seals: Viton.

2.04 APPURTENANCES AND MISCELLANEOUS ITEMS

A. Corporation Stops:

1. Type: AWWA standard tapered thread, ball valve.

2. Material: Bronze.

3. End Connection: Compression with Type 304 stainless steel stiffener rings.

4. Copper Pipe: Threaded flare.

5. Thermoplastic Pipe: Compression with Type 304 stainless steel stiffener rings.

B. Strainers:

1. Type: Y-pattern.

2. Body: Polyvinyl chloride (PVC), true union ends.

3. Screens: PVC, 1/32” size, 2.5 times the inlet area.

4. Seals: Teflon.

a. For caustic soda, use EPDM for seals.

5. Blowoff Port: same size as pipe diameter.

6. Rating: 150 psig at 70°F.

2.05 TESTING

A. All valves and valve sizes shall be tested in accordance with the manufacturer’s standard test procedures.

2.06 PAINTING

A. All valves and appurtenances shall be painted in accordance with Section 09 91 00 Painting.

3.00 EXECUTION

3.01 INSTALLATION

A. All valves and appurtenances shall be installed in accordance with manufacturer's instructions.

B. All valves shall be installed so that operating handwheels or wrenches may be conveniently turned from operating floor without interfering with access, and shall be as approved by the Engineer.

C. All valves shall be installed plumb and level. The valves shall be free from distortion and strain caused by misaligned piping, equipment or other causes.

D. For buried valve installations, the valve boxes shall be set plumb and centered, with carefully tamped to a lateral distance of 4 feet on all sides of the box, or to the undisturbed trench face if less than 4 feet.

3.02 FIELD TESTS AND ADJUSTMENTS

A. All parts and components shall be adjusted as required to provide correct operation.

B. A functional field test of each valve shall be conducted in the presence of the Engineer to demonstrate that each part and all components function together correctly.

3.03 MANUFACTURER'S SERVICE

A. Where required by the Detailed Specifications, the Contractor shall provide the services of qualified factory trained service technicians to check and approve the installation.

END OF SECTION

40 42 13 PROCESS PIPING INSULATION

1.00 GENERAL

1.01 WORK INCLUDED

A. Furnish labor, materials, equipment and incidentals necessary to install piping insulation for exposed piping, valves and fittings on lines as indicated for field piping (generally denoted on C series sheets). This specification does not cover insulation for condensate or refrigerant lines. An exposed line is one that is not buried nor in a building with a controlled environment. Unless otherwise specified, insulation shall be provided from a point 6" below the finished ground and shall be designed for temperatures down to -10° F.

1.02 QUALITY ASSURANCE

A. ACCEPTABLE MANUFACTURERS

1. Knauf Fiberglass
2. Owens/Corning Fiberglass Corporation
3. Pittsburg Corning
4. Armstrong World Industries
5. Imcoa

B. FACTORY TESTING

Insulation shall be tested and listed by U.L. Laboratories and shall have the following minimum properties: flame spread not to exceed 25 and smoke development not to exceed 50. Insulation shall conform to ASTM C-547, Class 1.

C. SUBMITTALS

Submittals shall be in accordance with Section 01 33 00 – Submittal Procedures.

2.00 PRODUCTS

2.01 SYSTEM A - ABOVE GRADE

A. PIPE INSULATION: 1 1/2" thick, heavy density preformed insulation composed of fine glass fiber bonded together with a thermosetting resin molded to form a single longitudinal seam. Insulation shall have a vapor barrier jacket, sealed with an adhesive self-sealing lap feature with a minimum 2" overlap. An outside protective jacket made of sheet aluminum not less than 0.016" in thickness with integral vapor barrier, shall be installed over the insulation.

B. PIPE FITTINGS, VALVES, AND ACCESSORIES: Fittings, valves, and accessories, except moving parts, shall be insulated using preformed fiberglass fittings or mitered sections of pipe insulation. The insulation shall be of the same thickness as the adjacent pipe insulation with matching aluminum jacket.

3.00 EXECUTION

3.01 PREPARATION

A. Outer surfaces shall be clean and free of dust or other materials. Test pipe for leaks prior to insulation application.

3.02 INSTALLATION

A. Insulation shall be installed by qualified personnel in accordance with the Manufacturer's recommendations.

B. Apply insulation over clean and dry pipe. Exposed piping shall have continuous insulation. Position longitudinal lap downward to avoid dirt and moisture infiltration.

C. Completely seal joints along the longitudinal seam and apply to shed water. Seal circumferential joints using preformed butt strips, minimum 2" wide. Butt strips shall overlap adjacent jacketing a minimum of 1/2". Seal and cover insulation with an aluminum jacket. Secure jacket and butt strips using 1/2" bands and seals. Spacing of bands shall be as recommended by the Manufacturer.

END OF SECTION

40 92 13.14 PUMP CONTROL BALL VALVES

1.00 GENERAL

1.01 WORK INCLUDED

A. Re-Pump Station

1. Furnish labor, materials, equipment and incidentals necessary to design, manufacture, fabricate, test, and deliver a total of five (5) Pump Control Ball Valves with electric motor operators to be used in the Re-Pump Station. Pump Control Ball Valves shall be either resilient seated ball valves or metal seated ball valves and meet requirements for AWWA C507. Five (5) identical units shall be furnished for the Pump Station and shall be designated as:

   - RPS-P1-BV (Deductive Alternate)
   - RPS-P2-BV
   - RPS-P3-BV
   - RPS-P4-BV
   - RPS-P5-BV

   The Owner may elect to utilize a deductive alternate to eliminate one pump control ball valve and electric motor operator from the Contract. The designated pump control ball valve and electric motor operator to be deleted by this deductive alternate will be RPS-P1-BV.

2. The Installation Contractor shall furnish all labor, materials and equipment including but not limited to flange bolts, nuts, gaskets, and interconnecting wiring as required for the proper functioning of the complete system, including the valve control panels.

3. The electric motor operator Manufacturer shall act as a subcontractor to the Valve Manufacturer. The Valve Manufacturer shall be responsible for the proper function of the entire Pump Control Ball Valve System.

4. Potable water pumped at the Re-Pump Station is treated with chloramines and caustic. The valve materials shall be compatible with the fluid and chemicals being pumped.

1.02 QUALITY ASSURANCE

A. Acceptable Metal-Seated Ball Valve Manufacturers

1. Henry Pratt
2. VAG – GA Industries, Inc.
3. Dezurik – Apco Willamette

B. Acceptable Resilient-Seated Ball Valve Manufacturers

1. VAG – GA Industries, Inc.

C. Acceptable Motor Operator Manufacturers are as follows:

1. AUMA

2. E.I.M
3. Limitorque
4. Rotork

D. Experience Requirements

1. The Pump Control Valves shall be the latest product of a manufacturer who has been regularly engaged in the production of equipment of the type and size specified for at least ten (10) years.
2. If required by the Engineer, the manufacturer shall provide satisfactory evidence of installations of similar equipment which have been in operation for a minimum of three (3) years.
3. Attention is directed to the fact that the Pump Control Valve/electric motor operator System is an integrated system and, as such, shall be designed and furnished by one (1) manufacturer who shall provide all of the equipment and appurtenances and be responsible for satisfactory design and operation of the entire system.

E. Factory Testing

1. Ball valves and operators shall be completely assembled at the factory, adjusted for correct seating, and tested as an assembly and in accordance with the AWWA C507 standards. Factory adjustments and operational tests shall be performed on each valve with the valve oriented in the same position as the installed field position. The valves shall be cycled five times (full open to full close) and successfully seat tested each cycle to certify proper seating (five individual seat tests per valve). Seat adjustments and manual indicators shall be set and checked at the factory. Ball valves and operators shall be factory tested for satisfactory performance at the maximum operating and differential pressures indicated in the valve schedule in Section 3.04 of this specification. Ball valves shall be tested for drop-tight performance at the minimum and maximum pressure differentials shown in the valve schedule in Section 3.04.
2. Document serial number on valve at time of testing and reflect in certified test reports furnished to the Engineer.
3. Identification plate must be permanently affixed to valve and operator prior to hydrostatic testing.
4. Valve hydrostatic tests shall be conducted as per AWWA C507 for all pump control valves.
5. The operators and Ball Valves shall be assembled and fully tested at the manufacturer's facility to verify proper mechanical, electrical and control design, operation, and coordination. A completed, dated, and signed copy of the detailed test procedure shall be shipped with each piece of equipment for verification of start-up settings.
6. During the factory testing the complete electric motor operator and Ball Valve assembly shall operate as specified.
7. The Owner reserves the right to provide one (1) or more witnesses at its own expense to observe the operational tests of the operator valve assembly, seat tests or hydrostatic tests. The valve manufacturer shall advise the Owner as to the location and time of the testing one (1) month prior so that the Owner can be present if he so elects.

8. Limit switches, seat adjustments, stops and functions shall be set and checked at the factory. Limit switches shall be set per the project requirements and verified during operation of the valve at the factory. Provide Certified Test Reports.
9. Valve, motor operator, limit switch and junction box shall all be factory tested as one complete unit. Manufacturer shall provide detailed test protocol for Engineer's approval prior to testing.
10. The manufacturer shall make thorough visual inspection and perform ultra-sound tests on all valve ball and valve body castings before assembly.
11. The manufacturer shall conduct ultrasound testing of each valve ball and valve body and certify there are no defects within the ductile iron material in accordance with the following test procedures.
    a. The testing will be performed using a hand-held ultrasonic velocity/thickness gage that uses pulse-echo techniques to measure material thickness and velocity. The gage will be used as a velocimeter by coupling the transducer to a ductile iron sample of known thickness and performing a velocity calibration. The ductile iron Sample will conform to ASTM A536 Gr. 65/45/12.
    b. A minimum of sixteen readings per body and ball will be taken for valves. The points of measurement should be equally spaced and represent the entire body and ball casting and not limited to one specific area.
    c. Velocity will be read off the gage display, recorded and included as a Certified Test Report. Components with measured velocities of less than .21 in/µS (5300 m/S) will be rejected. The gage will also be used as an ultrasonic thickness gage to confirm the minimum body shell thickness meets the requirements listed in Table 1 of the latest revision of ANSI/AWWA C507.
12. Provide Certified Test Reports for all factory testing.

F. Manufacturer's Representative for Installation, Startup and Testing

1. The services of a competent factory technician shall be provided for whatever period is required to assure proper installation, testing, start-up, and Owner training. The Technician shall be factory trained and have a minimum of 5 years of experience in the installation and adjustment of valves. The minimum time required, per each site, to be on-site for 8-hours, not including travel time, is as follows:
    a. Valve and system installation — 2 days (1 trip minimum)
    b. Valve and system start-up — 5 days (2 trip minimum)
    c. Trouble-shooting — 4 days (2 trip minimum)
    d. Owner training — 1 day (1 trip minimum)
2. Prior to start-up of the equipment the Equipment Manufacturer shall certify to the Owner in writing that the equipment has been properly installed and adjusted for satisfactory operation and all valve limit switches have been set per the project requirements.
3. The Technician shall instruct the Owner's personnel in the proper care, maintenance, adjustment, and operation of the equipment and shall issue a written certification that the equipment has been properly installed. The Technician shall also be on-site during

field pipe pressure testing and startup of valves and shall adjust the limit switches as required.

4. Ball Valve Manufacturer's Representative shall coordinate site visits and be on site with the electric motor operator Manufacturer's Representative.

1.03 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00 "Submittal Procedures" and shall include:

B. Pre and Post-Submittal Meetings:

1. A pre-submittal meeting shall be held before any shop drawings are submitted in offices of the Engineer or Owner in the Houston area (exact location to be determined later). As a minimum the following shall attend the meeting in person:

   a. Installation Contractor,

   b. Valve Manufacturer, operator Manufacturer and Engineer. Representatives from the manufacturers shall include the Project Manager who will be responsible for the project at the factory, no exceptions.

2. Any shop drawings submitted before the pre-submittal meeting will be rejected and sent back Not Approved, Revise and Re-submit. The manufacturer shall bring with them a detailed list of the items their submittal will include for review by the Engineer or a preliminary copy of the actual submittal.

C. Shop Drawings:

1. Shop Drawings shall show standard cut sheets, seat orientation, operator and materials of construction.

2. Drawings shall show complete physical description and performance capabilities of the equipment including, but not necessarily limited to, dimensions, flange ratings, weights, assemblies, sectional views, performance curve, torque or thrust calculations, power requirements and ratings, rated voltages and amperages, system operation, control description, and wiring diagrams as may be applicable.

3. Flow Hydraulic calculations and Cv characteristics certifying the valve can meet all design conditions as specified.

4. Provide project specific wiring diagrams for limit switch wiring with detailed drawing showing how limit switches are physically mounted to valve and wired to limit switch junction box. Provide physical layout of limit switch junction box. Show physical mounting location for limit switch junction box.

5. Motor operator motor data sheet showing voltage, horsepower, full load amps, locked rotor amps, opening/closing times, etc.

6. Weight of all equipment including valves, actuators and operators.

7. Description of valve body seats and ball seats with appropriate ASTM, AWWA, or ANSI material specification.

8. Valve flange pressure rating, flange bolt diameter, and flange bolt orientation

9. A description of the components that will be shipped separately, thus requiring field assembly

10. Both valve and motor operator manufacturer shall submit torque calculations signed and sealed by a professional engineer. Provide torque calculations through the full range of operations for motor operated valves. Submit as record data with the initial shop drawing submittal.

11. When the manufacturer's product differs from the specified requirements and/or catalog description, each point of difference shall be clearly stated. Shop Drawings shall also include a list of similar installations which have been in service a minimum of 3 years, catalog data, materials of construction, weights, dimensions, and assembly drawings, which show seat orientation, and operator orientation.

12. Provide an electronic 3-dimensional model file of the valve including the operator system. Provide file compatible with AutoCAD, Inventor, or Revit software and will be used for inclusion in the project process piping model.

D. Operation and Maintenance Manuals

1. Manuals shall be prepared by the equipment manufacturers per Section 01 78 23, "Operations and Maintenance Data", and shall include storage and installation instructions, operation and maintenance procedures, appropriate final certified shop drawings, wiring diagrams, all Certified Test Reports, all Equipment Installation Reports, and parts listings. Manuals may be the Manufacturer's standard instructions, but shall be supplemented as necessary to cover any special feature not included in standard material. Submit preliminary manuals for review prior to delivery of the equipment.

E. Certified Test Reports

1. Submit certified test reports for factory performance tests and hydrostatic tests.

F. Equipment Installation Report

1. Submit Equipment Installation Reports from the valve supplier and Electric motor operator system supplier.

G. Recommended Spare Parts List

1. Submit a recommended spare parts list with break out pricing for the entire package including balls, seats, actuator and motor operators.

1.04 STANDARDS

A. The applicable provisions of the following standards shall apply as if written here in their entirety:

1. American National Standards Institute (ANSI):

American National Standards Institute (ANSI)	
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings
ANSI B16.47	Pipe Flanges and Flanged Fittings
ANSI/NSF 60	Drinking Water Treatment Chemicals
ANSI/NSF 61	Drinking Water System Components

2. American Society for Testing and Materials (ASTM)

American Society for Testing and Materials (ASTM)	
ASTM A48	Standard Specification for Gray Iron Castings
ASTM A126	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A322	Specification for Steel Bars, Alloy, Standard Grades
ASTM A536	Standard Specification for Ductile Iron Castings
ASTM A564	Standard Specification for Hot-Rolled and Cold-Finished Age Hardening Stainless Steel Bars and Shapes

3. American Water Works Associations (AWWA):

American Water Works Associations (AWWA)	
AWWA C507	Standard for Ball Valves 6 inch through 48 inch
AWWA C542	Standard for Electric Motor Operators for Valves and Slide Gates

4. National Electric Manufacturers Association (NEMA).
   a. Electrical equipment and valve control panels shall conform to applicable NEMA Standards and shall be best quality for the industry and trade practice.

1.05 WARRANTY

A. Equipment Manufacturer shall warrant the equipment furnished under this Specification for a period of two (2) years against defects in materials and workmanship, equipment design, and operational failure.

B. Owner will remove and load the equipment on a vehicle provided by the Equipment Manufacturer if it is necessary to return the equipment to the manufacturer for correction of defects during the Warranty Period. Owner will reinstall the equipment when it is returned to the site after defects have been corrected. The Equipment Manufacturer is to provide all parts, labor, and incidental cost for making repairs, shipping the equipment to the site, and providing startup services.

C. The Warranty Period shall be interpreted as the twenty-four (24) month period following the installation, adjusting and acceptance testing, and the start of actual operation of the equipment.

1.06 OPERATING DETAILS

A. GENERAL

1. The pump control valves shall provide controlled opening and closing speeds designed for pump discharge service, as specified. The pumps will be started and stopped against a closed valve imposing full pump shut-off head on the valve when closed. Power for actuating the valve will be from the specified operator system.

2. The valves are to function as automatic pump discharge control valves, designed to operate in such a manner that surges due to starting and stopping of the pumps or power failure will be minimized.

1.07 DELIVERY AND STORAGE

A. The electric motor operators and pump control valves shall be delivered to the job site in good condition and free of defects. The Installation Contractor shall follow all requirements as stated in the manufacturer's instructions for intermediate and/or long-term storage as appropriate. The electric motor and pump control valves shall be stored indoors.

B. The pump control valves shall be completely assembled, requiring only electrical power, connection to electrical control circuits, by the Installation Contractor. The Installation Contractor shall furnish and install field control wiring.

C. All openings and/or connections for the Electric motor system shall be sealed prior to shipment. All field connection ports shall be clearly labeled.

D. All accessories shall be clearly labeled. Valve rotation direction shall be labeled.

2.00 PRODUCTS

2.01 GENERAL

A. The pump control valves, electric motor operator, and associated appurtenances shall be of first class quality and finish, entirely suited for the purposes intended and for operation per this specification. The electric motor operator system shall be designed to operate the valve over the full range of head conditions.

2.02 VALVE SCHEDULE

A. The valves required are indicated on the valve schedule in Section 3.04.

2.03 RESILIENT SEATED BALL TYPE PUMP CONTROL VALVES

A. GENERAL

1. The ball valves shall be resilient seated type valves with flanged-ends. The flanges shall be suitable for the appropriate pressure rating of the valves as indicated in the attached schedule. The valves shall be drop tight at the minimum pressure differential designated in the valve schedule. Valves shall be full port, single seated and pressure rated for the intended service. The ball valves shall be installed so that the seats are located on the pump side of the valves. The ball valves shall be the latest standard product of a manufacturer regularly engaged in the production of equipment of this nature and shall conform to the requirements specified herein. Ball valves shall be VAG-Golden Anderson Resilient-Seated Rotary Ball Valve.

2. The ball valves shall be furnished complete with operating mechanisms, controls and accessories as specified and needed for satisfactory operation.

3. Liberal safety factors shall be used throughout, especially in the design of parts subject to intermittent or alternating stresses. In general, working stresses shall not exceed one-third of the yield point or one-fifth of the ultimate strength of material. Bearing pressures shall not exceed 2,000 psi.

B. VALVE DESCRIPTION

1. Rotary valves shall be fully ported and shall meet or exceed the design requirements of AWWA Standard C507. The valves shall be suitable for tight shut-off at the rated pressure. The valves shall consist of four main parts:
    a. A body assembly with full, unrestricted, circular inlet and outlet ports equal to the rated size of the valve.
    b. A movable rotor having a full, unrestricted, circular opening equal to the rated size of the valve.
    c. An enclosed drive mechanism, attached to the body assembly, used to create a rotary movement of the rotor from the action of the operator.
    d. An operator which is attached to the drive mechanism and is used to power the valve open and closed.

C. VALVE BODY

1. The valve body shall be constructed of ductile iron, ASTM A536 Gr 65-45-12, or cast steel ASTM A216-WCB. The valve body shall be a one-piece casting with integral inlet and outlet flanges; two-piece body assemblies and/or bolt-on flange adapters are not acceptable. The valve body shall include integral mounting pads for supporting the weight of the valve body. All flanges shall be suitable for the pressure rating of the valve.
2. The valve shall be provided with a cover plate on which the operating mechanism is mounted. It shall be possible to remove the rotor from the valve body through the cover port without removing the valve body (or portion thereof) from the pipeline. The valve shall also be provided with a separate seat access cover that permits inspection, adjustment, and/or replacement of the rotor seat ring without requiring the removal of the rotor from the valve body or removal of the valve body from the pipeline.
3. Sleeve bearings shall be provided on both top and bottom rotor trunnions and shall be constructed of bronze or stainless steel. Rotor sleeve bearings shall be mated with bronze or stainless steel bushings mounted in the body assembly. Thrust bearings shall also be provided for both top and bottom rotor trunnions and shall be constructed of bronze or stainless steel.
4. Where the rotor trunnions pass through the body assembly, O-ring seals of Buna-N or other suitable AWWA material shall be provided.
5. Equip with four (4) 1-inch diameter threaded (NPT) taps, two upstream and two downstream of the ball, for pressure sensing devices and gauges. These connections shall be provided with removable steel plugs by the manufacturer.
6. Provide one (1) additional 1" diameter threaded tap (NPT) for a drain connection. This connection shall be provided with a removable steel plug by the manufacturer.

D. VALVE BALL

1. The rotor shall be constructed of ductile iron, ASTM A536 Gr 65-45-12 or cast steel A216-WCB. Two integrally cast trunnions shall be included on the axis of rotation. The rotor shall include a resilient, replaceable seat assembly for tight shut-off at the rated pressure.

2. The rotor shall be connected to the drive mechanism by means of an 18-8 stainless steel shaft securely attached to the rotor trunnion. Plated steel shafts are not acceptable. Shaft design shall transmit torsional force only to the rotor; the shaft shall not act as a bearing surface for side loads created by hydrodynamic forces in the valve.

3. The ball trunnions shall be fitted with bronze or Teflon bearings of sufficient difference in hardness from the body bushings to eliminate seizing and galling.

4. O-rings and packing material shall be resistant to chlorine, ammonia and chloramine compounds.

E. TORQUE UNIT

1. The torque unit (valve operating mechanism) shall be the product of the valve manufacturer. The assembly shall be mounted and attached to the valve body. The torque unit shall be designed to accept the motor operator. The torque unit housing shall be of ductile iron, ASTM A48 or A395, Class 35 or steel construction. Torque unit shall be the direct-drive worm gear type with field adjustable stops to prevent over travel in the open or closed positions. All gearing shall be totally enclosed and shall be pre-lubricated or grease packed.

2. All materials of the torque unit subject to rubbing shall be of different hardness. The torque unit shall be capable of being inspected, lubricated, removed and repaired without removing the valve proper from the line. The torque unit shall also be designed so that the packing on the main shaft can be replaced without removing the torque unit housing and while the valve is in the line under pressure.

F. VALVE SEATS

1. A bronze or stainless steel body seat ring shall be securely fastened to the valve body

2. The valve shall employ a hydraulically activated seating arrangement to minimize wear of the resilient rotor seat. The rotor seat shall be a resilient, replaceable seat ring of UHMW Polymer, Phenolic Laminate, or other resilient material suitable for the service conditions. The resilient seat ring shall be attached to an austenitic ductile iron, bronze, or stainless steel seat retainer by means of a bronze or stainless steel follower ring. The seat ring/retainer assembly shall move along adjustable tramming bolts in response to system hydraulic forces. When in the closed position, downstream static pressure shall move the seat ring/retainer assembly against the body seat to effect a tight seal. When opening, pump discharge pressure shall move the seat ring/retainer assembly away from the body seat to minimize seat ring wear when the rotor is turned. Seating and unseating torque requirements shall be significantly reduced to ensure smooth valve operation. The seating load shall be adjustable by means of the tramming bolts.

2.04 METAL SEATED BALL TYPE PUMP CONTROL VALVES

A. GENERAL

1. The ball valves shall be metal seated type valves with flanged-ends. The flanges shall be suitable for the appropriate pressure rating of the valves as indicated in the attached schedule. The valves shall be drop tight at the minimum pressure differential designated in the valve schedule. Valves shall be full port, double seated and pressure rated for the intended service. The ball valves shall be the latest standard product of a

manufacturer regularly engaged in the production of equipment of this nature and shall conform to the requirements specified herein.

2. The ball valves shall be furnished complete with operating mechanisms, valve control panel and accessories as specified and needed for satisfactory operation.

3. Liberal safety factors shall be used throughout, especially in the design of parts subject to intermittent or alternating stresses. In general, working stresses shall not exceed one-third of the yield point or one-fifth of the ultimate strength of material. Bearing pressures shall not exceed 2,000 psi.

B. VALVE DESCRIPTION

1. The ball valve shall be of the plug type employing rotary motion only to open and close the valve and shall consist of four main elements: a pressure vessel (body), a rotatable closing element (ball), a torque unit (valve operating mechanism), and a motor operator.

C. VALVE BODY

1. The body shall be constructed of ASTM A536 Grade 65/45/12 ductile iron or cast steel and shall have full, unrestricted circular inlet and outlet, with nominal opening diameter equal to the rated size of the valve. Each valve body shall be provided with flanged ends. All flanges shall be suitable for the appropriate pressure rating of the valves. The body shall have ample sized bronze bearings machined in accurate alignment for reception of the ball trunnions. It shall provide rigid means for supporting the torque unit without the necessity of additional supports. Means shall be provided to prevent entrance of grit into the bearing area.

2. Equip with four (4) 1-inch diameter threaded (NPT) taps, two upstream and two downstream of the ball, for pressure sensing devices and gauges. These connections shall be provided with removable steel plugs by the seller.

3. Provide one (1) additional 1" diameter threaded tap (NPT) for a drain connection. This connection shall be provided with a removable steel plug by the manufacturer.

D. VALVE BALL

1. The ball shall be constructed of ASTM A536 Grade 65/45/12 ductile iron or cast steel, with a full, unobstructed circular waterway with a diameter equal to the rated size of the valve. It shall have trunnion supports or shaft mounted cast integral on the axis of rotation. An extension of one trunnion, called the operating shaft, shall pass through the shaft seal chamber and connect to the torque unit. Shaft mounted balls are also acceptable.

2. The ball trunnions shall be fitted with bronze or Teflon bearings of sufficient difference in hardness from the body bushings to eliminate seizing and galling.

3. The ball shaft shall so be designed that the factor of safety for all combined stresses shall be at least 5 to 1. Maximum torsional deflection shall not exceed 1/16° per foot of unsupported length using a seat coefficient of friction of 0.5 and a bearing coefficient of friction of 0.3. The ball shaft shall be ASTM A564 Type 630, H1150 (17-4 PH) Stainless Steel and shall be turned, ground and polished to a 32 micro-inch finish or better. The ball shaft stuffing box shall contain four (4) rubber O-rings, a cast bronze O-ring retainer

and a stainless steel lock ring. For shaft mounted design, self-adjusting wear compensating Chevron V type packing is acceptable. O-rings and packing material shall be resistant to chlorine, ammonia and chloramine compounds. The box shall be easily repackable, using standard tools, while the valve is in the line and under full operating pressure. Shaft surfaces bearing against shaft seals shall have a 32 micro-inch or smoother finish in accordance with ANSI B46-1.

E. TORQUE UNIT

1. The torque unit (valve operating mechanism) shall be the product of the valve manufacturer. The assembly shall be mounted and attached to the valve body. The torque unit shall be designed to accept the motor operator. The torque unit housing shall be of ductile iron, ASTM A48 or A395, Class 35 or steel construction. Torque unit shall be the direct-drive worm gear type with field adjustable stops to prevent over travel in the open or closed positions. All gearing shall be totally enclosed and shall be pre-lubricated or grease packed.

2. All materials of the torque unit subject to rubbing shall be of different hardness. The torque unit shall be capable of being inspected, lubricated, removed and repaired without removing the valve proper from the line. The torque unit shall also be designed so that the packing on the main shaft can be replaced without removing the torque unit housing and while the valve is in the line under pressure.

F. VALVE SEATS

1. Valves shall be furnished with metal body seats and metal ball seats:

a. The body shall have a monel adaptor metal seat ring. The body seat shall be monel alloy 400 and be machined, ground, and polished for contact with the stainless steel seat mounted on the ball.

b. The ball shall have a stainless steel seat, ASTM A276 Type 316, which shall properly align with the body seat when the valve is in the closed position. The surfaces of the seat ring shall be spherically generated and shall be machined, ground and polished for contact with the body seat.

c. The ball seat shall not thread directly onto the valve ball. The ball seat shall thread directly onto a hardened stainless steel liner, which is pressed or welded on to the ball itself. The stainless steel ball seat shall have an o-ring backup.

d. The ball seat shall be field adjustable and replaceable.

2.05 ELECTRIC MOTOR OPERATORS:

A. General:

1. The valve operators shall be of the reversible motor type. The rate torque capacity of each operator shall be sufficient to seat, unseat, and rigidly hold in any position the valve ball that is controlled under the operating conditions.

2. Operators shall be self-contained units comprising housing, motor reversing contactor, limit switches, torque switches, relays, control transformer, gear train and auxiliary handwheel.

3. Electric motor operators shall comply with AWWA C542 except as herein modified.

4. All electric motor operators specified herein shall be a product of a single electric motor operator manufacturer.
5. Electric motor operators shall be designed for operation in corrosive, wet, 100 percent relative humidity environments having an ambient temperature ranging from minus 30 to plus 70 degrees C.
6. Electric motor operators shall be designed to develop at least 2.0 times the required operating torque of the valves they serve. Both valve and motor operator manufacturer shall submit torque calculations signed and sealed by a professional engineer.
7. Electric motor operators shall be designed for continuous duty for pump control valves.
8. Continuous duty shall be defined as continuous cyclic, forward and/or reverse motion under 100 percent torque output conditions, 24-hours a day, 7-days a week. Cyclic shall be defined as a start in either the forward or reverse direction every 5 seconds (i.e., 720 movements per hour).
9. Electric motor operators shall have control functionality as described herein and shall be factory configured to interface with field control and signal wiring as shown on the Drawings.
10. Actuators shall be of a non-intrusive design, making it possible to set the torque limits, configuration of the indication contacts, and interrogate the data logger without the need to remove any electrical compartment covers.
11. Operator shall move the valve from fully open to fully closed position, or from fully closed to fully open, in 300 seconds. This time of travel shall be based on a geared reducer, not jogging the motor.
12. Valve operators used with electric operators shall only be the worm gear type.

B. Operation (Pump Control Valve)

1. For normal start, once a minimum pressure rise is registered and the dedicated pump flow meter registers that the pump is producing continuously increasing flow through the PCV bypass for a minimum of 5 seconds, the pump control valve will be called to open. The pump control valve will go through a continuous opening sequence from full closed to full open in 5 minutes. The opening time shall be adjustable by password protected access at the pump control valve operator.
2. In the event the pump control valve fails to reach its open limit within 6 minutes (operator adjustable) or an alarm is triggered internal to the actuator such as for over-torque or component fail, then a pump control valve fail alarm shall be initiated.
3. For normal stop, once the normal stop is initiated, the pump control valve will begin to close. The pump control valve will go through a continuous closing sequence from full open to full closed in 5 minutes. The closing time shall be adjustable by password protected access at the pump control valve operator.
4. In the event the pump control valve fails to reach its closed limit within 6 minutes (operator adjustable) or an alarm is triggered internal to the actuator such as for over-torque or component fail, then a pump control valve fail alarm shall be initiated.
5. Once the PCV closed limit switch is activated, the pump is turned off.

6. Valve closed limit switch shall open when the valve lifts from its seat and act as an interlock to prevent a pump starting sequence being initiated unless the valve is seated closed.

7. Valve operator motor shall move the valve from full closed to full open or from full open to full closed in 300 seconds.

8. Provide two (2) limit switches on the valve for remote indication of valve limits. Valve closed limit switch shall open when valve lifts from its seat and valve open limit switch shall close when valve is fully open. Switches will turn-off remote lights and indicate valve is in the fully closed or open position.

9. Limit switches shall be set per the Limit Switch Positions Table shown in the electrical plans. The operator enclosure shall be NEMA 4X. Space heaters with thermostat shall be provided in the enclosure of wattage suitable for keeping the compartment dry at all times. There shall be installed also a suitable breather and drain. A laminated schematic wiring diagram shall be attached and protected from the environment for maintenance use. A terminal strip shall be provided in the switch compartment. Controls and switch compartments shall be shop wired to terminal strip complete and ready for field installation. All wires to terminal strip shall be identified.

10. Valves shall include outputs from the valve that shall include a 4-20 mA signal indicating valve position, and contacts for REMOTE STATUS, OPENED, CLOSED, HIGH TORQUE. Position Transmitter: An internally mounted position transmitter shall be provided with the operator. The position transmitter shall provide a 4-20mA valve position signal for use by the Owner. Transmitter shall be internally powered from the operator.

2.06 PUMP CONTROL VALVE ACCESSORIES

A. POSITION INDICATOR

1. The torque unit shall be fitted with an indicating pointer that is mounted on the outer end of the valve operating shaft extension and shall operate over cast markings on the torque unit cover.

B. VALVE BASES

1. Each valve shall be provided with legs or a pad for support of the valve on the concrete foundation.

C. NAMEPLATES

1. Nameplates shall be engraved metal. Nameplates shall show valve tag number and valve serial number.

2. Valve Control Panel nameplates and designations shall be 2” x 5” minimum, not less than 1/16” thick, engraved laminated plastic. Nameplates shall be 1” high white letters on a black background and shall indicate equipment designation as shown on the Drawings. Nameplates shall be bonded to the enclosure using an epoxy or similar permanent waterproof adhesive.

3. Provide legend plates or 1”x3” engraved nameplates with ¼” lettering for identification of all pilot devices and meters. Legend plates shall be bonded to the enclosure using an epoxy or similar permanent waterproof adhesive.

D. LIMIT SWITCHES

1. Each valve shall be provided with independent limit switches mounted on the valve (operating mechanism) to the ball shaft or shaft extension and as described in the applicable operator specification.

2.07 SHOP PAINTING

A. All ferrous metal unfinished surfaces of each valve and its accessories, both interior and exterior, shall be shop painted for corrosion protection.

B. All exterior surfaces, shall be painted per System No. 2 as specified in Section 09 96 00.01, HIGH PERFORMANCE COATINGS. The prime coatings shall be shop-applied prior to shipment and the final coat shall be shop-applied to match adjacent piping. Between the prime coat and intermediate coat, apply a separate strip coat on all angles, edges, welds, and bolted connections where coating film build will be reduced.

C. All interior surfaces, shall be painted per System No. 1 as specified in Section 09 96 00.01, HIGH PERFORMANCE COATINGS. The prime coatings shall be shop-applied prior to shipment and the final coat shall be shop-applied to match adjacent piping. Between the prime coat and intermediate coat, apply a separate strip coat on all angles, edges, welds, and bolted connections where coating film build will be reduced. Coating shall be NSF approved for potable water. Perform a holiday test and correct all defects. Interior coating shall be applied prior to factory testing. Holiday test coating using high voltage spark testing at a maximum voltage of 125 volts per mil. Wet sponge holiday testing will not be acceptable.

D. Extra paint shall be furnished for field touch-up. Paint shall match adjacent piping.

3.00 EXECUTION

3.01 GENERAL

A. Installation of equipment shall be performed by the Installation Contractor who will be required to assemble the equipment where required and install it in accordance with the Installation, Operation and Maintenance instructions which shall be furnished by the Manufacturer.

3.02 PUMP CONTROL VALVE INSTALLATION

A. Installation Contractor shall receive and unload pump control ball valves for installation at pump station site. Installation Contractor shall assemble the equipment where required and install it in accordance with the installation, operation and maintenance instructions which shall be furnished by the Manufacturer.

B. Install Electric motor operated pump control ball valves at their appropriate locations in the pump station.

C. Furnish and install flange gaskets, bolts, nuts and washers for watertight pipe connections. Do not stress the ball valve when tightening the flange bolts.

D. Installation Contractor shall furnish and install electrical conduit and wiring to the Electric motor operator.

3.03 FIELD QUALITY CONTROL

A. Upon completion of the installation of equipment, an acceptance test to verify the satisfactory installation and operation shall be conducted by the manufacturer's representative. The test shall be conducted in a manner approved and in the presence of the Installation Contractor, Engineer and Owner. Unit shall be checked for excessive noise, alignment, timing, limit switch settings, and general operation. Test for proper valve function and correct interlock with the motor starter. Verify valve operating speed, control for proper opening and closing speeds before operating pumps. Re-adjust valve operating speed with pump in operation. Run all combination of control valve units and control scenarios. The valves must perform in a manner acceptable to the Engineer before final acceptance will be made by the Owner.

B. The Manufacturer's representative shall submit a report of satisfactory valve installation and operation.

3.04 PUMP CONTROL VALVE SCHEDULES

A. Re-Pump Station

	Re-Pump Station Tags: RPS-P1-BV, RPS-P2-BV, RPS-P3-BV, RPS-P4-BV, RPS-P5-BV						
Valve Size, Inches	**Number Required**	**Pressure Class, psi**	**Pump Shut-Off Head, feet**	**Differential Pressure*, feet**	**Operating Pressure Valve Open, feet**	**Minimum Differential Pressure (ft)**	**Max Flow, MGD**
36	5	150	345	305	25-305	10	60

Operation	**Type Operator**	**Full Open/Full Close Operation Time (min)**	**Valve Orientation**	**Valve Seat Location**
Pump Control	Electric motor	Adjustable between 5-10	Horizontal Shaft	Metal-Double Seated Resilient-Single Seated

* Pump shut-off head pressure minus static pressure

B. Miscellaneous Notes:

1. A 25% safety factor shall be applied to the calculated pump control valve thrust prior to the sizing of the operator as specified in applicable section.
2. See pump performance requirements in specification Section 43 23 21.13, "Horizontal Split-Case Centrifugal Pumps" for additional information on expected head conditions during valve travel. Pump shut-off head shall be confirmed with Pump Manufacturer.

END OF SECTION

40 92 13.20 PUMP CONTROL BYPASS VALVES

1.00 GENERAL

1.01 WORK INCLUDED

A. Furnish labor, materials, equipment and incidentals necessary to install and test with all appurtenances and accessories to install pump control bypass valves on discharge piping for the pumps at the Re-Pump Station.

B. The equipment furnished under this specification shall be suitable for use in a potable municipal water system.

1.02 QUALITY ASSURANCE

A. Experience Requirements: Valves shall be the product of a manufacturer who has a least 10 years' experience of successful experience in the design, manufacture and application of pilot operated control valves used in water service.

B. Assembly: The valve, strainers, piping, opening and closing speed control valves and other appurtenances shall be completely assembled, wired and tested at the factory. The valve seats shall be adjusted at the factory for correct seating.

C. Manufacturer's Representative: The valve manufacturer shall furnish the services of a competent service technician for the duration of time necessary to assist in the installation, adjustment and start-up operation, and field acceptance testing. The technician shall instruct the Owner's personnel in the proper care, maintenance, adjustment and operation of the equipment and shall issue a written certification that the equipment has been properly installed.

D. Acceptable Manufacturers: Acceptable valve manufacturers include the following:

1. CLA-VAL Company.
2. Singer.
3. Bermad.

1.03 SUBMITTALS

A. Submittals shall be provided in accordance with Section 01 33 00 "Submittal Procedures" and shall include:

1. Shop Drawings.
2. Operation and Maintenance Manuals.

1.04 STANDARDS

A. The applicable provisions of the following standards shall apply as if written here in their entirety.

1. American Society for Testing and Materials (ASTM) Standards:

ASTM A48	Standard Specification for Gray Iron Castings

ASTM B61	Standard Specification for Steam or Valve Bronze Castings
ASTM B62	Standard Specification for Composition Bronze or Ounce Metal Castings

2. American Water Works Association (AWWA) Standards:

AWWA C530	Standard Specification for Pilot-Operated Control Valves
AWWA C550	Standard Specification for Protective Interior Coatings for Valves and Hydrants

3. American National Standards Institute (ANSI).

1.05 WARRANTY

A. Vendor shall warrant the equipment furnished under this specification for a period of 1 year against defects in materials, workmanship and operational failure from the date of project final acceptance.

B. In the event of failure of any part or parts of the equipment during the first year of operation, the Vendor shall furnish, deliver and install a replacement for the defective part or parts at no additional expense to the Owner.

2.00 PRODUCTS

2.01 MANUFACTURED PRODUCTS

A. General:

1. The valves shall meet NSF, TWDB, and AWWA requirements for potable water service.
2. The valve body shall be angle pattern incorporating in its design two operating chambers, sealed from one another by a flexible diaphragm.
3. Valves shall be diaphragm actuated, hydraulic operated, pilot controlled type, and designed to control starting and stopping surges from the pump. The diaphragm assembly shall be the only moving part and shall be fully guided by bearings in the valve cover and lower operating unit.
4. Valves shall be tight closing, with BUNA-N-Synthetic rubber discs. The discs shall be field replaceable and the valves shall be serviceable inline by removing the cover. Valves shall be drip tight at rated pressures with flow in one direction and shall be satisfactory for applications involving valve operation after long periods of inactivity.
5. Valve body interior and exterior surfaces shall be epoxy resin coated and shall be suitable for high velocity service. The coating shall be applied by the fusion bond method and will be a minimum thickness of 8 mills when complete.
6. Valves shall be equipped with opening and closing speed control by means of an exterior flow rate control valve.
7. Provide piping to convey water expelled from the valve bonnet to floor drains, sumps or as directed by the Owner.

8. The valve body and cover shall be ductile iron in accordance with ASTM A536. The disc guide, seat, and cover bearing shall be bronze in accordance with ASTM B61. Valves shall have pressure rating as indicated on the drawings.

B. Operation:

1. The function of this valve is to act as a non-slam check valve when reverse flow is detected through the pump control valve bypass piping. The valve will be located on the pump control valve bypass piping. The valve opens when the pressure at the inlet exceeds the discharge pressure. A gradual rate of opening prevents sudden opening surges. When a pressure reversal occurs the higher downstream pressure is applied to the cover chamber through the control tube lines, and the valve closes drip tight. Valves shall be Model # 60A-41YBKCKR as manufactured by Cla-Val Company, Newport Beach, CA.:

Material Specifications	
Main Valve body & Cover	ASTM A536
End Connections	150# Fig. Class ANSI Standard B16.42 rated for 250 psi max. working pressure
Main Valve Trim	Brass QQ-B-6265 Bronze ASTM B61
Pilot control system	Cast Brass ASTM B62 with 303 Stainless Steel trim
Rubber parts	Buna-N-Synthetic Rubber
Tubing & Control Piping	Stainless Steel Piping & Fittings

3.00 EXECUTION

3.01 INSTALLATION

A. Install the valve in the pump discharge piping with the valve diaphragm shaft in the vertical position. Make all connections between the valve and the valve pilot. Installation of the valve shall be in accordance with the valve manufacturer's recommendations.

3.02 FIELD QUALITY CONTROL

A. Upon completion of the installation of the equipment, an acceptance test to verify the satisfactory operation of the valve shall be performed. The test shall be conducted in a manner, approved by and in the presence of the Engineer. The valve manufacturer's representative shall be present during the valve acceptance test. The unit must perform in a manner acceptable to the Engineer before final acceptance will be made by the Owner.

3.03 CLEAN AND ADJUST

A. All adjustments will be performed in accordance with the valve manufacturer's instructions.

3.04 SCHEDULES

A. The control valve furnished under this specification shall meet the following requirements:

Number Required	Size (in.)	Pressure Class	Location
5	12	150	Pump Control Bypass

END OF SECTION

DIVISION 41

MATERIAL PROCESSING

AND HANDLING EQUIPMENT

41 22 13.13 BRIDGE CRANES

1.00 GENERAL

1.01 WORK INCLUDED

A. Furnish labor, materials, equipment and incidentals necessary to install bridge crane and hoist assembly as indicated.

1.02 QUALITY ASSURANCE

A. Acceptable Manufacturers, subject to limitations indicated in this specification and the Drawings:

1. Ace Industries, Inc.
2. Konecranes, Inc.
3. OMi Crane Systems, Inc.
4. ProservCrane Group
5. Or approved equal

B. Design Criteria:

1. Crane design, including stress limitations, factors of safety, bearing life and contactor rating, shall be in accordance with the latest edition of CMAA 70 specification.
    a. Duty Classification: Class C (moderate service).
        1). Tolley and Hoist: H3
    b. Service Environment: Interior
2. Equipment shall be in accordance with all safety features required by OSHA standards.
3. Components of each bridge crane shall be designed for not less than the rated capacity indicated on drawings and specified herein.
4. Provide a service platform between bridge crane girders**.** Service platform elevation and configuration shall coordinate with access landing from building structure as indicated on the drawings.

C. Factory Test: Equipment shall be fully assembled, subjected to no-load running tests and dismantled only as required to facilitate shipment.

D. Manufacturer's Representative for Startup and Testing: The services of the Manufacturer's technical representative shall be provided for pre-startup installation checks, startup assistance, training of Owner's operating personnel, troubleshooting and other services as required in Section 01 91 14 "Equipment Testing and Project Startup."

1.03 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00 "Submittal Procedures" and shall include:

1. Product Data.

a. Data sheets for miscellaneous equipment. Data sheets shall clearly indicate the model number being provided.

1). Including but not limited to: disconnect, fuses, cable, pushbutton station, etc.

2. Shop Drawings. Including, but not limited to:

a. Bridge crane cut sheets.

b. Project specific electrical equipment wiring diagrams.

c. Detailed drawing indicated location and elevation of bridge crane service platform compared to access from pump station vault stairwell.

3. Operation and Maintenance Manuals (O&M):

a. Shall be prepared by the bridge crane manufacturer and shall contain the final certified shop drawings, product data submittals, list of manufacturer recommended spare parts, schematics, and maintenance procedures.

1). All field changes made during startup and testing shall be included.

b. Shall include warranty information, including, but not limited to:

1). Warranty start and end date.

2). Contact information for service.

c. May be manufacturer's standard instructions, but shall be supplemented as necessary to cover any special feature not included on standard models.

1.04 STANDARDS

A. The applicable provisions of the following standards shall apply as if written here in their entirety:

AGMA	American Gear Manufacturer's Association
ANSI / ASME B30.2	Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)
ASTM	American Society of Testing and Materials
AWS	American Welding Society
CMAA 70	Crane Manufacturers Association of America, Inc. – Specifications for Top Running Bridge & Gantry Type Multiple Girder Electric Overhead Traveling Cranes
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
OSHA Part 1910.179	Occupational Safety and Health Administration - Overhead and Gantry Cranes
OSHA Part 1926.554	Occupational Safety and Health Administration - Overhead Hoists

1.05 COORDINATION

A. Coordinate location and elevation of bridge crane service platform access with openings in pump station vault walls and stair landings prior to stair shop drawing submittal or affected wall construction.

2.00 PRODUCTS

2.01 GENERAL

A. All components shall be designed and constructed to meet or exceed specified duty class.

B. Wheels shall be hardened. 320 Brinell or better.

1. Tapered or flat tread design as required by the construction documents or referenced specifications.

C. Bearings shall be combined radial and thrust type, double-row, spherical ball bearings, anti-friction type, either pre-lubricated and sealed, or fitted for pressure lubrication.

1. Pressure lubrication fittings shall be located in accessible locations for ease of maintenance.

2. Bearing assemblies shall ensure correct wheel alignment.

D. Heat treated alloy steel axles or pinions shall be supported on each side of the supporting frame.

1. When rotating axles are used, wheels shall be mounted on axles with a press fit and keys, or with keys alone.

E. Gears shall be made from rolled or cast steel, with machine cut teeth.

F. Truck reductions within reach of personnel are to be guarded.

G. Provide electrically operated shoe or disc brakes.

H. Secure rails to the runway beam by bolted rail clips. Hooked bolts are not acceptable.

2.02 BRIDGE GIRDER

A. Construction shall either be of rolled structural shapes, full reinforced, or fabricated box type sections with diaphragms as required to maintain girder stiffness.

B. The girders shall be either unnotched or notched at each end to meet design requirements.

C. End trucks shall be of welded construction and shall provide:

1. Centrally locate wheels in each truck to distribute equal loading to each truck side.

2. Energy absorbing rubber bumpers at each end to operate against runway stops.

3. Rail sweeps in front of bridge wheels.

4. Brakes shall have a 75 percent torque rating and be adjustable .

2.03 TROLLEY

A. Frame shall be of welded construction.

B. Brakes shall have a 50 percent torque rating and be adjustable.

C. Coordinate trolley stops with hook access areas.

1. On north side of pump station adjust stop as required to meet hook access area and to prevent damage to HVAC ductwork that is routed along the inside face of the north wall.

2.04 HOIST

A. Hoists shall be electric, wire rope type, as specified herein.

B. The hoisting machinery shall consist of a rope drum, driven through suitable gear reductions by an electric motor operator, load blocks, hooks, hoisting rope, sheaves, and hoist braking.

C. Hoist gearing shall be enclosed in an oil tight gear case. Bearings and gears shall be splash lubricated and bearings selected to provide a L-10 life or greater.

D. Gear case shall be provided with a bolt-on cover for full access to bearings and gears.

E. The hoist drum shall be cast or welded steel, grooved to take the full length of each cable in one layer.

1. At least two wraps of rope shall remain on the drum when the bottom block is in the lowest position.

F. Hooks shall have:

1. Sufficient ductility to open noticeably before hook failure as a result of overload.

2. Equip hooks with safety latch.

3. Load hook shall be free to rotate 360 degrees with rated load, and shall be positively held in place with locknuts, collars, or other suitable devices.

G. Hoist brake shall be capable of holding the load when power to the hoist motor is off.

H. Equipped with lifting lugs.

2.05 ELECTRICAL EQUIPMENT

A. The crane manufacturer shall furnish and install on the bridge crane:

1. All electrical equipment, including but not limited to, motors, motor starters, pendant control, and conduits, in accordance with Article 610 of NEC, latest issue.

2. All wiring, as much as practical for shipment, in accordance with Section 26 05 00, “Common Work Results for Electrical.”

3. Bridge conductors may be removed for shipment.

B. Refer to scheduled electrical power requirements in table below and power supply from a fused disconnect switch. If larger ampacity is provided as an alternate, then provide, at no cost to the Owner, all required electrical system modifications servicing the bridge crane. This includes, but is not limited to, disconnects, feeders to the equipment, feeders from the switchboard, circuit breaker at switchboard, etc.

1. All modifications required shall be tracked for incorporation into Record Drawings.

C. Motors shall be squirrel-cage type and shall be built in accordance with NEMA Standards, Design D.

D. Bridge conductors shall be of the enclosed bus bar or festooned cable type as indicated herein, and trolley conductors shall be of festooned cable type, as hereinafter specified.

1. Festooned flat, multi-conductor cables shall be, supported by lubricated bearing systems that will dispense and retrieve the flexible conductor cable during trolley travel without twisting, tangling, or causing sharp bends. Provide 20 percent spare conductors in each cable assembly.

E. Controls shall be fully magnetic of the plain reversing type:

1. Housed in NEMA Type 12 enclosure.

2. Logically arranged and neat wiring, secured at each end.

3. Fully marked terminal strips at the bottom of each panel for all external wiring connections.

4. Provide a block operated, upper limit switch.

5. Supply 120 volts AC to the controls.

6. Pushbuttons for control of the entire bridge crane and an ON/OFF switch.

a. Festooned and suspended from a track running the full length of the bridge permitting operation from any point along the span independent of trolley location.

b. Pendant control having momentary contact pushbuttons, and shall be provided with a device which will disconnect motors from the line on failure of power and will not permit any motor to be restarted until the controller handle is brought to the OFF position, or a reset switch or button is operated.

2.06 CRANE INTERCONNECTION WIRING

A. Bridge crane shall be wired in accordance with NEC, Article 610, latest issue. Wiring shall be enclosed in galvanized steel conduit or steel raceway.

B. On cranes which must be disassembled for shipment, conduit runs shall be furnished and made up, wires cut to proper length and tagged. Junction boxes shall be provided at all places where electrical reconnections must be made in the field.

2.07 ACCESSORIES

A. Equipment Identification Plates: Stainless steel identification plates shall be securely mounted on the equipment in a readily-visible locations. The plate shall bear the 1/4-inch die-stamped equipment identification number indicated in the specification and/or shown on the drawings. The equipment identification number shall be mounted on each of the separate components of the equipment to facilitate assembly in the field.

B. Grease Fittings: Manufacturer shall extend all grease fittings into one of the following service platform accessible locations: each end truck or on platform side of trolley.

C. Equipment weighing over 100 pounds shall be equipped with lifting lugs.

D. Chain Hoist: Provide one 3-ton chain hoist. Chain hoist shall have same hook-height as the bridge crane. Provide two eye-brackets on the bridge girder. The chain hoist and eye-brackets shall be designed so that the chain hoist can be installed on either bracket with a reusable pin connection.

E. Service Platform: A service platform shall be located along the full length of the drive girder on the opposite of the bridge festoon. The platform shall have safety rails and shall provide easy access to control panels, grease fittings, trolleys, hoist, motors, etc. The service platform shall be located on the side of the bridge that faces the electrical room and bridge crane access platform. Coordinate the elevation and location of the platform access point with the stairs and platform above electrical room.

3.00 EXECUTION

3.01 PREPARATION

A. Prepare steel substrates to not less than SSPC-SP3.

B. Three coat epoxy system: Manufacturer's standard epoxy system with an inorganic zinc rich primer. Minimum 8 mil total DFT.

C. Finish coat of Manufacturer's standard colors.

3.02 INSTALLATION

A. Carefully handle and install the bridge crane in strict accordance with the Manufacturer's recommendations and as indicated on the plans.

B. The crane shall be provided with the necessary lubrication fittings and lubrication. Before initial startup at final installation, lubricate bearings, gears, etc., in accordance with the Manufacturer's recommendations.

3.03 FIELD QUALITY CONTROL

A. Conduct field tests with the equipment in its installed position. Tests shall include a load test in compliance with OSHA requirements and demonstration to the Owner's Representative that under this load condition, the equipment shall perform satisfactorily throughout the complete range of operation. The unit shall be checked for excessive noise, vibration, alignment, speeds, and general operation. The unit must perform in a manner acceptable to the Owner's Representative before final acceptance will be made by the Owner.

3.04 SCHEDULES

A. General:

Equipment No.	
Equipment Capacity (ton)	25
Electrical Voltage (VAC)	460V, 3-phase, 60Hz

B. Bridge Crane:

Speed (FPM, maximum)	60 FPM Maximum, VFD
Max Motor Horsepower	30
Main Runway Connector Type	Bus Bar
Method of Control	Pendant
Rail Size	ASCE 40/60 (depending on manufacturer)
Main Railway Conductor Type	Duct-O-Bar, 90-amp

C. Trolley:

Type	Motor Driven
Service Class (MMA)	H3
Speed (FPM, Max.)	65 FPM Maximum, VFD
Max Motor Horsepower	2

D. Hoist:

Service Class (HMI)	H3
Speed (FPM)	10 FPM Maximum, Vector
Max Motor Horsepower	3

E. Dimensions:

Maximum Distance From Raised Hook to Finished Floor	21.25
Floor Elevation	94.0
Lowest Required Hook Elevation	94.0
Highest Required Hook Elevation	115.25
Crane Pick Area	See Plans

END OF SECTION

DIVISION 43

PROCESS GAS AND LIQUID HANDLING

43 23 21.13 HORIZONTAL SPLIT-CASE CENTRIFUGAL PUMPING UNIT

1.00 GENERAL

1.01 WORK INCLUDED

A. Furnish labor, materials, equipment and incidentals necessary to design, manufacture, fabricate, test, and deliver a total of five (5) horizontal centrifugal pumping units and electric motor drivers to be used in the Re-Pump Station as a part of the base bid. Five (5) identical units shall be furnished for the Pump Station and shall be designated as:

- RPS-P1 (Deductive Alternate)
- RPS-P2
- RPS-P3
- RPS-P4
- RPS-P5.

The Owner may elect to utilize a deductive alternate to eliminate one pump and motor lineup from the Contract. The designated pump and motor to be deleted by this deductive alternate will be RPS-P1.

B. Pumping units include but are not necessarily limited to: horizontal split-case, double suction centrifugal pump with side suction and side discharge, horizontal motor, coupling, common pump and motor base, spreader bar, anchor bolts and template, electrical, instrumentation, special services, spare parts, and all lubrication and oil. Furnish accessories as required for a complete functioning pumping unit in accordance with the specified performance and installation conditions.

C. For this specification section, the Equipment Manufacturer is defined as the Pump Manufacturer or his designated representative. The Equipment Manufacturer is responsible for supplying and coordinating the design, testing, and installation of the pump and motor. The Equipment Manufacturer shall be responsible for the adequacy and compatibility of the pump and motor. The Motor Manufacturer shall act as a subcontractor of the Equipment Manufacturer. The Motor Manufacturer shall provide a representative capable of coordinating the design, testing, and installation of the motors. The Installation Contractor will install the pumping unit under the supervision and guidance of the Equipment Manufacturer's representative.

D. Pumping unit shall be operated by a variable frequency drive (VFD). The Motor Manufacturer shall issue a letter of compatibility with the VFD Manufacturer, reference Section 26 29 33.01, "Medium Voltage Variable Frequency Drives".

1.02 ACCEPTABLE MANUFACTURERS

A. PUMPS

1. Fairbanks-Morse
2. Flowserve
3. ITT Goulds
4. Patterson
5. Flygt - AC
6. Ebara
7. No other manufacturers will be accepted

B. MOTORS

1. TECO-Westinghouse
2. Baldor (Reliance)
3. National Oilwell Varco (NOV)
4. No other manufacturers will be accepted

1.03 QUALITY ASSURANCE

A. EXPERIENCE REQUIREMENTS

1. Pumping unit shall be the product of manufacturers who have had at least ten (10) years of successful experience in the design, manufacture, and application of pumping units of the type, size, and performance capabilities as specified. The pump manufacturer shall have at least three similar size pumps of the model, type, and size of pump in service and operational for at least five (5) years. It will be acceptable for the manufacturer to meet the pump experience requirements by referencing installations belonging to the pump's heritage line (previous ownership of the pump by a different company). The pumps referenced for the experience requirement shall be the same pump being proposed and the pump shall not have undergone substantial, material changes in engineering, design, and/or hydraulic characteristics. The assembly shall be an existing design that has been manufactured and is in operation. Prototype pumps will not be allowed.

2. Equipment Manufacturer shall maintain a quality assurance system in compliance with ISO 9001:2015 during the life of the contract.

3. All components of the pump and baseplate shall be supplied, assembled, and warranted by one of the approved pump manufacturers. Pump components shall NOT be acquired from separate entities and assembled as a final product by a manufacturer's representative.

B. FACTORY INSPECTION AND TESTS

1. GENERAL

a. Equipment furnished under these specifications shall be subject to inspection during manufacture by a representative of the Owner who shall be afforded proper facilities for determining compliance with the specifications.

b. The Owner may elect to have the factory performance tests witnessed by the Owner, or designated representatives of the Owner. All pump and motor factory performance tests may be witnessed by a representative of the Owner at the Owners expense.

c. If performance tests are to be witnessed by the Owner or Owner's representatives, the Manufacturer shall notify the Owner sufficiently in advance (minimum 14 days) of the dates that tests will be made, so that the Owner can make arrangements for his representative to be present. The Owner will pay for the cost of the representative's time, travel, lodging, meals, and other expenses. The Equipment Manufacturer shall bear all other costs for performing the witnessed tests. If a test must be re-run due to failure in meeting the specified requirements, then the Owner representative's labor and travel costs for the re-test shall be borne by the Equipment Manufacturer at standard rates.

d. A Manufacturer's technical representative shall be present throughout the testing period to aid the Owner's representative in performing and verifying all calculations. The technical representative shall be fully versed in the testing methods and calculations and shall be capable of certifying test results.

2. PUMPS

a. Pumps shall be factory performance tested using one of the previously tested job motors at the pump factory and certified copies of test data and test curve shall be furnished to the Engineer. The efficiency, capacity, and horsepower requirements shall be determined for not less than ten (10) points throughout the specified head range from shut-off to maximum specified operating capacity. Test procedures, interpretation, and conversion of data shall conform to the latest requirements of the Test Code of the Hydraulic Institute standards, except as modified herein.

b. Thirty (30) days prior to the factory test, the Equipment Manufacturer shall submit a test procedure booklet which provides a plan and profile view of the test piping layout including locations of the test instruments. A description of the test shall be included along with the calibration sheets on the proposed instrumentation. Provide example calculations for the wire-to-water efficiency.

c. The pump test results shall indicate that the performance of the pump from run-out head to shutoff head is similar to the pump curve submitted with the bid submittal.

If the test results indicate that the pump performs substantially differently from the curve submitted with the bid, the Owner, at his option, may accept the unit at a reduced price, or may refuse to accept the unit as a consequence of breach of contract on the part of the Equipment Manufacturer.

d. Pumps shall be tested at maximum operating speed. Test pumps at reduced speed as required to meet the specified duty and rated points.

e. Test results shall show no minus tolerance or margin with respect to capacity, total head or guaranteed efficiency at the specified conditions. Pumps shall have a continuous down slope in the head-capacity curve. Pumps shall be within the following plus tolerance:

   1). At rated head: +10% of rated flow capacity

   2). At rated capacity: +5% of rated head.

f. Perform an NPSHr test on each pumping unit. The test shall include operating the pump at the minimum discharge head condition with the minimum suction head available, as shown in performance requirements herein. The NPSHr test shall verify the pump meets the NPSH margin requirements specified herein.

g. Following completion of factory performance tests, the Equipment Manufacturer shall furnish to the Engineer for review and approval certified copies of all test data and test curves for the pump. Test curves shall also show calculated curves for expected performance at 100 percent speed for all pumps and 90, 80, 70 and 60 percent of rated speed for variable speed pumps. The Engineer shall promptly review test data and, upon determining that the pump meets contract requirements, authorization will be given for shipment. Shipment shall not be made without written approval of test data by the Engineer, except at the risk of the Equipment Manufacturer.

h. The Owner, or a representative of the Owner, at his option, may visit the manufacturing site at the time of witness tests or prior to shipping for the purpose of inspecting and verifying the accurate machining and dimensions of the casings, bearings, shaft and other parts. The Equipment Manufacturer shall make available to the Owner, the pump parts to be inspected, and such tools, facilities and labor required to verify the alignment accuracies. The Equipment Manufacturer shall submit machine drawings along with a proposed inspection procedure. Include a description of the inspection table, the instrumentation that will be used, and the acceptance criteria for a good machined part. All costs for re-inspection shall be paid by the Equipment Manufacturer.

i. The Equipment Manufacturer shall perform radiographic tests on all casing and impeller castings before assembly. Perform radiographic testing in accordance with ASME Section V articles 2 and 22. Acceptance criteria will be per ASME Section VIII,

Division I, Appendix 7. Perform radiographic testing prior to drilling and tapping holes.

1). Cast Steel or Stainless Steel: Perform radiographic test as defined in referenced ASME code sections.

2). Cast Ductile Iron: Perform radiographic test on all critical sections for ductile iron casings. Critical sections include suction flange, discharge flange, casing split flange, and transitions from flanges into the casing. All machined surfaces shall be examined by the magnetic particle or liquid penetrant method. The acceptance criteria will remain as defined in Appendix 7 even though the material is ductile iron. Reference radiographs are to be ASTM E689 (ductile iron).

j. The Equipment Manufacturer or his representative shall make metallurgical analysis from coupons cast on the piece of each pour of metal going into the castings and shafting, and shall provide certified reports to the Owner, showing that the specified alloys are being furnished, and the materials meet ASTM standards.

k. The Equipment Manufacturer shall perform a hydrostatic pressure test on the casing assembly at 1.5 times the shut-off head for a minimum of 30 minutes.

3. 4000 VOLT MOTORS

a. All motors shall receive a short commercial test in accordance with NEMA MG1 and IEEE 112, latest version.

b. In addition, all motors shall receive a complete test in accordance with IEEE 112, and certified copies of the test data recorded on the appropriate forms of IEEE 112, together with a certified statement of compliance with minimum specified power factor and efficiencies shall be furnished to the Engineer. The recorded data on the forms shall be in sufficient clarity and detail to permit third-party longhand validation and verification of any computer generated results. Any longhand calculations shall be done in English.

c. Tests to be performed on each motor shall include, but not be limited to the following:

1). Reference Resistance per IEEE Std. 112, latest version.

2). Reference Ambient of 25 degrees centigrade.

3). Efficiency using one of the following methods:

a). Efficiency using an equivalent circuit with direct measurement of stray load loss per Method F.

b). Efficiency at rated voltage and frequency by a dynamometer, Method B (6 point minimum). Dynamometer correction shall be applied.

4). Bearing Loss Stabilization.

5). Locked Rotor Test (two line method).

6). Slip.

7). Core Losses and Friction and Windage Losses.

8). Power Factor.

9). Load test at rated temperature rise (Stable to 1° within 30 minutes).

10). Speed-Torque and Speed Current Curves.

11). Stator Temperature Rise Measurements by embedded detector and resistance at rated load per IEEE Std. 112, latest version.

12). High Potential Tests.

13). Winding Resistance Measurements.

14). Bearing Insulation Tests.

15). Noise Measurements per IEEE Std. 85, latest version (4 positions).

16). Vibration Measurements

17). Locked Rotor Power Factor

18). No load amps and power factor.

19). Measured report values of motor weight. Measured values shall be within 5% of stated value.

20). Perform an impact test on one motor of each size. Bolt the motor to a large mass and strike the motor to measure the first and second natural frequency. Furnish a report that compares the measured natural frequencies with the frequencies predicted during the submittal process. If the first natural frequency is not within 10% of the submitted natural frequency, the pump manufacturer shall produce a revised lateral frequency analysis to show how the total unit natural frequency has varied from that predicted during the submittal process.

21). Substitutions for or waivers of the tests and methods listed above will not be permitted.

d. The Engineer or Owner, at his option, may witness the tests of all motors.

e. Following completion of factory tests, the Equipment Manufacturer shall furnish to the Engineer for review and approval four (4) certified copies of all test data and test curves for each motor. The Engineer shall promptly review test data and, upon determining that the motor meets contract requirements, authorization will be given for shipment. Shipment shall not be made without written approval of test data by the Engineer, except at the risk of the Equipment Manufacturer.

C. ASSEMBLY

1. One job motor shall be shipped to the pump manufacturer for testing and alignment with the pumps. The pumps and motors may be disassembled for shipment, but the Equipment Manufacturer shall certify that at the factory, prior to shipment, the units have been completely assembled, each part to each adjoining part and match-marked if appropriate.

2. The pumping units (casings, impellers, pump shaft, and pump bearings) shall be disassembled for shipment, and the Equipment Manufacturer shall certify that at the factory, prior to shipment, the units were completely assembled each part to each adjoining part and match-marked if appropriate. The pumping units (casings, impellers, pump shaft, and pump bearings) can be shipped assembled only if measures are taken to block up the rotating assembly so that it is not riding in the bearings during shipment to and handling at the site. Mechanical seals shall be disassembled and packaged separately for shipping to the job site.

3. The Equipment Manufacturer shall be responsible for coordination with the Motor Manufacturer to ensure that no undue difficulty in assembly will be occasioned when units are received at the project site. If the motor does not match properly, the defect shall be corrected to the satisfaction of the Owner. The pump and motor base shall be drilled for assembly of the pump and motor and installation onto the foundation bolts. Leveling shims shall be furnished by the Equipment Manufacturer.

D. MARKING

1. Pump and motor shall each have a standard Manufacturer's stainless steel nameplate securely affixed with tapping screws in a conspicuous place, showing the ratings, speed, rotation, serial number, model number, manufacturer, and other pertinent data.

E. SERVICE OF MANUFACTURER'S REPRESENTATIVE

1. Pump Manufacturer Representative

a. The pump manufacturer shall furnish the services of a competent factory technician, who shall have had a minimum of five (5) years' experience in the installation, adjustment, and operation of the equipment which is being furnished under this specification. This service is to ensure proper installation and adjustment of the equipment; instructing operating personnel in proper operation, maintenance, and

care of the equipment; for making operation tests of equipment and making recommendations for obtaining the most efficient use thereof.

b. The service representative shall be at the site at any time the Construction Contractor is assembling, setting, aligning, connecting or adjusting and testing the pump and motor assembly, and shall direct such work and certify in writing to the Owner that it has been properly installed and operates satisfactorily during acceptance tests.

c. The Equipment Manufacturer shall have total responsibility to see that all connections (mechanical, electrical, and control) made to the installed pumping units are correct prior to start-up and testing.

d. The minimum time required to be on-site for 8 hours per day, not including travel time, is as follows:

1). Pump and motor installation	8 days (2 trips minimum)
2). Pump start-up and testing	8 days (2 trips minimum)
3). Troubleshooting	4 days (2 trips minimum)
4). Personnel training	1 days (1 trip minimum)

2. Motor Manufacturer Representative

a. The Motor Manufacturer shall furnish the services of a competent factory technician, who shall have had a minimum of five (5) years' experience in the installation, adjustment, and operation of the equipment which is being furnished under this contract. This service is to ensure proper installation and adjustment of the motor, instruct personnel in proper operation, maintenance, and care of the equipment, for making operation tests of equipment, and recommendations for obtaining the most efficient use thereof. The motor technician shall be an employee of the motor manufacturer unless otherwise approved by the Engineer.

b. The service representative shall verify the proper installation, alignment, wiring, lubrication, and connection of all appurtenances prior to start-up. Representative shall be present during testing, and start-up and shall certify to the Owner in writing that the motors have been properly installed and operate satisfactorily.

c. The minimum time required to be on-site for 8 hours, not including travel time, is as follows:

1). Check motor installation	4 days (2 trips minimum)
2). Pump start-up and testing	8 days (2 trips minimum)
3). Troubleshooting	4 days (3 trips minimum)
4). Personnel training	1 day (1 trip minimum)

F. PUMP ROTO-DYNAMIC ANALYSIS

1. The pump speed will be varied by a variable frequency drive (VFD) controller and will operate for extended periods of time at speeds from 60% to 100% of the rated synchronous motor speed. Individual pumps may be operated at different speeds concurrently, but the primary mode of operations is to operate identical pumps at the same speed.

2. LATERAL, TORSIONAL AND STRUCTURAL ANALYSIS

    a. To determine the potential for a critical lateral frequency occurring within the normal operating speed range of the pump, a level 3 lateral dynamic analysis shall be performed by the Equipment Manufacturer in accordance with ANSI/HI 9.6.8 Rotodynamic Pumps Guideline for Dynamics of Pumping Machinery, Table 9.6.8.4. The pump shall be subject to an undamped natural frequency analysis as a minimum in accordance with Section 9.6.8.6.2.1.1. The minimum frequency separation margin obtained by analysis shall be ± 15%. The pump shall also be subject to a lateral forced response analysis in accordance with Section 9.6.8.7.2.1.1. The lateral forced response analysis of the structure shall demonstrate compliance with the vibration acceptance criteria as per ANSI/HI 9.6.4 Rotodynamic Pumps for Vibration Measurements and Allowable Values. The Equipment Manufacturer shall be responsible for obtaining machine weight, center of gravity, machine static deflection and any other relevant information necessary to perform the lateral dynamic and lateral forced response analysis.

    b. To determine the potential for a critical torsional frequency occurring within the normal operating speed range of the pump, a level 3 torsional dynamic analysis shall be performed in accordance with ANSI/HI 9.6.8 Rotodynamic Pumps Guideline for Dynamics of Pumping Machinery, Table 9.6.8.4. An undamped torsional natural frequency analysis in accordance with Section 9.6.8.6.2.2.1 shall be performed. The minimum frequency separation margin obtained by analysis shall be ± 15%. A torsional forced response analysis in accordance with Section 9.6.8.7.2.1.1 shall also be performed. The torsional forced response analysis of the structure shall demonstrate compliance with the specified vibration acceptance criteria and shall demonstrate compliance with criteria established for service life. The torsional analysis shall be performed for all operating conditions, all continuous operating conditions (constant load), all dynamic operating conditions (accelerating and decelerating) and worst case electrical fault conditions. The Equipment Manufacturer shall obtain all data from the VFD and motor manufacturers as required to conduct the Torsional Analysis.

    c. To determine the potential for a critical structural natural frequency occurring within the normal operating speed range of the pump, a level 3 structural dynamic analysis shall be performed in accordance with ANSI/HI 9.6.8 *Roto-dynamic Pumps Guideline for Dynamics of Pumping Machinery*, Table 9.6.8.4. The pump and supporting structure (baseplate) in combination shall be subject to a shaft-end

deflection analysis (static structural FEA) in accordance with Section 9.6.8.6.2.3.1. The pump and supporting structure (baseplate) in combination shall also be subject to a natural frequency analysis (modal FEA) in accordance with Section 9.6.8.6.2.3.2. The minimum frequency separation margin obtained by analysis shall be ± 15%. The pump and supporting structure (baseplate) in combination shall be subject to a forced response analysis in accordance with Section 9.6.8.7.2.3.1. The forced response analysis of the structure shall demonstrate compliance with the vibration acceptance criteria as per ANSI/HI 9.6.4 Rotodynamic Pumps for Vibration Measurements and Allowable Values.

d. The Equipment Manufacturer shall advise the Owner and Engineer of the calculated resonant frequency of the pumping unit and shall verify its accuracy when the unit is installed at the project site. The analysis shall be based upon the mounting details shown on the drawings. If a resonant frequency problem exists for the installed unit, the Equipment Manufacturer shall be responsible for correcting the problem.

1.04 SUBMITTALS

A. BID SUBMITTAL

Submit the following information in order to evaluate the bids.

1. General: Furnish a complete description of all equipment offered under these specifications, including catalogs, cuts and pertinent engineering data. Where the Bidder's product differs from the specified requirements and/or catalog description, each point of difference shall be clearly stated. This requirement is set forth to facilitate the review of bids and not to be construed by the Bidder as waiving any of the requirements of the specifications.

2. Characteristic Pump Curves: Characteristic pump curves for the pumps offered shall be submitted with the bid. Curves shall show the capacity, head, minimum continuous stable flow (MCSF), efficiency, required NPSH, and brake horsepower throughout the operating range of the pump from shut-off to maximum specified operating capacity. Submit curves with the above data at speeds from 60 percent to 100 percent. Characteristic curves shall have the capacity plotted as abscissa and the operating head, brake horsepower, efficiency and required NPSH plotted as ordinates. Provide four quadrant curves and WR^2 for the pump. In the event four quadrant curves are unavailable for the specific pump being proposed, the Owner may consider allowing the submittal of four quadrant curves based on other similar pumps.

3. Data Sheet: Submit information requested on the Data Sheet (for both the pump and motor), included with the Bid Proposal forms.

4. Outline Drawings: Submit outline drawings of the pumps, motors and appurtenances, showing layout dimensions of the proposed equipment and materials to be used.

5. Pump and Motor Testing Information: Provide information on the pump and motor testing facility, location and test method. Provide a testing schedule and plan.

6. Provide a plan and a schedule indicating dates for submittals, manufacturing, testing, and delivery.

7. Provide a list of at least three units in service for at least the last five years and a name and telephone number for an operations personnel reference for each of these installations. Units shall be the same pump model and size.

B. PRE AND POST SUBMITTAL MEETINGS

1. Equipment Manufacturer shall include in his bid the cost of attending a one-day pre-submittal meeting and a one-day post-submittal meeting at the office of Freese and Nichols, Inc. in Houston, Texas. Specific location will be determined when the meeting is scheduled.

2. A pre-submittal meeting shall be held before any submittals of the pumping units shop drawings and shall be attended by the Owner, Engineer, Contractor, and Equipment Manufacturer.

3. Representative(s) from both the Pump and Motor manufacturer shall include individuals who have technical knowledge of the equipment and will be responsible for putting together the submittal. A sales person may attend, but not as a substitute for the individuals indicated above.

4. Upon completion of the shop drawing review by the Engineer, a second meeting with the same parties shall be held to discuss review comments in order to resolve issues and allow equipment to be released for manufacturing. This second meeting may only be waived at the Engineer's discretion.

5. Any shop drawings submitted before the pre-submittal meeting will be rejected and sent back Not Approved, Revise and Resubmit. The Pump and Motor manufacturers shall send a detailed list of the items their submittal will include for the review by the Engineer or a draft copy of the actual submittal prior to the pre-submittal meeting.

C. SHOP DRAWINGS

1. Submit Shop Drawing in accordance with the Section 01 33 00, "Submittal Procedures." ANY DEVIATIONS FROM THE SPECIFICATIONS SHOULD BE CLEARLY NOTED AND IDENTIFIED IN THE SHOP DRAWING SUBMITTALS.

2. Drawings shall show complete physical description and performance capabilities of the equipment, including, but not necessarily limited to dimensions, weights, materials, assemblies, sectional views, performance curves, four quadrant curves and WR^2 power requirements and ratings, rated voltage and amperage, wiring diagrams as may be applicable, and on-site storage requirements.

3. Submittal shall include all information requested in the Data Sheet (for both the pump and motor, Attachments A and B) submitted with the proposal. The data sheet shall be updated as necessary.

4. Submit drawings as a complete package of all equipment furnished. Partial drawings will not be reviewed. Shop drawings shall include the following:

    a. Pump Outline drawings showing all components, anchor bolts, external connections, and appurtenances.

    b. Pump Sectional drawings with all components identified.

    c. Provide an electronic model file of the pump and motor. Provide file compatible with AutoCAD, Inventor, or Revit software and will be used for inclusion in the project process piping model.

    d. Characteristic curves showing capacity, head, efficiency, NPSHr, and brake horsepower at each operating speed for the range specified.

    e. Pipe layout drawings for drainage and seal piping.

    f. Pump speed vs. torque curves for applicable starting conditions.

    g. Weights, including “wet” and “dry” weights of equipment, shipping weights and dimensions, and center of gravity for lifting.

    h. Bearings information, cut sheets, plan and section and data sheets and bearings life calculations for pump and motor.

    i. Identify sequence and tags for terminal strips and wiring.

    j. Name plate data sheets.

    k. Oil type and maintenance procedures.

    l. Paint selection chart for factory painting.

    m. Certified calculations of the Forces and Moment Analysis of the pump.

    n. Provide confirmation from the motor supplier that the motor is suitable for the maximum backspin speed.

    o. Submit drawings of lab testing set-ups, test procedures, testing equipment calibration certification, and sample performance calculations

    p. Provide a description of the components that will be shipped separately, thus requiring field assembly. Provide a general description of the installation requirements, including sequence and installation tolerances.

5. Submit motor documentation as required per paragraph 2.02.I of this specification. Incomplete data submitted will not be reviewed and will be returned “Not Approved, Revise and Resubmit”.

6. Provide a copy of Pump Manufacturer’s quality system registration to ISO 9001:2015.

7. Provide resume’ of proposed Pump Supplier’s Representative for field services.

8. Provide wiring/interconnection diagram for pump and motor RTD's. Diagram shall clearly identify which RTDs (inboard, outboard) is connected to the specific terminal blocks.

9. Provide wiring/interconnection diagram for motor space heater.

10. Provide alarm and trip temperatures for pump RTDs.

11. Provide a quality control plan that indicates materials and components included in the pump, the quality control procedure, and whether a certified test report will be provided to the Engineer

12. Submit a lateral and structural dynamic analysis report including the following information:

    a. Computer program used.

    b. Assumptions made in order to model the system.

    c. Schematic diagram of the model depicting nodes and elements.

    d. Input data consisting of node coordinates, element types, material properties, element characteristics, element connectivities (typically presented graphically), and specified displacements and/or excitation force spectra.

    e. Any supporting calculations and data.

    f. Motor or other drive reed frequency data (or dynamic analysis, if recommended).

    g. Motor or other drive critical speed data, by the manufacturer.

    h. Shafting critical speed data, by the manufacturer.

    i. Anticipated excitation frequencies

    j. Analysis results, including all significant natural frequencies and a description of the corresponding mode shapes.

    k. A Campbell diagram depicting a plot of excitation frequency versus operating speed, with the following information:

        1). A plot of all excitation sources that are multiples of the operating speed, properly labeled.

        2). A plot of natural frequencies versus operating speed.

        3). Areas of interference of 1) and 2) described above clearly identified, or the lack of likely resonance indicated.

l. Interpretation of the results and recommendations, including recommendations for appropriate corrective action.

13. Submit a torsional dynamic analysis report including the following information:

    a. Computer program used.

    b. Assumptions made to model the system.

    c. Schematic diagram of the model depicting nodes and elements.

    d. Input data consisting of node coordinates, element types, material properties, element characteristics, element connectivities, and specified displacements.

    e. Any supporting calculations and data.

    f. Pump and drive equipment torsional data by the respective vendors.

    g. Shafting or coupling torsional data by its vendor.

    h. Anticipated exciting frequencies.

    i. Analysis results including all significant torsional critical speeds and a description of the corresponding mode shapes.

    j. A Campbell diagram depicting a plot of excitation frequency versus operating speed, with the following information:

        1). A plot of all excitation sources, including strong multiples of the operating speed, properly labeled.

        2). A plot of torsional natural frequencies versus operating speed.

        3). Areas of interference of 1) and 2) described above clearly identified, or the lack of likely resonance indicated.

    k. Interpretation of results and recommendations, including recommendations for appropriate corrective action.

14. Submit a pump, motor, baseplate installation and precision alignment plan. Plan shall include:

    a. Appropriate methods and tools necessary to perform a laser precision alignment of the pump and motor.

    b. Specific installation methods and tolerances for installation of baseplate including checks for leveling of mounting pads along with checks for warping or other out-of-tolerance elements that could induce a soft foot condition.

c. Appropriate methods for jacking, shimming, and leveling baseplate along with proper grouting methods.

d. Method for correctly shimming and leveling pump along with tolerances.

e. Methods for precision alignment of motor to pump along with methods for correctly shimming motor complete with tolerances for all shaft misalignment scenarios.

f. Methods for correcting soft foot conditions to within 2 mils.

g. Designation of most appropriate tool for each check including laser alignment, dial indicator or feeler gage.

h. Methods for performing a “hot” alignment if deemed beneficial by the equipment manufacturer.

i. Process for iterative checks of alignment and soft foot to obtain precision alignment.

D. OPERATION AND MAINTENANCE MANUALS

1. Submit Manuals with instructions for installation, adjustment, lubrication, operation and maintenance of the equipment in accordance with Special Conditions and Section 01 33 00, “Submittal Procedures” and 01 78 23, “Operation and Maintenance Data”.

2. Manuals shall be prepared by the Equipment Manufacturer and shall also incorporate appropriate final shop drawings, certified test reports, certified performance curves, and test data. Manual shall include nameplate data including serial numbers. Provide O&M data for all pump, motor, and accessories. Provide set points for vibration sensors, motor thermal switches, and all other protection devices. Manuals may be manufacturer's standard instructions but shall be supplemented as necessary to cover any special feature not included in standard material. Submit preliminary manuals for review prior to delivery of the equipment. Separate or combined manuals may be provided for the pump and motor.

E. CERTIFIED TEST REPORTS

Submit the following certified test reports for pump, motor and variable frequency drive.

1. Provide CTR for pump factory performance tests.
2. Provide CTR for motor factory performance tests.
3. Provide CTR for metallurgical analysis of castings and shafting.
4. Provide CTR for stress relieving of components.
5. Provide CTR for pump casing hydrostatic tests.
6. Provide CTR for radiographic tests.
7. Provide CTR (with EIR) for pump field tests.
8. Provide CTR (with EIR) for motor field tests.

F. EQUIPMENT INSTALLATION REPORT

1. Submit Equipment Installation Reports from the motor manufacturer and pump manufacturer indicating the equipment was installed in accordance with the manufacturers' instructions and that the equipment was adjusted and aligned to be in the best operating condition.

2. The report shall indicate that the equipment is operating satisfactorily in accordance with the project specifications.

3. Provide photo of inside of RTD box showing how terminal blocks are labeled identifying which RTD is on inboard and outboard bearings. Photo shall be submitted to the Engineer for review.

G. All submittals shall be in English with English units.

1.05 STANDARDS

The applicable provisions of the latest edition of the following standards shall apply:

A. American Water Works Association (AWWA)
   1. C210 – Liquid Epoxy Coating Systems
   2. E103 – Horizontal and Vertical Line-Shaft Pumps
B. American National Standards Institute (ANSI)
   1. B16.1 – Cast Iron Pipe Flanges and Fittings
C. American Standards for Testing and Materials (ASTM)
   1. A48 – Standard Specification for Gray Iron Castings
   2. A276 – Standard Specification for Stainless Steel Bars and Shapes
   3. A345 – Standard Specification for Flat-Rolled Electrical Steels for Magnetic Applications
   4. A487 – Standard Specification for Steel Castings Suitable for Pressure Service
   5. A536 – Standard Specification for Ductile Iron Castings
   6. A582 – Standard Specification for Free-Machining Stainless Steel Bars
D. National Electrical Manufacturers Association (NEMA)
E. Hydraulic Institute Standards (HIS)
F. Institute of Electrical and Electronic Engineers (IEEE)
G. International Standards Organization (ISO)
   1. 1940-1:2003 – Balance Quality Requirements for Rotors in a Constant (Rigid) State – Part 1: Specification and Verification of Balance Tolerances
   2. 9001:2015 – Quality Management systems – Requirements

H. National Electrical Code (NEC)

I. American Society of Mechanical Engineers (ASME)

1. Section V – Nondestructive Examination

2. Section VIII – Pressure Vessels

3. Section IX – Welding, Brazing, and Fusing Qualifications

J. American Petroleum Institute (API)

1. 610 – Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries

2. 682 – Pumps-Shaft Sealing Systems for Centrifugal and Rotary Pumps

1.06 DELIVERY AND STORAGE

A. Pump assemblies and motors shall be shipped with sealed accelerometer devices (horizontal and vertical) in good working order for determining excessive impact during transit and handling. Devices shall be mounted to the case. Devices shall be read in presence of Carrier, Installation Contractor, Owner, Engineer, and Equipment Manufacturer. Any readings in excess of 2g or a malfunctioned accelerometer shall result in return of the equipment to the factory for full disassembly, inspection, testing, and repeat of the performance testing as directed by the Owner.

B. The Equipment Manufacturer shall be responsible for delivery of the base, pumps, drivers, and accessories, to the job site or to such storage site as may be designated by the Owner or Installation Contractor in good condition and undamaged. The Equipment Manufacturer shall submit a shipping notice and delivery, unloading, assembly, storage and installation instructions at least seven (7) days prior to shipment.

C. Unloading and storage of the equipment shall be the responsibility of the Installation Contractor who shall inspect the equipment for apparent damage. Equipment which is found to be damaged will not be accepted until properly repaired or replaced by the Equipment Manufacturer.

D. The pump, motor, and accessories shall be stored indoors, and the motor space heaters shall be energized. If motors are to be stored for longer than 14 days, the oil reservoirs should be filled. The Equipment Manufacturer is responsible for the supply of this oil. The Installation Contractor shall rotate the motor rotor by hand several rotations each week until the motor is placed into service.

E. Furnish anchor bolts and anchor bolt template as necessary to meet the Installation Contractor’s schedule prior to delivery of pumping units.

F. Spare parts shall be shipped and suitable for long term storage at a location designated by the Owner.

1.07 EQUIPMENT WARRANTY

A. Equipment Manufacturer shall warrant the equipment furnished under this Specification for a period of two (2) years against defects in materials and workmanship, equipment design, and operational failure.

B. Owner will remove and load the equipment on a vehicle provided by the Equipment Manufacturer if it is necessary to return the equipment to the manufacturer for correction of defects during the Warranty Period. Owner will reinstall the equipment when it is returned to the site after defects have been corrected. The Equipment Manufacturer is to provide all parts, labor, and incidental cost for making repairs, shipping the equipment to the site, and providing startup services.

C. The Warranty Period shall be interpreted as the twenty-four (24) moth period following the installation, adjusting and acceptance testing, and the start of actual operation of the equipment, or thirty-six (36) months after delivery, whichever occurs first.

1.08 PUMPING CRITERIA AND DATA

A. GENERAL CRITERIA

1. Liquid to be pumped is treated lake water fed with chloramines and caustic upstream of the on-site ground storage tanks. The pump suction will be from on-site ground storage tanks. The pumps and motors will be mounted on a steel baseplate provided with the pumps.

2. Pumps will be started and stopped against a closed pump control valve that will open and close slowly (5 to 15 minutes per cycle) to minimize transient pressure surges in the discharge pipeline. The pump shall be designed for full shut-off head pressures during starting and stopping. Control valves may be closed for up to three minutes while the pump is running (during the starting or stopping sequence). A bypass in provided at the pump control valve to allow about 10% of the design flow to bypass during the starting or stopping sequence.

3. The pump control valves also serve as pump station and pipeline surge control devices. The pumps and motors (1 through 5) shall be designed for a 130 percent minimum reverse rotation in the event of a power failure to the pump(s). The pump and motor shall also be designed so that no damage occurs from back-spinning at speeds which will be generated by the differential operation pressure in the discharge system of 110 psi. The slow closing of the pump control valve is how the surge pressures are controlled. As the pump control valve is closing, the pump is rotating backward while pressures vary from maximum to minimum limits. All components and operations associated with the pumps will be designed and performed to meet or exceed the reverse flow/rotation operating and pressure conditions.

4. The pump and motor shall be compatible for use with a variable frequency drive with speeds from 60 percent to 100 percent. The pumping unit will be started using a variable

frequency drive which will ramp to a preset speed and will remain at this speed until the control valve is fully open, at which time an operator will adjust the speed as needed.

5. The design of the pumping units shall be compatible with the mode of operation as set forth in Section 26 29 23.01 “Medium Voltage Variable Frequency Drives”.

6. The top of the pump casing shall have a 3” threaded outlet for an air valve assembly that will release air if the pump is drained and re-filled. The air-valve assembly will be provided and installed by the Installation Contractor.

7. Pump shall operate alone, as well as in parallel with other pumps. The system curves in Attachment C show the maximum and minimum system heads at which the pumps will operate.

8. The pumping heads tabulated below are total dynamic heads (TDH) under field conditions and are inclusive of all pump losses from pump suction flange to discharge flange. The more explicit definition is “Total Head” as defined by ANSI/HI 14.6-2011, Paragraph 2.6.3.12.7. The Total Discharge Head component of the Total Head calculation shall be understood as the total head produced at the discharge flange of the pump as installed in the field plus the suction head at the suction flange.
9. It is desired that the pump has its highest efficiency at full speed within the TDH range bounded by Efficiency Evaluation Point No. 1 and Efficiency Evaluation Point No. 2.

10. Pumps shall have a continuously rising performance curve from pump run-out to shut-off head with no intermediate flat places.

11. The motors provided under this contract shall be of sufficient size to drive the pumps at the rated head capacity and head. Motors shall be non-overloading over the entire pump performance curve.

12. All wetted materials shall be designed for drinking water contact and shall meet the intent of NSF Standard 61. Leaded bronze materials shall not be used.
13. The discharge piping includes a pipe anchor and dismantling joint between the pump discharge flange and the pump control valve as shown in the plans.

B. PERFORMANCE REQUIREMENTS

1. Pump Selection - Listed below are the performance requirements for RPS-P1, P2, P3, P4, and P5 and defined as:

    a. Rated Point: The overall firm capacity (four pumps running) of the pump station is 160 MGD at 163’ TDH. Each pump shall produce a minimum of 40 MGD at 163’ TDH. The pump manufacturer shall guarantee the capacity of the pump at this rated point. No efficiency guarantee is required at this point. Failure to meet this operating condition shall be cause for rejection of a pumping unit.

b. Duty Point No. 1: The pump shall be capable of operating at 180’ TDH at full speed within the Allowable Operating Range (AOR) of the pump. A flow requirement or efficiency guarantee is not required at this point.

c. Duty Point No. 2: The pump shall be capable of operating at 125’ TDH at full speed within the Allowable Operating Range (AOR) of the pump. A flow requirement or efficiency guarantee is not required at this point.

d. Duty Point No. 3: The pump shall be capable of operating at a reduced speed to produce 25 MGD at 45’ TDH within the Allowable Operating Range (AOR) of the pump. There is not an efficiency guarantee required at this point.

e. Efficiency Evaluation Point No. 1: The pump supplier shall provide the guaranteed wire-to-water efficiency for the Efficiency Evaluation Point No. 1 in Attachment A and on the Bid Proposal Form. The wire-to-water efficiency shall be for the pump and motor at full speed at 170’ TDH. There is not a flow requirement for the Efficiency Evaluation Point.

f. Efficiency Evaluation Point No. 2: The pump supplier shall provide the guaranteed wire-to-water efficiency for the Efficiency Evaluation Point No. 2 in Attachment A and on the Bid Proposal Form. The wire-to-water efficiency shall be for the pump and motor at full speed at 140’ TDH. There is not a flow requirement for the Efficiency Evaluation Point.

2. See Attachment C for System Curves.

PUMPING CONDITIONS	PUMPS 1 - 5
Rated Point (no efficiency guarantee)	40 MGD @ 163’ TDH
Duty Point No. 1 (full speed)	180’ TDH w/in AOR
Duty Point No. 2 (full speed)	125’ TDH w/in AOR
Duty Point No. 3 (reduced speed)	25 MGD @ 45’ TDH w/in AOR
Efficiency Evaluation Point No. 1 (full speed)	170’ TDH
Efficiency Evaluation Point No. 2 (full speed)	140’ TDH
NPSHa, FT (at Rated Flow)	32.3’
Maximum Shutoff Head, FT	250
Motor Voltage	4,000
Maximum Motor Horsepower, HP	1,750
Maximum Motor Speed, RPM	600

C. PUMP SETTING REQUIREMENTS

PUMP SETTING REQUIREMENTS	PUMPS 1 - 5
Elev. Concrete Support Block	To be determined by mfr.

Elev. Operating Floor	94’
Elev. Pump Centerline	97.5’
Discharge Diameter (ID), IN (TBD by mfr)	36
Suction Diameter (ID), IN (TBD by mfr)	48
Max. Dimension Suction Flange to Discharge Flange, IN	120
Elev. Max. Water Level (on-site ground storage tank)	134’
Elev. Min. Water Level (on-site ground storage tank)	100’

D. The pump shall have suitable Net Positive Suction Head Required (NPSHr). The NPSH margin, i.e. ratio of NPSHa to NPSHr shall be consistent with the suction energy conditions as defined by the HI standards. Minimum margin shall be 10 percent at BEP, or five (5) feet, whichever is greater. The NPSHr with the margin applied at BEP shall be less than the NPSHa with the minimum suction water level as shown in the pump setting table. The NPSHr with the margin applied at pump run-out shall be less than 50 feet. For the purposes of calculating NPSHa at the Rated Flow, the manufacturer may assume the total friction and minor losses in the suction piping (ground storage tank to pump flange) to be 2.6 feet from the tank outlet to the pump suction flange for analysis.

1.09 BID EVALUATION

A. GENERAL

1. The Bidder shall fill in the blank(s) in the Bid Proposal indicating the guaranteed wire-to-water efficiency of the pumping units at the specified operating heads.

2. The contract adjustment to be assessed in the event of failure to meet guaranteed efficiency and outline dimensions are not to be construed as a penalty, but as a reasonable contract adjustment due to the impracticality and extreme difficulty in calculating actual damages. By submitting a Bid Proposal and executing the Contract Agreement, the Equipment Manufacturer agrees to such contract adjustment assessments.

B. PUMPING UNITS

1. In comparing proposals, the Owner will take into consideration the guaranteed efficiencies of the pumps at the specified rated head and flow conditions as stated in the bid proposal. For purposes of evaluation, the overall efficiency of the pumping units shall be the average of the guaranteed wire-to-water efficiencies (exclusive of VFD efficiency) at Efficiency Evaluation Point No. 1 and Efficiency Evaluation Pont No. 2. The total value for all pumps of one (1%) percent in overall wire-to-water efficiency (the average of the two guaranteed efficiency points) shall be worth $40,000. Due consideration will also be given to pump performance at other operating conditions in evaluating the pumping units, in order to select the pumping unit best suited to the operation of the system, in the opinion of the Owner.

2. The wire-to-water efficiency of the pumping units shall be guaranteed at the rated operating conditions as specified and stated in the proposal. In the event that the Factory Tests show that the actual efficiency of a pumping units is less than that guaranteed, the Owner, at his option, may accept the unit at a reduced price, or may refuse to accept the unit as a consequence of breach of contract on the part of the Equipment Manufacturer. The price reduction per pump will be based on the difference between the guaranteed efficiency and the actual efficiency times the factor for efficiency evaluation. In addition, if the Factory Test results indicate that the pump performs substantially different from the curve submitted with the bid, the Owner, at his option, may accept the units at a reduced price, or may refuse to accept the units as a consequence of breach of contract on the part of the Equipment Manufacturer.

3. The Owner will also evaluate the NPSH required for the pumps at the various specified pumping conditions. A pump that does not meet the minimum specified NPSH margin may be disqualified.

4. Efficiency is defined as overall efficiency of the complete pumping unit expressed as "a ratio of the energy delivered by the pump to the energy supplied to the input side of the pump driver…" as per the Hydraulic Institute Standards for centrifugal, rotary, and reciprocating pumps, fourteenth or higher edition.

5. The Owner may also consider the size of the pumping unit and motor horsepower in relation to offerings by other Equipment Manufacturers in the equipment selection.

C. EFFICIENCY EVALUATION EXAMPLE

1. The following hypothetical example is shown to explain the proposal evaluation factors:

Pump Evaluation	Bidder No. 1	Bidder No. 2	Bidder No.3
Pump Stated W-W Eff. @ 140' TDH	87.5%	87.0%	87.5%
Pump Stated W-W Eff. @ 170' TDH	88.0%	86.0%	87.0%
Average of W-W Eff. @ 140' TDH & @ 170' TDH	87.75%	86.5%	87.25%
Pump Calculated Reduction (Each)	$0	$50,000	$20,000

Pump Evaluation	Bidder No. 1	Bidder No. 2	Bidder No.3
Pump Calculated Reduction Total for 5 Units	$0	$250,000	$100,000
Stated Bid Price	$4,000,000	$3,800,000	$3,950,000
Evaluated Bid Price	$4,000,000	$4,050,000	$4,050,000

2. The following hypothetical example is shown to explain the contract adjustments failure to meet guaranteed efficiencies of the pumping units.

Description	Evaluated Bid Eff.	Average Test Eff.	Average Difference	Adjustment
Pump Test (RPS-P1)	87.75%	87.25%	-0.50%	-$20,000
Pump Test (RPS-P2)	87.75%	88.10%	+0.35%	+$14,000
Pump Test (RPS-P3)	87.75%	87.50%	-0.25%	-$10,000
Pump Test (RPS-P4)	87.75%	88.00%	+0.25%	+$10,000
Pump Test (RPS-P5)	87.75%	87.60%	-0.15%	-$6,000
TOTAL ADJUSTMENT				-$12,000

3. Hence, the contract amount will be adjusted downward by $12,000. In no event will the amount be adjusted upwards, even if the test efficiencies are greater than the bid efficiencies.

2.00 PRODUCTS

2.01 PUMPS

A. GENERAL

1. Pumps shall be horizontal, single-stage, split-case, double-suction, double volute, centrifugal pumps with side suction and side discharge for pumping potable water. When viewed from the driver end, the discharge shall be on the right hand side of the pump and rotation shall be counter-clockwise.

2. The pump supplier shall furnish all bolts, nuts, and gaskets for the pumping units, except bolts, nuts, and gaskets for the suction and discharge flanges, which shall be supplied by the Installation Contractor. All bolts, nuts and washers shall be carbon steel.

3. Pumps shall be designed, manufactured, and installed to meet all requirements of the ANSI/HI 9.6.4-2016 standards for *Rotodynamic Pumps for Vibration Measurement and Allowable Values* except as modified below:

    a. Pumps shall have less than 0.095 in/sec RMS unfiltered in the x, y, and z direction when measured at the pump and motor outboard bearings.

    b. Pumps shall have less than 0.095 in/sec RMS unfiltered in the x and y direction when measured at the pump and motor inboard bearings.

    c. These limits shall apply anywhere within the preferred operating region of the pump and at the full rotational speed. The limits shall not be exceeded by more than 30% outside of the preferred operating region but within the allowable operating region.

    d. Variable speed pumps shall operate over their specified speed range without exceeding the higher vibration limit specified above.

4. The Equipment Manufacturer shall stress relieve all fabricated components, and pump/motor base prior to final machining in accordance with ASME Code, Section VIII, Division 1; ASME Code Section IX, and API Standard 610.

B. CASING

1. Pump casing shall be of ductile iron in accordance with ASTM A536 designed for heavy duty service, double volute design, free of blow holes, or other detrimental defects. The casing shall be horizontally split with the suction and discharge flanges cast integrally with the lower half in order that the upper part may be removed for inspection of the rotating element without disturbing pipe connections or pump alignment. The joint between halves of the casing shall be heavily flanged, bolted, and provided with dowel pins to ensure accurate alignment. The interior shall be smooth and free from surface defects. The diameter and drilling dimensions of suction and discharge flanges shall be ANSI B16.1 drilling and shall be adequate to withstand shut-off pressure plus 50 percent.

2. Casings shall be drilled and tapped for air/vacuum valve, gauge, and drain connections. Suitable lifting lugs or eye bolts shall be provided. Casing shall be tested in accordance with Hydraulic Institute Standards under a hydrostatic pressure of 150% of maximum shut-off head.

C. ROTATING ASSEMBLY

1. SHAFT

a. Pump shaft shall be of ample conservative design such that it will be suitable to transmit the maximum brake horsepower required by the pump and be of sufficient stiffness to prevent contact of the wearing rings under any condition of operation.

b. The shaft shall be stainless steel, ASTM A276 Type 410 Condition 1 or ASTM A582 Type 416. Keyways in the shaft shall be provided with stainless steel keys. Assemble using anti-seize compound on fasteners to prevent galling.

c. The shaft section shall be fitted with stainless steel sleeves in the pump and through the stuffing box area. The shaft sleeve shall be Type 410 stainless steel and shall be minimum 50 points Brinell hardness greater than the shaft.

2. IMPELLER

a. Impellers shall be of strong dense castings free of structural defects with uniform thickness of vanes and shrouds. They shall be the enclosed type with split vane design, have smooth water passages for high efficiency, and shall be statically and dynamically balanced. Perform a two plane dynamic balance to ISO 1940-1 Grade 2.5 or better. Thinning of the shroud shall be allowed only when uniform and spread over as wide an area as possible. An engineering evaluation shall be made by the manufacturer as to the amount of thinning which can be done and still preserve the integrity of the casting. In no case shall the thickness of the shroud be less than this value.

b. Impellers shall be of cast stainless steel, ASTM A487 CA-6NM Class “B” containing 13 percent chrome and 4 percent nickel.

c. Welding on the raw castings will be allowed if the proposed repaired defect is within allowable standards and prior to any machining, polishing, and/or balancing. Welding, fillers or coatings for head, flow, and/or efficiency performance reasons will not be allowed. Notify Installation Contractor, Owner, and Engineer prior to making major repairs on the impeller. Major repairs are defined as those that are 1) >20% of material thickness, 2) are 1” (25 mm) or greater in depth, or 3) exceed 10 square inches (65 mm^2). Submit welding procedures and welder qualifications prior to welding on impeller castings. Welders must be qualified to ASME Section IX.

d. The Impeller shall be keyed to the shaft and securely held in axial position on the shaft by means of stainless steel sleeves properly secured to the shaft so that it cannot become unfastened when the pump is reversed. All rotating parts of pumps shall be machined true to insure rotational balance with the impeller, coupling, and other parts that may be mounted on the shaft, such that the pump shall operate within allowable vibration tolerances specified.

3. WEAR RINGS

At the running joint between the suction and discharge chambers, there shall be provided on both the casing and impeller, renewable wear rings with large running surface area and designed for smooth flow areas. The casing rings shall be secured by stainless steel screws or other suitable method. Impeller rings shall be securely attached and so fastened that they cannot become loose when the pump is reversed. Wear ring material shall be 400 series stainless steel compatible with the impeller material. Casing wear ring shall be an alloy with a Brinell hardness of 100 points greater than the impeller wear ring. Wear rings shall have a straight face only, L-shaped rings will not be allowed.

D. STUFFING BOXES

1. Stuffing boxes shall be water sealed and shall be designed to ensure tight seal without excessive wear or friction on the shaft sleeve, and to prevent air leakage into the pump under all conditions of operation.

2. The stuffing box shall be fitted with a mechanical seal. Mechanical seals shall be the split-type as manufactured by Chesterton, Type 442. The hardware shall be 316 stainless steel, rotary face shall be silicon carbide, stationary face shall be carbon, and elastomers shall be EPDM. Copper piping for recirculation shall be provided from the discharge side of pump to the seal (API Plan 11). The seal installation shall be inspected by the seal manufacturer prior to testing the pump.

3. Provide throat bushing, SpiralTrac Version F or approved equal.

4. Drip pockets shall be provided for all water sealed glands and the Installation Contractor shall provide piping to common drains handle leakage.

5. Pump Manufacturer shall verify compatibility of mechanical seal, throat bushing, and seal water system.

E. BEARINGS

Bearings shall be oil lubricated anti-friction ball type adequately sized to carry radial and thrust loads without the addition of external cooling. Anti-friction bearings shall have a L-10 bearing life of 100,000 hours at the rated head and flow of the pump in accordance with the standards of the Bearings Manufacturers Association. No cast-in bearings will be allowed, so that a spare rotating assembly could be easily installed. Bearings oil baths shall have a constant level oiler. Bearing oil bath shall be designed for adequate lubrication at maximum forward and reverse speeds.

F. BEARING TEMPERATURE SENSORS

Each pump shall be equipped with four 100-ohm platinum RTDs to detect bearing temperatures. RTDs shall be mounted on the inboard and outboard bearing, and not the bearing oil bath. The RTDs leads shall terminate in one electrical box on barrier type terminals with stainless steel screws. Terminations to the terminals shall be with ring type connectors.

Terminal blocks shall be 600V, NEMA rated. Leads shall be suitably marked and identified with heat shrink markers. Accessories terminal boxes shall be located on the same side of pump as motor terminal box. Accessories boxes shall have phenolic nameplates, white with black lettering, attached with stainless steel screws. The nameplates shall say "PUMP BEARING RTDs." Accessories boxes shall be bottom or side entry. Conduit shall be rigid aluminum, and conduit location shall not interfere with pump maintenance. Accessories box shall be sized to accept 1" conduit for bearing RTDs. Boxes shall have a NEMA 4X rating and be 316 Stainless Steel. Inside accessories box provide tagging clearly identifying which RTD (inboard, outboard) that the terminal blocks are wired to. Provide picture of proposed tagging scheme for Engineer review and comments.

G. COUPLING AND GUARD

Flexible couplings shall be the heavy-duty type, designed so that the pump shaft may be removed without disturbing the position or adjustment of the driving unit. Coupling shall be all stainless steel, Kop-Flex Fast's gear coupling as manufactured by Emerson Power Technologies, or approved equal. Minimum factor of safety of 1.5 times shaft strength shall be used. Horizontal surface of the coupling shall be machined parallel to the axis of the shaft, and faces shall be machined perpendicular to the axis of the shaft. Provide an appropriate coupling guard, acceptable to OSHA, securely attached to the pump base with stainless steel bolts and nuts.

H. PUMP AND MOTOR BASE

Pump and motor shall have a common one-piece base. The length and width of the base shall be of suitable size for the equipment to fit within the limits of the concrete block pump support as shown on the drawings. The base shall be fabricated steel of sufficient strength and depth to ensure rigidity and so designed as to make a good appearance and provided with adequate grout holes. The base shall be heat induced stress relieved, at the factory prior to shipment. The base shall be provided with planed supports or bearing pads for the pump and motor. Base shall be drilled to receive a suitable number of foundation bolts. Base shall have a minimum of eight heavy duty jacking bolts welded to the base, positioned around the motor base to aid in alignment. Stainless steel foundation bolts complete with sleeves, washers, nuts, etc., shall be furnished for each pumping unit by the pump manufacturer. The pump and motor shall be mounted on the supports or bearing pads with full faced stainless steel shims. The Equipment Manufacturer shall furnish foundation bolts, sleeves and a steel template for setting anchor bolt and sleeves and shipped ahead of the pumps as necessary to meet the schedule of installation by the Installation Contractor.

I. PUMP PAINTING

1. All exterior surfaces, including the pump base, shall be painted per System No. 2 as specified in Section 09 96 00.01, HIGH PERFORMANCE COATINGS. The prime coatings shall be shop-applied prior to shipment and the final coat shall be shop-applied to match adjacent piping. Between the prime coat and intermediate coat, apply a separate strip

coat on all angles, edges, welds, and bolted connections where coating film build will be reduced.

2. Coat interior of pump casings with a ceramic epoxy coating. Prepare surface to SSPC–SP-10 minimum, or as recommended by the coating manufacturer. Prime and finish coat shall be 10 mils each DFT Belzona 1341NSF efficiency enhancement coating system for potable water. Perform a holiday test and correct all defects. Interior coating shall be applied prior to factory testing. Interior coating shall be smooth for efficiency. Holiday test coating using high voltage spark testing at a maximum voltage of 125 volts per mil. Wet sponge holiday testing will not be acceptable.

J. SPREADER BAR

The Equipment Manufacturer shall furnish a spreader bar that is suitable for lifting the motor and pump casing. The spreader bar shall be designed to minimize vertical space requirements and safely balance the load. The spreader bar shall have hooks for each size of motor and pump or shall be adjustable. The spreader bar shall be made of steel with the maximum capacity painted on the beam.

2.02 4000 VOLT MOTORS

A. GENERAL

1. Motors shall be horizontal, air cooled, solid shaft, copper wound stator, copper bar rotor construction, squirrel cage induction type. The motors shall be designed for starting using across the line starter and adjustable frequency drive. The motor supplier shall be responsible for coordinating with the adjustable frequency drive supplier (to be determined at a later date) to meet the requirements of this specification.

2. Horsepower nameplate rating of motor, at the 1.0 service factor, shall be equal to or greater than the total horsepower requirement of the pump when operating at any head between shut-off and minimum specified operating heads. Motor shall have a service factor of 1.15 and shall be designed and manufactured in accordance with applicable provisions of the latest NEMA Standard Publication for Motors and Generators, MG-1 Part 20, subject to modifications and additions as herein set forth.

3. The variable frequency drive (VFD), and motor shall be completely compatible electrically. The variable frequency drive supplier and the motor supplier shall together issue a guarantee of compatibility once the VFD manufacturer has been determined. The motor suppler shall determine the insulation voltage rating required to accommodate common mode voltage and prevent insulation failure.

4. Motors shall be rated for inverter duty per NEMA MG-1, Part 31.

5. The locked rotor torque and breakdown torque shall not be less than shown in NEMA 20.10.

6. The locked rotor KVA/HP shall not exceed NEMA code Letter F, 5.59 KVA/HP.

7. Motor shall have a sound power level of no more than 80 dBA average at 1 meter (3.3 ft) distance when measured per IEEE Std. 85 “Test Procedure for Airborne Measurements on Rotating Electrical Machinery”.

8. Rotor shall be “precision” balanced to within an amplitude peak to peak in accordance with the requirement of NEMA MG-1.

9. Rotor bars and end rings shall be copper or copper alloy (no substitution). The rotor bars shall be swaged. The end rings shall be joined to the rotor bars by high frequency induction brazing. The rotor cores shall be held together by through-bolts and end plates.

10. The stator shall have all connections brazed with silver brazing alloy. The stator shall be braced and supported to eliminate any detrimental winding movement.

11. The stator core shall be built up with high grade, non-aging laminated silicon steel, C5 or better in accordance with ASTM A 345. Each lamination core shall be plated to minimize eddy current losses. The laminations shall be adequately secured to the stator frame and securely held in place at each end. There shall be no perceptible buzzing of laminations during operation. Provide slot wedges for rigidity.

12. Stator windings to be designed to have surge withstand capability of 3.5 p.u. at rise time of 0.1 to 0.2 μs and 5 p.u. at a rise time of 1.2 μs or longer.

13. Motor shall be rated at 4000 volts, 3-phase, 60 hertz.

14. Motor efficiency shall not be less than 95% and power factor not less than 85% uncorrected when operating at full load and rated voltage and frequency. The VFD manufacturer will provide power factor correction capacitors to correct the power factor to 95% when the VFD is in bypass with the across the line starter.

15. Motors shall be capable of bringing the pumps up to speed with a closed control valve and 80% of rated voltage.

16. Motors shall be painted with two (2) coats of manufacturer's standard exterior enamel.

B. ENCLOSURE

1. Motor enclosure shall be Weather Protected NEMA Type II in accordance with NEMA MG-1. Arrange air discharge louvers to direct air in an upward direction.

C. INSULATION

1. Motor windings shall be full Class F insulated. Motor leads shall have the same insulation class as the windings. After stator assembly, the stator assembly shall be sealed vacuum-pressure impregnation (VPI) of epoxy resin. The stator shall receive two

VPI treatments, each treatment consisting of a dip followed by an oven bake. After the final cure, the stator assembly shall receive a final (third) coating of a durable epoxy varnish to further protect against dust, moisture, and chemical degradation. The windings shall comply with the latest applicable provisions of NEMA MG-1, and end winding coils shall be braced to limit displacement to no more than 5.0 mils under any condition of starting or running.

2. Motor shall operate continuously while driving the specified pump at rated voltage and frequency (6 to 60 hertz) at 50°C ambient temperature, with a temperature rise not to exceed both:

   a. A Class B rise (70°C), per NEMA MG-1 20.8, measured by resistance at a 1.0 service factor when operating at 100% of the nameplate rated horsepower.

   b. A Class B rise (80°C), per NEMA MG-1 20.8, measured by embedded detector (RTD) at a 1.0 service factor when operating at 100% of the nameplate rated horsepower.

3. Insulation shall be capable of preventing failure as a result of common mode voltages.

D. BEARINGS

1. Bearings shall be ring oiled, split-sleeve type. Bearings shall be insulated to prevent shaft-bearing-frame current. Insulating means shall also be provided for any oil-supply connections and monitoring equipment to prevent electrical bypassing of the bearing insulation. Provide grounding brush on shaft as required for the elimination of the circulating currents.

E. MOTOR TERMINAL BOX

1. Motor terminal box shall be of adequate size to accommodate stress cones to make up cable terminations of 5000 volt shielded cable. Motor terminal box shall be suitable for terminating 1 set of (3-350 kcmil, #4G. in a 4” Conduit) without exceeding minimum bending radius per National Electrical Code. Terminal box shall be provided with standoff insulators and suitable for terminations using a NEMA two-hole long barrel compression lug. The minimum vertical distance from the bottom of motor terminal lugs to the bottom of the box shall not be less than 26”.

2. The box shall be located on the left side (NEMA F1) of the motor when viewed from the connecting shaft. Terminal box shall be designed for bottom entry and shall have removable sides to allow for easy access. Terminal box shall be adequately insulated to prevent excessive vibration. Terminal box shall be supported by motor frame. Terminal box dimensions, size, position, and layout shall be submitted for Engineer’s approval.

F. ACCESSORIES TERMINAL BOXES

1. Motor shall have accessory leads from space heaters, RTDs and vibration sensors terminated in separate boxes. Leads for space heaters and RTDs shall be terminated on

barrier type terminals with stainless steel screws. Terminations to the terminals shall be with ring type connectors Leads for bearing and winding RTDs shall be brought to the same box. Leads shall be suitably marked and identified with heat shrink markers. Accessories terminal boxes shall be located on the right side (NEMA F2) when viewed from the connections shaft.

2. Accessories boxes shall have phenolic nameplates, white with black lettering, attached with stainless steel screws. The nameplates shall say “SPACE HEATER”, “BEARING RTD’S”, “WINDING RTD’S”, “VIBRATION INSTRUMENTS”, etc. Accessories boxes shall be bottom or side entry. Terminal blocks shall be 600V, NEMA rated. Provide nameplates on terminal blocks in RTD accessories box clearly identifying what each RTD is associated (ex: Winding Phase A, etc. and Bearing Drive end, Non-Drive end).

3. Accessories boxes shall be sized to accept conduits of the following sizes:

    a. Winding/Bearing RTDs: one (1)-2” conduit

    b. Motor Space Heater: one (1)-1” conduit

    c. Vibration Switches: one (1)-1.5” conduit and one (1)-1” conduit.

4. Accessories boxes sizes, position and layout shall be submitted to the Engineer for approval.

5. Terminal boxes shall be bottom or side entry for all field cabling.

6. Terminal boxes shall be bottom or side entry for all internal factory routed cabling. No top entry into the terminal boxes is acceptable.

G. GROUNDING MEANS

1. Provide a grounding lug threaded into the motor frame, within the motor terminal box and other motor conduit boxes. Lug shall be similar and equal to Burndy KC Servit. Provide two NEMA 2-hole stainless steel grounding pads on diagonally opposite corners of motor frame. Ground pads shall be stainless steel and suitable for terminating #4/0 ground conductor.

H. APPURTENANCES: All wires and electrical connections shall be copper. All wiring penetrating motor frame shall be protected against chaffing with a rubber grommet.

1. Space Heaters: Motor shall be equipped with space heaters for operation on 120 volt, 60 hertz, single-phase. They shall maintain the internal temperature above dew point when motor is not operating. Space heaters shall not be located directly in the access holes where they may pose a danger of burn or shock to servicemen. Space heater wiring shall be routed to prevent wire being between the frame and the space heater.

2. Temperature Monitors: Motor shall be equipped with nine 100-ohm platinum resistance temperature detectors (RTD), three per phase, spaced around the motor windings and located at the hot spots of the stator. In addition, each bearing shall have a 100-ohm platinum RTD installed for sensing bearing temperature and integral to the bearing housing.

3. Vibration sensors and switches:

    a. Each pump and motor combination shall have four (4) vibration sensors (transducers). All sensors shall be located in the horizontal axis in the following locations: Outboard Pump Bearing Housing; Inboard Pump Bearing Housing; Outboard Motor Bearing Housing; Inboard Motor Bearing Housing. Sensors shall be wired back to the vibration switches (one switch for each sensor) located in a NEMA 4 junction box located on or near the motor. All control wires shall be brought to the junction box. Junction box shall be termination point for vibration sensors' control cable. All vibration sensors shall be provided with integral cable of sufficient length to be routed to the junction box located on the motor. Pump and Motor vibration sensors shall be factory mounted.

    b. Vibration switches shall be provided with a 4-20mA output for remote monitoring. Vibration switches shall be provided with mechanical relays with isolated contacts for external alarm and shutdown purposes. Relay shall be SPDT and rated for 10 amps. Vibration switches (X and Y axes) shall have their normally open alarm contacts wired in parallel and their normally open shutdown contacts wired in parallel in the junction box to be used by OWNER for remote indication of common alarm and common shutdown.

    c. An external terminal strip shall be mounted in junction box for terminating field wiring for common alarm and common shutdown signals and also the 4-20mA signals. Any wiring between the vibration switches and the terminal strips is the responsibility of the vibration switch/ motor supplier. Terminals shall be NEMA rated 600V. Cable for wiring of 4-20mA signals shall be shielded, twisted pair, 600 Volt rated.

    d. Vibration sensors (transducers) shall be Metrix Model SV6300 or approved equal. Vibration switches shall be Metrix Model 440DR or approved equal.

4. Conduits

    a. Liquidtight flexible metal conduit shall be UL Listed and shall be Anaconda Sealtite, Type HTUA by Anamet Electrical, or equal. Fittings used with liquidtight flexible metal conduit shall be of the screw in type with insulated throat by Thomas & Betts Co.; no equals.

b. Rigid aluminum conduit, couplings, factory elbows, and fittings shall be 6063 alloy by Allied Tube & Conduit Co., or approved equal. Conduit hubs shall be insulated throat by Crouse-Hinds.

c. Liquidtight strain relief cord and cable connectors shall be Series LS by Crouse-Hinds, or approved equal.

d. Design neat layout of conduit from sensors to the accessory terminal boxes. Submit a detailed layout Drawing to the Engineer for review.

e. All conduits and wire shall be routed and installed in an identical fashion for like motors.

f. Minimum conduit size shall be 3/4-in.

g. Top conduit entry into accessories terminal boxes is not acceptable.

5. Mounting Hardware – All mounting hardware including, but not limited to strut channels, clamps, etc., shall be 316 stainless steel.

6. All appurtenance boxes shall be laid out to avoid overlap and access limitations to the boxes. Appurtenance boxes shall be secured with stainless steel screws.

I. DOCUMENTATION

1. Motor Manufacturer shall supply documentation for the motors as follows:

a. Complete dimensional data including the following:

1). Dimensional outline drawings

2). Maintenance clearances

3). Locations and sizes of lubrication connections, vents, drains, etc.

b. Letter of Coordination: The Motor Manufacturer shall provide a Letter of Coordination indicating that the VFD manufacturer has coordinated with the Motor Supplier on the size of the PFCC unit, and that the size of the PFCC unit being provided is acceptable for use with the motor being provided and will not overexcite the motor. The PFCCs will be installed in the VFD, but will come on-line when the VFD is in bypass mode and the motor is running across the line.

c. Letter of Compatibility with VFD Manufacturer: The Motor Manufacturer in conjunction with the VFD manufacturer shall issue a letter of compatibility stating that the VFD and motor are compatible.

d. Data Sheet: Fill out and submit with the Shop Drawing submittal the information requested on the Motor Submittal Data Sheet (included in the proposal)

e. Complete nameplate data. Motor nameplate data as a minimum shall include the following: HP, RPM, Volts, FLA, Service Factor, Ambient Ratings, Locked Rotor kVA/HP, Inverter Duty and Enclosure Type.

f. Allowable time periods between starts.

g. Subtransient reactance and X/R.

h. Speed-torque curve at 100%, 80% and 75% of rated voltage.

i. Speed-current curve at 100%, 80% and 75% of rated voltage.

j. Acceleration time at 100%, 80% and 75% of rated voltage.

k. Thermal damage curve (I^2t)

l. Locked rotor withstand time.

m. Rotor inertia.

n. Schematic and interconnection diagrams.

o. Bearing descriptions.

p. Motor weights.

q. Alarm and shutdown values for temperatures of the winding and bearing RTDs.

r. Alarm and shutdown values for vibration switches.

s. Motor Insulation Voltage rating.

t. Detailed conduit layout for motor

u. Dimensions and layouts of terminal box and accessories terminal boxes.

v. Elevations of motor showing vibration sensors on the motor with associated cable routing, cable supports details, and connection details

w. Maximum kVAR allowed for power correction without overexciting the motor. Maximum allowed kVAR shall be included on the motor nameplate as well.

x. Bill of Materials with Manufacturer's cut sheets for all major equipment, RTD's, bearings, vibration sensors/switches, terminal blocks, etc. Clearly identify on cut sheets the exact model number being provided.

y. Updated speed-torque curves, speed current curves and acceleration time curves at 100%, 80% and 75% of rated voltage after motor test has been completed.

z. Measured locked rotor current and torque, and locked rotor power factor.

aa. Motor no load data (i.e. amps, power factor, etc.)

bb. Instruction manual.

cc. Results of tests.

2. Note: All documentation listed above shall be supplied with the motor's initial submittal with the exception of the motor test results and instruction manual, which shall be furnished later on in the project. Incomplete submittals will be returned "Not Approved, Revise and Resubmit".

2.03 SPECIAL TOOLS

Furnish with the equipment, one (1) set of any special tools or devices required for the assembly, operation, and maintenance of all equipment furnished, including but not limited to a spreader bar and Altek RTD calibrator.

2.04 LUBRICANT

Furnish with the equipment, oil of the recommended type and grade, in sufficient quantity for initial filling, operation during acceptance tests, and as listed in Section 2.05 - SPARE PARTS. Advise Owner of type and available sources of lubricants. Manufacturer shall specify ISO 4406 contaminant code cleanliness requirements of oil. Oil shipped to site provided to owner shall be pre-filtered to meet recommended ISO 4406 cleanliness requirements. Manufacturer shall provide oil sample analysis demonstrating compliance with the ISO 4406 requirement.

2.05 SPARE PARTS

A. Provide spare parts as follows:

1. One complete set of mechanical seals (one mechanical seal per pump supplied)

2. One complete set of wear rings (one wear ring per pump supplied)

3. All lubricants and other consumables necessary for first year of operation for all the pumps supplied or 2000 hours per pump, whichever is greater.

3.00 EXECUTION

3.01 GENERAL

A. The Equipment Manufacturer's Representative, including Motor Manufacturer, have responsibilities in the installation and field testing of the equipment as described in this section. Installation of equipment shall be performed by the Installation Contractor who shall be required to assemble the equipment and install it in accordance with Installation, Operation and Maintenance instructions which shall be furnished by the Equipment Manufacturer, the installation drawings for this project and applicable Installation Instructions of the Hydraulic Institute Standards.

B. The Installation Contractor shall schedule the service of the Equipment Manufacturer to assist in the assembly installation, lubrication, adjustment, testing and acceptance of the equipment.

C. The Installation Contractor shall furnish all labor, tools, equipment and machinery necessary to receive, inspect, unload, store, protect, and install completely, in proper operating condition, the equipment. Installation Contractor shall protect and store the motors indoors and as recommended by the manufacturer, keeping bearings lubricated and the motor space heaters energized during storage and until they are put into service.

D. The Installation Contractor shall also furnish such incidental items not supplied with the equipment, but which may or may not be described in the Plans and Specifications, for complete installation, such as welding, drain lines, gaskets, flange bolts for suction and discharge piping, connecting piping, wiring, conduit, ducts, mounting brackets, anchors and other appurtenances as necessary.

3.02 FIELD QUALITY CONTROL

A. GENERAL

1. The Equipment Manufacturer shall inspect and determine that the motor base has been installed correctly and field verified to the recommended tolerance prior to installation of the pump. This determination shall be made prior to grouting with the base properly welded or shimmed. Before placing the grout scarify the adjoining concrete and pour a non-shrink epoxy grout. After properly curing, remove the temporary wedges or shims and hand pack voids with grout. Then torque the anchor bolts to the appropriate values. A second inspection shall be made after the base has been completely grouted in place, but prior to installation of the pump.

2. Calibrated testing equipment shall be provided by the Equipment Manufacturer to measure setting, alignment, speed, noise, temperature, and vibration of the pump.

B. PRELIMINARY OPERATIONAL TEST

1. After the pumps have been installed, including all piping connections, and electrical system construction is complete, and after the piping has been tested, the Installation Contractor, with assistance from the Equipment Manufacturer, shall perform preliminary operational tests over a period of not less than two 10 hour tests or one 24 hour test.

2. The pumping units shall be operated throughout their full range of operating heads, if possible, recording data including suction pressure, pump discharge pressure, pump speed, flow rates, water levels, motor voltage and current, power factor, vibration, noise, deflection, pump and motor bearing temperatures, and winding temperatures, as applicable. This information shall be properly documented and included in the Equipment Installation report. The unit must perform in a manner acceptable to the Owner and Engineer before Final Acceptance of the installation will be made.

3. Vibration shall be no greater than the *Rotodynamic Pumps for Vibration Measurement and Allowable Values* as defined by the Hydraulic Institute Standards, except as modified by this specification above. Vibrations shall be measured in the x, y, and z direction on the outboard pump bearing and motor bearing. Vibrations shall be measured in the x and y direction of the inboard pump and motor bearings.

4. Vibration data shall be recorded for variable speed pumps within the specified operating speed range at increments of 5% from minimum speed to full speed. Actual pump rotational speed shall also be recorded with each vibration data set.

5. The Equipment Manufacturer shall furnish calibrated testing devices to measure setting, alignment, speed, noise, and vibration of the pump. Vibration data shall be recorded with a Vibscanner as manufactured by Pruftechnik or approved equal. The Equipment Manufacturer shall supply calibrated pressure gauges on suction and discharge of pump for use during testing.

6. Conduct a backspin test of the installed pumping unit. Allow reverse flow from the discharge piping at full operating head and measure speed and vibration of the pump and motor. Speed and vibration shall not exceed manufacturer's recommended limits.

7. The Installation Contractor and his Equipment Manufacturer shall be responsible for operating the equipment and recording and submitting the necessary data from the test. All information required above shall be properly documented and included in the Equipment Installation Report. The units must perform in a manner acceptable to the Owner and Engineer before Final Acceptance of the installation will be made.

8. The Equipment Manufacturer shall submit to the Installation Contractor an Equipment Installation Report certifying that the equipment is properly installed, lubricated, is in accurate alignment and is free from undue stress from connecting appurtenances, that it has been operated under full load conditions and that it is operating satisfactorily. The Installation Contractor shall provide copies of the report as required by this specification and SECTION 01 33 00, "Submittal Procedures".

9. The cost for power required for the test shall be borne by the Owner.

C. SYSTEM OPERATIONAL TEST

1. After the preliminary operational test is complete and prior to final acceptance of the project, the Installation Contractor shall conduct a 30-day system operational test. The Owner will be responsible for operating the equipment and recording data during this test. The Equipment Manufacturer, Installation Contractor, and any subcontractors will be responsible for troubleshooting and adjustments to the equipment during the test. The 30-day test is required to achieve Substantial Completion – the purpose of the test is to demonstrate and check the ability of the pump to operate continuously as the system requires.

2. The cost for power for the System Operational Test shall be borne by the Owner.

END OF SECTION

ATTACHMENT A

PUMP DATA SHEET – HORIZONTAL SPLIT-CASE PUMPING UNITS

Submit the following data for the Pumping Unit:

Pump Data

1. Make and Type Design _____
2. Full Speed _____
3. Speed at Duty Point No. 2 _____
4. Impeller Diameter and Material _____
5. Shutoff Head _____
6. Suction/Discharge Diameters (inches) _____
7. Impeller Specific Speed _____
8. Maximum Backspin Speed _____
9. Suction Specific Speed _____
10. Maximum Brake Horsepower _____
11. NPSH Required at Rated Head _____
12. NPSH Required at Minimum Head of 95' (full speed) _____
13. Wire-to-Water Efficiency at Efficiency Evaluation Point #1 _____
14. Wire-to-Water Efficiency at Efficiency Evaluation Point #2 _____
15. Rotor polar moment of inertia WR^2 or equivalent WR^2, as viewed from the pump end for the driver, coupling, pump and enclosed fluid as applicable. _____

Weights (indicate dry and wet)

1. Pump _____
2. Motor _____
3. Complete Unit (including Mounting Base) _____

Miscellaneous Information

1. Motor Factory Test Location (City, State, Country) _____
2. Pump Factory Test Location (City, State, Country) _____

THIS FORM MUST BE RETURNED WITH YOUR BID

ATTACHMENT B

MOTOR DATA SHEET – HORIZONTAL SPLIT-CASE PUMPING UNITS

Submit the following data for the Pumping Unit:

Motor Data

Manufacturer	_____	Motor HP	_____
Frame	_____	Enclosure	_____
Type	_____	RPM	_____
Voltage	_____	Phase	_____
Starting Method	_____	Hertz	_____
Shaft Size	_____	Rotor WK2 (lb-ft2)	_____
Insulation Class	_____	Duty	_____
Full Load Amps	_____	No Load Amps	_____
Locked Rotor Amps	_____	Locked Rotor Torque	_____
Locked Rotor Torque	_____	% Breakdown Torque	_____
Locked Rotor KVA/HP	_____		

NEMA Design _____

Service Factor _____

Inrush Current (% of Full Load) _____

Max Safe Stalled Time (seconds) _____

Number of Safe Starts Per Day _____

Number of Consecutive Starts _____

*Full Load Temp Rise, in Degree Celsius over 50 Celsius Ambient (at 1.0 S.F.) _____

*Service Factor Temp Rise, in Degree Celsius over 50 Celsius Ambient (at 1.15 S.F.) _____

*Limiting Temperature Rise

Resistance (at 25° C):_____

Bearings: Type/Size _____ Life _____ Lubrication: _____

Exhaust Air (CFM): _____ Exhaust Air Temp Rise (°F): ____

	Efficiency	Power Factor	Current
1.15 S.F. Load	_____	_____	_____
4/4 Load	_____	_____	_____
3/4 Load	_____	_____	_____
1/2 Load	_____	_____	_____
1/4 Load	_____	_____	_____

Vibration Alarm and Trip Set Point _____

RTD Types and Mounting _____

RTD Alarm and Trip Set Point _____

Motor Sound Power Level _____

Motor Recommended Power Factor _____

Space Heater Voltage _____ Wattage _____

THIS FORM MUST BE RETURNED WITH YOUR BID

ATTACHMENT C

PUMP AND MOTOR MANUFACTURER QUALIFICATIONS STATEMENT

Bidders must submit documentation, with their Proposal prior to the Proposal opening, of their and their pump and motor suppliers qualifications and experience with projects similar to this project involving pumps with horsepower, speeds, heads and NPSH requirements similar to the pumps being proposed. Provide additional copies as necessary for multiple Pump Proposals. Provide the information required below and that required by the individual technical specification sections. Attach additional information as appropriate.

A. Offeror:
   1. Name: _____
   2. Address: _____
      _____

B. Pump Manufacturer:
   1. Name: _____
   2. Address: _____
      _____

C. Motor Manufacturer:
   1. Name: _____
   2. Address: _____
      _____

D. Qualifications and Experience: Please attach information.
   1. Firm's years of experience as manufacturer
   2. Firm's years of experience under present name

E. Firm's local sales representative: Attach for each supplier/manufacturer.
   1. Name: _____
   2. Planned Role: _____
      _____
      _____

3. Qualifications: _____

_____

_____

4. Experience: _____

F. Firm's local service representative: Attach for each supplier/manufacturer.

1. Name: _____
2. Planned Role: _____

_____

_____

3. Qualifications: _____

_____

_____

4. Experience: _____

G. Firm's plan to subcontract the Work. State planned role in project along with Subcontractors' qualifications and experience. Attach additional information and sheets as appropriate.

1. Name: _____
2. Planned Role: _____

_____

_____

3. Qualifications: _____

_____

_____

4. Experience: _____

H. List up to five major projects currently in progress on this date. State owner, architect or engineer, and construction contractor.

Project	Contractor	Engineer

I. List up to five major projects with pumps completed in the past five years.

1. _____
2. _____
3. _____
4. _____
5. _____

J. List names, address, and telephone number of a reference for each project listed under I above.

1. _____
2. _____
3. _____
4. _____
5. _____

K. List name and construction phase experience of the individuals of your firm who will be assigned as office and field representatives.

_____

_____

_____

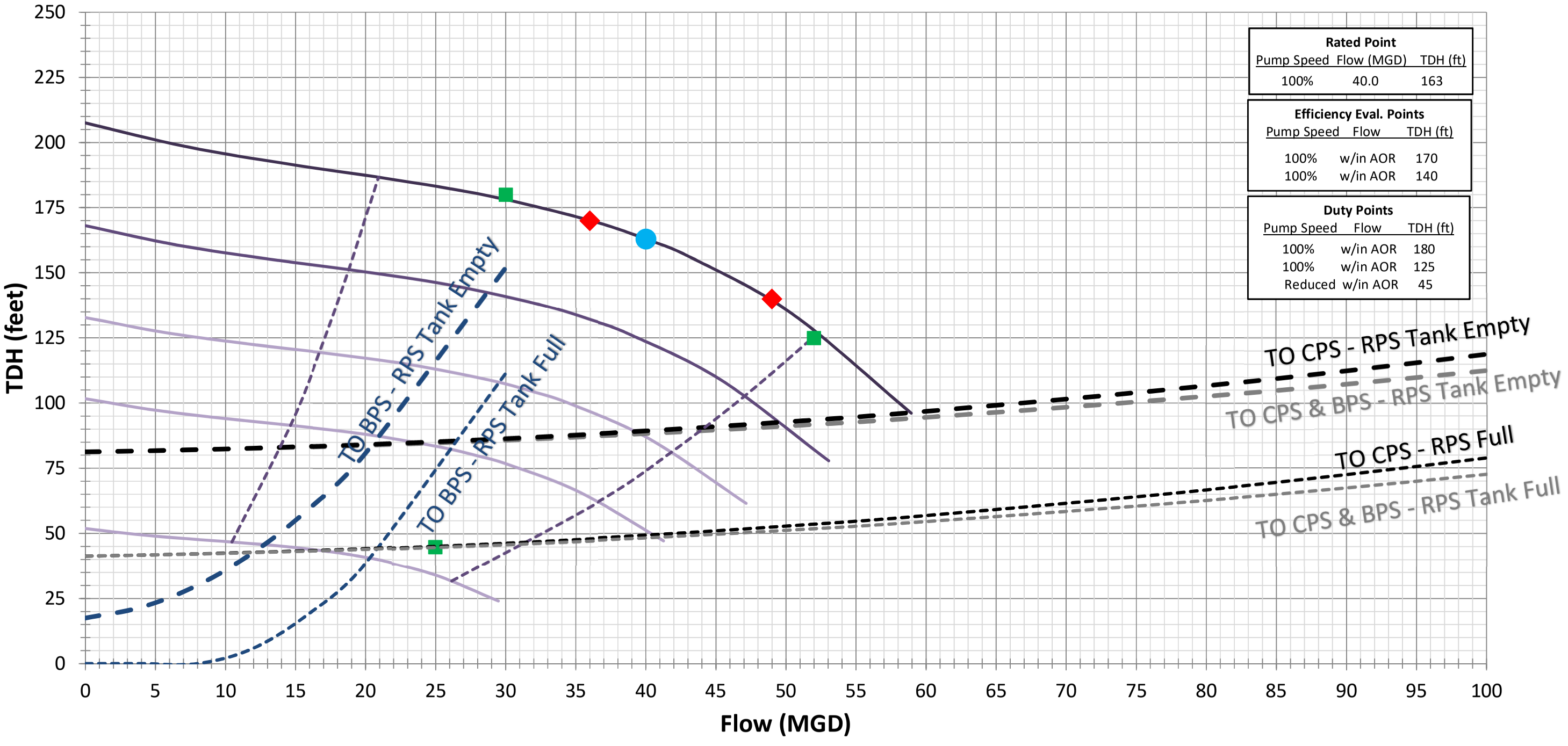
_____

_____

L. Attach detailed resumes of individuals of your firm or your subcontractor(s) who will perform the key duties of this project, including project manager, field representative, and systems checkout/startup/testing specialist.

THIS FORM MUST BE RETURNED WITH YOUR BID

Attachment C
System Curve Showing One Pump



43 41 43 SINGLE WALL HIGH DENSITY CROSS-LINKED POLYETHYLENE STORAGE TANKS

1.00 GENERAL

1.01 DESCRIPTION

A. Scope: The Contractor shall provide all labor, materials, equipment and incidentals required to provide single-walled, high-density, cross-linked polyethylene (HDXLPE) flat-bottomed vertical storage tanks complete and operational with accesso¬ries as shown and specified, for the chemical storage described herein.

B. Related Sections:

1. Division 33 Sections on piping.

2. Section 40 90 01, Instrumentation.

3. Division 40 sections on valves.

1.02 QUALITY ASSURANCE

A. Manufacturer Qualifications: The tanks shall be supplied by a single manufacturer having a minimum of five years experience in the design and manufacture of single-walled HDXLPE tanks.

B. Quality Control:

1. The tank manufacturer shall have quality control procedures adequate to ensure that all tank fabrication complies with these specifications. Quality control shall include a final inspec¬tion. The objective of the manufacturer's quality control and inspection procedure shall be to have the tanks comply with the specifications and drawings at the time of first inspection, thus eliminating any need for rework by the manufacturer or a second inspection.

2. Manufacturer's inspection of the tanks shall include the following:

a. Thickness measurements.

b. Measurements showing compliance with dimensions and tolerances and fittings.

c. Surface quality: Presence of pits, foreign inclusions, dry spots, air bubbles, delamination, crazing, cracking and pimples.

3. All cutouts from each tank shall be retained and upon request shall be delivered to the Engineer.

4. Requirements of Regulatory Agencies: Comply with applicable provisions of regulatory agencies below and others having jurisdic¬tion:

    a. Local and State Building Codes and Ordinances.

    b. Texas Commission on Environmental Quality.

5. Comply with ASTM D-1998, latest edition, “Standard Specification for Polyethylene Upright Storage Tanks”.

C. Shop Tests:

1. Testing, inspection, and acceptance criteria shall conform to the applicable codes, standards, and requirements stated herein.

2. All deficiencies or malfunctions which occur during the tests shall be corrected and the test repeated. Defective material shall not be repaired and used in the construction of the supplied equipment, without prior approval of the Engineer.

3. Submit to the Engineer results of impact test, gel-test, and visual inspection. Test methods shall be per ASTM D1998.

4. Hydrostatic Test: Tanks shall be filled with water and checked for leaks for no less than two hours after filling. Allowable leakage shall be zero. Hydrostatic test shall be performed after all fittings are installed.

1.03 SUBMITTALS

A. Shop Drawings:

1. The manufacturer shall furnish complete detailed shop drawings and descriptions of the tanks. Shop drawings shall show fabrication, assembly, and installation instructions and diagrams. Tanks shall not be manufactured until the shop drawings are approved by the Engineer.

2. Furnish detailed drawings for tank installation on concrete pads. The detailed drawings shall contain the number, size and location of anchoring devices required for each tank.

3. Submit manufacturer's literature, illustrations, specifications and engineering data including: tank dimensions, materials, size, and wall thickness.

4. Provide manufacturer’s literature on dome fittings and other appurtenances.

5. Submit a statement from the Manufacturer certifying the tank material compatibility with each specified chemical.

B. Test Reports and Inspection Records:

1. A separate inspection report shall be provided for each tank. Through the Contractor, the manufacturer shall send a copy of the inspection records to the Engineer for review prior to tank shipment.

2. Hydrostatic test results shall be submitted to the Engineer for each tank prior to tank shipment.

C. Operation and Maintenance Data:

1. Upon receipt of approved shop drawings, submit three copies of a complete Operation and Maintenance Manual per Section 01 78 23.

2. Provide a written guarantee for a minimum period of five years from the date that the tanks are placed into continuous operation that each tank will perform the service for which it is intended and designed, and should it fail to do so, it will be modified or replaced at no cost to the Owner.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery:

1. The Contractor shall arrange for delivery, unloading, and storage of the tanks and all appurtenant items.

2. The Contractor shall require the manufacturer to assume responsibility for packaging to prevent transit and handling damage to the tanks. The tanks shall be shipped with temporary bracing, as required, to maintain shape during transportation, storage, and handling and to protect flange fittings.

3. All tank openings shall be covered to prevent entrance of dirt, water and debris during shipping.

B. Storage:

1. The Contractor shall obtain from the manufacturer all requirements for field storage. Items not amenable to outdoor storage shall be noted and storage requirements shall be provided prior to delivery.

2. Store equipment in a manner to permit easy access for inspection and identification. Store equipment in covered storage, off the ground, using pallets, platforms, or other supports.

1.05 SUBSTITUTIONS

A. Should equipment which differs from the Contract Documents be offered and determined by the Engineer to be equal to that specified and shown, such equipment shall be acceptable only on the basis that any revisions to the design and/or construction of the

structure, piping, or appurtenant equipment required to accommodate such a substitution shall be made at no additional cost to the Owner and be as approved by the Engineer. Substitutions shall be per Section 01 60 00 and the General Conditions.

2.00 EQUIPMENT

2.01 MANUFACTURER

A. The specified tanks shall be furnished as a system by the tank manufacturer who shall be responsible for integration of all system components. The tank manufacturer shall review and approve all submittals for all system components furnished under this section.

B. Tank Manufacturer:

1. Assmann Corporation of America.
2. Snyder Industries, Inc.
3. Or Approved Equal.

2.02 SERVICE CONDITIONS

A. The tanks shall be suitable for continuous 24 hour per day operation in an outdoor, environment. The maximum ambient temperature shall be 120°F and the minimum ambient temperature shall be 15F. Tanks shall be used for bulk storage of the chemicals listed below.

1. Liquid Ammonium Sulfate, 38% solution, specific gravity = 1.23.
2. Caustic Soda, 25% solution, specific gravity = 1.27
3. Sodium Hypochlorite, 12.5% solution, specific gravity = 1.18.

2.03 TANK SCHEDULE

A. Tank Schedule:

Chemical	Tank I.D.	Min. Nominal Volume (gals)
Sodium Hydroxide (Caustic)	CA001 CA002 CA003	8,400 (x3)
Liquid Ammonium Sulfate (LAS)	LAS001 LAS002	2,500 (x2)

Sodium Hypochlorite (Bleach)	SH001 SH002 SH003	6,400 (x3)

2.04 DETAILS OF CONSTRUCTION

A. Tank Materials:

1. The tanks shall be constructed of translucent HDXLPE capable of containing liquids with specific gravities as specified in paragraph 2.2.

2. The material used shall be virgin polyethylene resin as compounded and certified by the manufacturer.

3. All polyethylene resin material shall contain a UV stabilizer as compounded by the resin manufacturer. Pigments may be added, but shall not exceed 0.25% (dry blended) of the total weight.

4. Gaskets and seals shall be used for all fittings that are compatible with the stored chemicals.

5. Hardware for securing tank fittings shall be Type 316 stainless steel.

B. Tank Construction:

1. The assembly shall consist of one cylindrical, closed top tank. The top head of the tank must be integrally molded with the cylinder shell of the tank. The minimum thickness of the top head shall be equal to the top of the straight wall. The tank top shall be configured to prevent rainwater from accumulating on the top of the tank.

   a. The tank wall thickness shall be a continuous thickness from the base of the tank to the top sidewall of the tank.

2. Each tank shall be rotationally-molded, cylindrical, vertical and of seamless construction. Final location of all fittings will be determined in the field by the Contractor prior to submittal of shop drawings.

3. The Contractor shall field-verify access routes on which the tank is to be brought to the concrete pad prior to submittal of shop drawings.

4. No penetrations, holes, or other cuts shall be made in the sidewalls of any tanks.

C. Dimensions:

1. 2,500-gallon Tanks

   a. Maximum diameter: 8 feet, 3 inches.

b. Maximum height: 10 feet, 0 inches.

2. 6,400-gallon Tanks

a. Maximum diameter: 8 feet, 9 inches.

b. Maximum height: 16 feet, 0 inches.

3. 8,400-gallon Tanks

a. Maximum diameter: 12 feet, 0 inches.

b. Maximum height: 16 feet, 9 inches.

D. Appearance:

1. The finished tank surface shall be free from visual defects such as foreign inclusions, air bubbles, pin holes and craters.

2.05 ACCESSORIES

A. Storage tanks shall be provided with the following items located as shown on the Drawings. Exact orientation shall be determined by the Contractor in the field.

1. Minimum 24 inch diameter opening with non-vented cover in top of tank.

2. Flanged connection for tank fill line, diameter sized per drawings.

3. Flanged connection for pump suction line, diameter sized per drawings.

4. Dome fittings as specified below:

a. 3”-diameter flanged opening for ultrasonic level sensor.

b. Tank vent with chemical-resistant insect screen, diameter sized per drawings.

B. Fittings:

1. All fittings and flanges shall be made of a material that is resistant and to the chemicals being stored in the tanks.

2. Dome Fittings: Shall be ball and socket self-aligning, and shall be flanged, 150-lb. ANSI B16.5, connections.

3. Sidewall Fittings: shall be flanged, 150-lb. ANSI B16.5, connections.

C. Pipe Supports:

1. All piping outside of the tank, associated with fill and discharge, shall be secured without bolting to the sidewall.

D. Appurtenances:

1. For tank fill lines, tanks shall be furnished with a flanged end drop pipe inside the tank, connected to the fill connection at the top of the tank. The purpose of the pipe is to convey discharge into the tank to the tank bottom during filling operations to minimize splashing and turbulence. The pipe shall be the same diameter as its associated fill line. Pipe shall be PVC schedule 80. Pipe shall extend down to within 12 inches of the tank bottom.

2. The drop pipe shall be restrained from movement by means of a weight at the bottom of the tank, or some other device that does not require anchorage in the sidewalls of the tanks. The drop pipe restraint system shall allow for removal of the drop pipe.

3. Lifting Lugs: Lifting lugs shall be provided and shall be constructed of HDXLPE and capable of withstanding weight of empty tank with a minimum safety factor of 5. A minimum of three lugs shall be provided on each tank. Lifting lugs shall be constructed to prevent tear-out of the hole when in use.

4. Tie-down Lugs: Tie-down lugs shall be provided integral to each tank and shall be the same material as the tank. The CONTRACTOR shall furnish all required stainless-steel hardware necessary to secure the tank to the concrete pad, as recommended by the tank manufacturer. Tie-down lugs shall be placed and arranged on tanks so they do not protrude below bottom surface of each tank. The design, number and attachment of such lugs is the responsibility of the tank fabricator.

    a. The tie down system shall be designed to withstand 150 MPH wind loads when the tank is empty.

    b. The tie down system shall be resistant to the chemical stored in the tank. See the Tank Schedule in Section 2.3.A.

E. Access Ladders and Platforms

1. Access ladders and Platforms shall be provided on all chemical bulk storage tanks described in this section. Access ladder and platform shall be provided by the tank Manufacturer and of the tank Manufacturer’s design.

2. Use proper chemical resistant materials when anchoring the ladder to the tank dome or concrete pad. Safety cages shall not be added to ladders. Access ladders shall include a fall protection device in accordance with OSHA fall protection standards 2206; 1910.27.

3. The standing platform shall incorporate a grating surface and handrails in accordance with OSHA standards.

4. Ladders and platforms shall be constructed of a material that is resistant to the chemicals being stored in the tanks, such as FRP, and shall be resistant to UV degradation.

5. Ladders shall be supported entirely by anchorage to the concrete pad. No supports bolted through the sidewall are permitted.

2.06 IDENTIFICATION

A. Label: Permanently attach label to each tank with the following minimum information:

1. Chemical to be stored including:

a. Concentration.

b. Specific gravity.

c. Maximum temperature.

2. Tank manufacturer.

3. Date of manufacture.

4. Tank serial number.

5. Tank material.

6. Tank capacity.

B. Tanks shall be furnished with OSHA approved 20-inch by 24-inch chemical warning signs with NFPA 704 hazard numbers for the chemical services intended. Chemical signs shall include, as a minimum, the name of the product stored in the tank, signal word (danger, warning, caution), statement of hazard, precautionary measures, instructions in case of contact, exposure, etc. and NFPA 704 hazard numbers.

3.00 EXECUTION

3.01 INSPECTION

A. Inspection:

1. Inspect and verify that structures or surfaces on which the equipment will be installed have no defects which will adversely affect installation.

2. The Contactor and Engineer shall inspect each tank for defects, damage and conformance with the Specifications prior to installation. Should defects become evident during inspection, testing or within the guarantee period, the Contactor shall repair or replace the defective tank or fitting as approved by the Engineer.

3. Promptly report defects which may affect the Work to the Engineer.

3.02 INSTALLATION

A. Installation shall be in complete accordance with manufacturer's instructions. Factory-trained manufacturer's representative shall be present for unloading and installation of the tank.

B. Tanks shall be installed on neoprene bearing pads placed on the concrete pads as shown on the Drawings. Concrete pads shall have a smooth, troweled finish. The top of the pad shall be level.

C. Tanks shall be secured with 316 stainless steel anchoring devices in accordance with the manufacturer's recommendations.

D. The Contractor shall make adjustments required to place tanks in proper operating condition following installation.

E. The Contractor shall provide vertical pipe supports anchored to the concrete pad, independent of the tanks, to support fill and discharge pipes.

3.03 FIELD TESTING

A. After installation, each tank shall be field-tested by filling with potable water. The tank with its fittings shall hold water, without loss, or evidence of weeping or capillary action for a period of 24 hours prior to acceptance. The field test will be witnessed by the Engineer. Submit copies of the test report to the Engineer within seven days of completing the field test.

B. Upon successful completion of the test, the Contractor shall remove the water from the tank and dispose of it to a drainage point approved by the Owner and Engineer.

END OF SECTION

DIVISION 44

POLUTION AND WASTE CONTROL EQUIPMENT

44 42 60 SUBMERSIBLE SUMP PUMPS

1.00 GENERAL

1.01 WORK INCLUDED

A. Furnish labor, materials, equipment and incidentals necessary to install submersible sump pumps in the yard piping butterfly valve vaults, as shown in the plans. Each yard piping butterfly valve vault shall include a duplex sump pump system with two liquid level sensors (High and Low, both field adjustable) for automatic operation of the sump pumps and a sump pump control panel exterior to the vault. Manufacturer shall design and provide any wirings between liquid level sensors and the sump pump control panel (both Power and Control).

B. Duplex sump pump system shall be capable of operating pumps individually or together.

C. The sump pump, liquid level sensors, & control panel shall be by the same manufacturer.

D. Control panel shall allow for local automatic control or local manual control of the duplex sump pump system.

E. The pump supplier shall furnish discharge elbows, pump impellers, brackets, anchor bolts and anchor bolt layouts and bases, power cables, and control panels as indicated on the plans.

F. The pumps shall have a standard manufacturer's nameplate securely affixed showing the serial number, model number, manufacturer, ratings, and other pertinent nameplate data.

1.02 QUALITY ASSURANCE

A. Acceptable Manufacturers:

1. Aurora
2. Hydromatic
3. Sulzer
4. Flygt
5. Liberty
6. Zoeller
7. Approved Equal.

B. Manufacturer's Representative for Startup and Testing:

The services of the manufacturer's technical representative shall be provided for pre-startup installation checks, startup assistance, training of Owner's operating personnel, troubleshooting and other services as required to demonstrate that the sump pump operates properly as specified.

C. Testing:

1. Each pump and motor shall be performance tested at the factory. All pumps shall be tested with motor cables to be supplied with the pumps. Three copies of certified test

reports, including actual test records, shall be submitted and approved by the Engineer prior to shipment of the equipment.

2. Each pump shall be tested for performance at the factory to determine the head vs. capacity, and motor input power for the full speed at which the pumps are specified and shown on a certified performance test curve as continuous functions throughout the pump's performance range. Tests of models, prototypes or similar units will not be acceptable. All tests shall be run in accordance with the test code for centrifugal pumps of the Standards of Hydraulic Institute, latest edition. The motor and cable on each pump shall be tested for moisture content or insulation defects. After the test, the pump cable end shall be fitted with a shrink-fit rubber boot to protect it from moisture or water.

1.03 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00 "Submittal Procedures" and shall include:

1. Shop Drawings.

a. Shop drawings shall include a complete description of the equipment offered. Shop drawings shall include catalog cuts and pertinent engineering data required to fully evaluate the equipment. Characteristic curves shall be submitted with the shop drawings showing the capacity, head, efficiency, and brake horsepower throughout the full operating range of the pump. Complete specifications on the control equipment including a list of optional features shall be submitted with the shop drawings. Submittal data shall be in such form and so presented that the Engineer may readily review the data.

b. The Equipment Manufacturer shall submit with the shop drawings a list of 10 similar installations in Texas which have been in satisfactory operation for at least two years. Shop drawings not including this required information will not be accepted. Also, manufacturer must furnish evidence of having an authorized fully staffed and stocked service facility within 200-mile radius of the jobsite as well as having 24-hour parts availability.

c. Any deviations from the specifications should be clearly identified on a separate sheet of paper in the shop drawing submittal.

d. Data sheets supplying the following information for the pumping units shall be submitted with the shop drawings.

1). Pump:

Make and type of pump	
Speed	___ rpm
Horsepower at rated head	__ HP

2). Pump:

Total weight (pump and motor)	___ lb.
Rated capacity and head on pump curve	____ gpm @ ____ TDH

High and Low AOR points	___ High & __ Low TDH

e. Shop drawings shall be supplied to insure successful installation and operation of the pump and control system and shall consist of all of the following:

1). Sufficient detail to evaluate compliance with these specifications.

2). A detailed component list including manufacturer and catalog number.

3). Any deviations from the specifications should be clearly identified on a separate sheet of paper in the shop drawing submittal.

4). Warranty Information

5). Cut sheets on power/control cables

6). Cut sheets on motor protective devices – thermal switches and seal failure sensors

7). Rated full load horsepower

8). Rated volts

9). Number of phases

10). Frequency in hertz

11). Full load amperes (FLA)

12). Motor no load data (i.e. amps, power factor, etc.)

13). Locked rotor amperes (LRA) at rated voltage and Locked rotor KVA/HP.

14). Synchronous speed (srpm)

15). Guaranteed maximum slip at full load in percent

16). NEMA insulation system classification and description of manufacturer's method of application.

17). Temperature rise at rated full load by resistance temperature detector

18). Maximum ambient temperature for which motor is designed

19). Service factor

20). The temperature at which klaxon thermal switches operate

21). The limiting temperature rise by resistance as design and corresponding horsepower

22). Bearing size and calculation

23). Safe stall time

24). Number of safe starts in succession when starting from a 40 degree Celsius ambient, intermediate waiting periods, and other conditions for driving equipment with a NEMA standard Wk2 value

25). Efficiency at 1/4, 1/2, 3/4, full load; and service factor

26). Power factor at 1/4, 1/2, 3/4, full load; and service factor

27). Maximum kVAR allowed for power correction. Maximum allowed kVAR shall be included on the motor nameplate as well.

28). Surge protection information, including mounting details

29). Thermistors literature with wiring diagram.

2. Operation and Maintenance Manuals:

   a. Manuals shall be prepared by the equipment Manufacturer per Section 01 78 23 “Operation and Maintenance Data” and shall incorporate storage and installation instructions and operation and maintenance procedures, appropriate final certified shop drawings, performance curves, and test data. Manuals may be Manufacturer’s standard instructions, but shall be supplemented as necessary to cover any special feature not included in standard material. Submit preliminary manuals for review prior to delivery of the equipment.

   b. Manufacturer's written instructions for testing, adjusting, and reprogramming pump controllers.

   c. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

   d. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.

1.04 WARRANTY

A. Manufacturer shall warrant the equipment and motors furnished under this specification for a period of 1 year against defects in materials and workmanship and operational failure.

   1. In the event of failure of any part or parts of the equipment and motors during the first 1 year of service, provided that the equipment and motor has been operated and maintained in accordance with good practice, the Vendor shall furnish, deliver and install the defective part or parts at the Vendor’s own expense. Vendor is also responsible for pump and/or motor removal, reinstallation and freight.

   2. The first 1 year of service shall be interpreted as the 12 month period following the installation, adjusting and acceptance testing, and the start of actual operation of the equipment, or 24 months after delivery, whichever occurs first.

2.00 PRODUCTS

2.01 SUBMERSIBLE SUMP PUMPS

A. Each pump, motor, and cable assembly shall be furnished in one integral unit, factory assembled by the Pump Manufacturer.

B. The pump design shall be such that the pumping unit will be automatically and firmly connected to the discharge piping when lowered into place on its mating discharge connection. The discharge connection shall be permanently installed in the wet well. The

pump shall be easily removable for inspection or service, requiring no bolts, nuts or other fastenings to be disconnected.

C. The pump assembly shall also be capable of running dry or partially submerged for extended periods without any damage to the pump, motor, seals, or accessories.

D. Major parts, such as the stator casing, oil casing, sliding bracket, volute, and base coupling shall be constructed of cast iron or bronze. Surfaces coming into contact with the pumped liquid shall be protected by a factory-applied epoxy coating or shall be stainless steel. External bolts, nuts, and fastening hardware shall be a minimum 300 series stainless steel.

E. Pumps shall fit, be installed, and operate properly in the space indicated in the plans. Pump manufacturer shall coordinate dimensions of: vaults, openings, piping, etc. with contractor.

F. The motor shall be totally-encased, sealed, non-ventilating and shall have automatic thermal overload protection. The motor shall be suitable for plugging into a receptacle and shall be suitable for continuous duty.

G. The electrical cable entrance to the motor shall be provided with positive strain relief to prevent leakage or pullout of the cable in the event that a force is accidentally placed on the cable during the raising or lowering of the pump. Manufacturer's supplied cable shall be one continuous cable from pump to pump control panel. No splicing allowed. Provide stainless steel cable strain relief on each cable at top of sump pump pit.

2.02 PUMP CONSTRUCTION

A. Pump Volute: The pump volute shall be constructed of cast iron. A wear ring shall be provided in the volute which is constructed of 304 stainless steel with a minimum Brinell hardness of 300. For pumps smaller than 40 HP, stainless steel wear plate shall be acceptable in place of wear rings.

B. Impeller: The impeller shall be constructed of cast stainless steel, ASTM A487, CA-6NM Class "B" containing 13 percent chrome and four percent nickel. Impellers shall be enclosed, dynamically balanced, one-, two- or three-vane design. The impeller shall have a slip fit onto the motor shaft and drive key and shall be fastened using the manufacturer's standard technique. The impeller wear ring shall be 304 stainless steel, with a minimum Brinell hardness of 200.

C. Shaft: The pump shaft shall be series 421 stainless steel. Carbon steel shafts or shafts with sleeves of any type are not acceptable. The shaft shall be one piece construction without joints or stubs attached. All shafts shall be dynamically balanced and shall be amply sized to minimize shaft deflection. Shaft overhang shall not exceed 2.5 times the shaft diameter.

D. Mechanical Seals: Each pump shall be equipped with a double mechanical seal of the cartridge type or a balanced tandem-type design, running in an oil reservoir. The upper and lower faces of the rotating portion of the seal shall be made of tungsten carbide or a high quality silicon carbide. The two faces shall be held in contact by multiple springs or bellows to insure uniform face following of the rotating faces against the stationary faces. The entire seal shall be mounted within the oil chamber. The lower stationary seal face shall be made of tungsten carbide or a high quality silicon carbide. The seals shall require neither routine maintenance, nor adjustment, and shall not be damaged when the pump is run dry. When required, seal oil inspection shall be achieved without disassembly of the pump. The

seal shall not require the pumped liquid as a lubricant. All metal parts shall be 300 series stainless steel.

E. O-Rings and Fasteners: All mating surfaces of the pump and motor shall be machined and fitted with Viton or Buna-N O-rings where watertight sealing is required. Sealing shall be accomplished by the proper fitting of the parts and not be compression or special torque requirements. All external screws and fasteners shall be made of 300 series stainless steel.

F. Bearings: The impeller and motor shaft for each pump shall be suspended on two permanently lubricated ball bearings that are designed by the manufacturer for minimum 50,000-hour AFBMA B10 bearing life under the design conditions.

2.03 MOTOR AND CABLE

A. The motor shall be housed in either an air or oil filled chamber, watertight enclosure. The motor shall conform to NEMA design Class B, and incorporate minimum Class F insulation material to withstand a continuous operating temperature of 155 C (311 F). The pump and motor shall be capable of handling liquids with a maximum temperature of 40 C (104 F).

1. The motor shall be capable of sustaining up to 10 evenly spaced starts per hour.
2. The motor shall be capable of operating in dry or partially submerged conditions for extended periods without damage. If the motor is expected to be exposed for longer than 15 minutes, furnish air filled motors with a water jacket if required.
3. The nameplate motor service factor shall be at least 1.15.
4. The motor shaft shall be 400 series stainless steel.
5. The motors shall be 480-volt, 3-phase, 60-cycle.
6. Lead wires shall be suitable for operation in oil. The motor shall be provided with Klixon motor thermal switches embedded in the windings to protect the motor from burnout due to excessive heating.

B. If a larger motor than that listed in the schedule in section 3.04 of this section is proposed as an alternate, the Contractor shall be responsible for all modifications required to the electrical system, including starters, feeders to the equipment, feeders from the utility company, switch gear, etc. at no additional cost to the Owner.

C. The electrical cable entrance to the motor shall be provided with positive strain relief to prevent leakage or pullout of the cable in the event that a force is accidentally placed on the cable during the raising or lowering of the pump. The design of cable entry shall preclude specific torque requirements to insure a watertight and submersible seal. Cable entry shall consist of a single cylindrical elastomer or Buna-N grommet, flanked by stainless steel washers all having a close tolerance fit against the cable's outside diameter and the entry inside diameter and compressed by the body containing the strain relief function separate from the function of sealing the cable. One spare set of cable seal accessories shall be provided. The entry cable system shall be warranted as described in Paragraph 1.06, Warranty.

D. Wire leads entering the junction box chamber and motor shall be separated by a terminal board, which shall isolate the interior from foreign material gaining access through the pump top. Alternately, the junction box chamber shall be sealed from the motor with a poured epoxy seal with bared conductor to prevent wicking. The assembly shall provide ease of changing the cable when necessary using the same entry seal. Sufficient cable shall be supplied to extend from the motors to the pump control without splicing. Each pump shall be equipped with adequate cable to be routed from the submersible cable termination junction box to the pump without any splices at a minimum. The power cable shall be sized according to NEC and ICEA standards and also meet P122-MSHA approval and this classification shall be embossed on the cable. The cable entry junction chamber shall be isolated from the motor by a terminal board.

E. The junction chamber, containing the terminal board, shall be sealed from the motor by elastomer compression seals (O-ring). Connection between the cable conductors and stator leads shall be made with threaded compressed type binding post permanently affixed to a terminal board each with an individual O-ring to prevent liquid passage.

F. Each unit shall be provided with an adequately designed cooling system. Provision for external cooling and flushing shall also be provided, if the cooling system consists of a water jacket. Each unit shall have motor seal failure sensor(s).

G. The motor, cable, and electrical controls shall be sized, furnished, and installed so that the motor shall never exceed the nameplate rating at any point on the pumping curve.

H. Provide stainless steel cable strain relief on each cable at wet well roof slabs.

2.04 PUMP MONITORS

A. Provide a motor stator and cable entry leak sensor for each pump. The sensor shall be as manufactured by Flygt, Crouzet model NR series, or approved equal.

B. Provide a motor stator temperature relay as manufactured by Flygt, Siemens 3RS10 Simirel, or approved equal.

C. Provide a lower bearing sensor.

D. The pump monitors shall be mounted in the pump control panel.

3.00 EXECUTION

3.01 INSTALLATION

A. Install submersible sump pumps pump, control panel, and motor in accordance with manufacturer's recommendations.

3.02 FIELD QUALITY CONTROL

A. Upon completion of installation of the equipment, an acceptance test to verify the satisfactory operation of each unit shall be conducted. The Contractor shall provide the services of authorized representative to conduct all field tests. The test shall be conducted in a manner approved by and in the presence of the Engineer. The unit shall be checked for excessive noise, vibration, alignment, general operation, ease of removal, etc. All automatic and manual controls shall be tested to verify that they function in accordance with the

requirements. Verify that drive equipment operates without being overloaded. The unit must perform in a manner acceptable to the Engineer before final acceptance will be made by the Owner.

3.03 PAINTING

A. Pumps, motors, baseplates, and discharge elbows shall be painted in accordance with Section 09 96 00 “High-Performance Coatings” of these Specifications.

3.04 SCHEDULES

ID Tag	Number of Pumps*	Maximum Horsepower	Maximum Full Load Amps	Voltage	Design Flow (gpm)	Design TDH (ft)
RPS-YP1-SP	2	2 HP	8A	460V, 3PH	150	25
RPS-YP2-SP	2	2 HP	8A	460V, 3PH	150	25
RPS-YP6-SP	2	2 HP	8A	460V, 3PH	150	25
RPS-YP7-SP	2	2 HP	8A	460V, 3PH	150	25

*RPS-YP1-SP, RPS-YP2-SP, RPS-YP6-SP, & RPS-YP7-SP shall all be duplex sump pump systems, including two sump pumps which meet the above criteria. For example, RPS-YP1-SP will include a duplex sump pump system with two 3 HP sump pumps rated for 150 gpm at 25 ft TDH.

END OF SECTION

DIVISION 46

WATER AND WASTEWATER EQUIPMENT

46 33 31 CHEMICAL SUMP PUMPS

1.00 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required and completely install, put in operation and field test the pumps and motors as listed below, shown on the Drawings and as specified herein.

B. The units shall be furnished and installed with all necessary accessory equipment and auxiliaries whether specifically mentioned in these Specifications or not and as required for an installation incorporating the highest standards for the type of service required including field testing and instructing the regular operating personnel in the care, operation, and maintenance of all pumping equipment.

C. Listing of pumping equipment included in this Section:

1. Sump Pump – Vertical, Centrifugal Type – Chemical Duty

1.02 COORDINATION:

A. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before chemical sump pumps and appurtenances Work.

1.03 RELATED SECTIONS:

A. Section 40 70 05, Primary Sensors and Field Instruments.

B. Division 40, Mechanical.

C. Division 26, Electrical.

1.04 SUBMITTALS

A. In accordance with Section 01 33 00 Submittal Procedures, submit the name of the pump manufacturer proposed for use, catalog sheets showing pump characteristics and dimensions and the following items:

1. Certified dimensional drawings of each item of equipment and auxiliary apparatus to be furnished.

2. Schematic electrical wiring diagram and other data as required for complete pump installation. All electrical, instrumentation and controls related to this specification shall be submitted with the pump submittal. Separate submittals are not acceptable and shall be returned without review.

3. Literature and drawings describing the equipment in sufficient detail, including parts list and materials of construction, to indicate full conformance with the detail Specifications.

4. A letter stating that all components used on the chemical duty sump pumps are fully compatible with the service and chemicals specified in this specification. The letter shall state that the chemical duty sump pump system supplier has reviewed the MSDS sheets of all the chemicals being pumped including the summary of hazards, and physical and chemical data.

1.05 QUALITY ASSURANCE

A. The equipment covered by these Specifications is intended to be standard pumping equipment of proven ability as manufactured by reputable concerns having extensive experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with the best practice and methods and shall operate satisfactorily when installed as shown on the Drawings.

B. The pump manufacturer shall be fully responsible for the design, arrangement and operation of the assembled pumping unit mounted to ensure that neither harmful nor damaging vibrations occur at any speed within the specified operating range.

C. The pumping unit shall be supplied by one manufacturer and shall be complete including pump, motor, and controls. The pump manufacturer shall be responsible for the furnishing and performance of the complete pumping unit.

1.06 MAINTENANCE

A. Special tools and the manufacturer's standard set of spare parts required for normal operation and proper servicing shall be furnished with the equipment.

B. One spare vertical sump pump and motor.

C. One parts instruction booklet for each pump.

D. One preventative maintenance and repair kit.

E. All tools and spare parts shall be properly packed and protected for long-term storage and placed in containers clearly identified in indelible marking as to contents. All tools shall be furnished in labeled steel tool boxes.

1.07 WARRANTY

A. Each chemical duty vertical sump pump and all accessories shall have a 3-year warranty against defects in workmanship or materials under normal use of operation. Warranty period shall be in accordance with General Conditions.

2.00 PRODUCTS

2.01 GENERAL

A. The use of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

2.02 SUMP PUMP, VERTICAL, CENTRIFUGAL, CHEMICAL DUTY

A. Furnish and install vertical centrifugal type sump pumps as shown on the Drawings in the Acidic and Alkaline Waste Sumps of the Chemical Facilities.

B. Drawings are developed based on Vanton Sump Gard Model SG-Py 1200 model pump.

C. Performance and Materials of Construction

1. Vertical centrifugal sump pumps, constructed of unfilled virgin PVC/PP, selected for compatibility with the following chemicals: Sodium Hydroxide, Sodium Hypochlorite, and Liquid Ammonium Sulfate (LAS). Pump manufacturer shall coordinate MSDS sheets of all chemicals from the OWNER through the Contractor.

2. Pump casing, and casing cover to be precision molded. Impeller to be molded around a dynamically balanced radial star insert bored and grooved for mounting shafts. Impeller also to have welded to front vanes a molded shroud with suction nozzle allowing for movement within pump casing due to temperature changes of fluid being handled without effecting pump performance.

3. Column sections to be made from heavy walled PVC/PP tubing with provisions for mounting of column adaptors and connection of bearing lubrication lines in same.

4. Shaft to be made from centerless ground stainless-steel bar stock sleeved from below bearings in motor mounting brackets to impeller end in PVC/PP of equal compatibility to that used in pump construction. Provision on sleeving to mount ultra-pure (99.7%) aluminum-oxide inner sleeve bearings used to stabilize shaft for the entire length in conjunction with the outer sleeve bearings selected for chemical compatibility with liquid being handled. Lubrication of sleeve bearings to be either liquid being pumped or clean water. Type of lubrication used depends upon solids or abrasive content of liquids being pumped or whether the fluid will form crystalline deposits during evaporation.

5. Motor mounting brackets to be precision bored cast iron from containing 2 ball-bearings with camlocks. Camlocks used to lock pump shaft in position and at the same time eliminate any vertical thrust from motor.

6. All bolts below pump mounting plate to be solid PVC/PP in full compatibility with liquid being handled and those above mounting plate to be stainless steel.

7. Pump to have a fume-guard at the upper-end consisting of a Viton "V" on shaft sleeve above mounting plate and an ultra-pure ceramic ring inserted in top side of "V" seal housing threaded into upper end of column assembly.

8. All "O" rings, used for sealing PVC/PP between shaft sleeve sections and impeller and sleeving at lower end of shaft to be Viton along with casing cover "O" rings.

9. Pump mounting of cover plate to be solid PVC/PP sheet of thickness required to support pump and motor unit and to have space available to insert and mount bearing lubrication manifold if required. The pump manufacturer shall be responsible for all mounting hardware and shall be responsible for structural support of pump and motor including all necessary plates, supports, etc. required to fully support the pump.

10. Pump to be completely assembled and performance tested at factory before shipment. Electric motor to be sized for non-overloading performance for complete length of pump requirements with impeller diameter required.

2.03 ELECTRICAL, INSTRUMENTATION, AND CONTROLS

A. Motor shall be 480V, 3 Phase, 60 Hz and shall conform with Division 26.

B. A complete control panel shall be provided for mounting and shall be completely wired and ready for field connection of power, control/sensory and alarm wiring. The control panel shall be of NEMA 4X stainless steel designed for outdoor mounting. Environmental protection shall be provided for the outdoor mounted panels. The panel shall be mounted in the location shown on the Drawings.

C. Power supply to the control panel will be 480-volt, 3-phase, 3-wire, and 60-Hz. For each pump motor, provide an individual thermal magnetic circuit breaker/disconnect switch interlocked with the door handle, 3-phase overload protection with manual reset. NEMA-rated motor starters shall be provided in the control panel by the pump supplier in accordance with Division 40. A 480/120-volt transformer shall be provided within the control panel. The transformer shall be as specified in Division 26. Control design shall provide for automatic and manual operation. Level switches as shown on the Drawings and controls shall be UL approved as intrinsically safe. Control leads to and from the sump shall be low-voltage, microwatt type designed such that if system components fail, voltage and current will not exceed their normal values. All of the low-voltage, intrinsically safe components shall be isolated by and mounted through a grounded metal barrier. All field connections shall be by means of terminals. Panel shall have Hand/Off/Automatic selector switch, pump run light, a thermostatically (adjustable) controlled condensate heater and lightning protection. Controls shall provide for pump alternation. The control panel shall be UL 508 listed and the completed panel shall be labeled as such.

D. Control design shall provide for manual operation by the local pump control panel. Pump operation shall alternate between starts and once started shall operate in an automatic mode based on sump level. Control leads to and from the sump shall be low-voltage, microwatt type designed such that if system components fail, voltage and current will not exceed their normal values. All of the low-voltage, intrinsically safe components shall be isolated by and mounted through a grounded metal barrier. All field connections shall be by means of terminals. Panel shall have Hand/Off/Automatic selector switch, pump run light, a thermostatically (adjustable) controlled condensate heater and lightning protection. Controls shall provide for pump alternation. The control panel shall be UL 508 listed and the completed panel shall be labeled as such.

E. SCADA output signals shall consist of the following:

   1. When pump running a “RUN” signal shall be sent to SCADA.

   2. When a pump, motor, or general fault is captured, a “FAIL” signal shall be sent to SCADA.

   3. Requirements for monitoring/control are further defined in Division 40.

3.00 EXECUTION

3.01 INSTALLATION

A. All the items specified under PART 2 shall be installed according to the applicable manufacturer's recommendations, the details shown on the Drawings and as specified herein.

3.02 TESTING

A. The manufacturers of the installed pumping units and equipment shall furnish the services of a competent factory representative familiar with the procedure for each unit installed, and to supervise the installation and operation of the pumping equipment and systems specified. At a minimum, 2 man-days shall be provided for installation and training.

3.03 ACCEPTANCE TESTING

A. Sump pumps (vertical) chemical duty shall undergo Acceptance Testing in accordance with Section 01 75 00 Starting and Adjusting.

3.04 CLEANING

A. At the completion of the work, all pumping equipment, apparatus, and adjacent components serving same included in this Section shall be cleaned (including the sump basins) and, where required ready for use.

3.05 PROTECTION

A. Controls and equipment shall be properly protected at all times during construction to prevent obstruction and damage. Equipment damaged during construction shall be replaced at no additional cost to the Design-Builder.

3.06 VENDOR TRAINING

A. Provide vendor training for the sump pumps (vertical) chemical duty in accordance with Section 01 78 23 Operation and Maintenance Data.

END OF SECTION

46 33 44 PERISTALTIC METERING PUMPS

1.00 GENERAL

1.01 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals required to furnish, install, test and place in satisfactory operation, positive displacement peristaltic metering pumps with self-contained variable speed drives as shown and specified herein. All pumps specified in this section shall be provided from one single pump Supplier. This Section includes:

a. Metering pumps complete with pumps, piping, and appurtenances shown on the drawings as typical for the metering pump operation.

B. Coordination:

1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before peristaltic metering pumps and appurtenances Work.

C. Related Sections:

1. Section 40 90 01, Instrumentation.
2. Division 40, Mechanical.
3. Division 26, Electrical.

1.02 REFERENCES

A. Standards referenced in this Section are:

1. American Bearing Manufacturers Association, (ABMA).
2. American Gear Manufacturers' Association (AGMA).
3. American National Standards Institute (ANSI).
4. API 675, Positive Displacement Pumps Controlled Volume.
5. American Society for Testing and Materials (ASTM).
6. Institute of Electrical and Electronics Engineers (IEEE).
7. National Electrical Code (NEC).
8. National Sanitation Foundation (NSF).

1.03 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer: Shall have minimum of five years experience producing substantially similar equipment to that required and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.

B. Component Supply and Compatibility:

1. Obtain all materials and equipment included in this Section regardless of component Manufacturer, from a single pump Supplier, certified by the Manufacturer to provide the specified equipment.

2. Peristaltic tube metering pump Manufacturer shall review and approve or prepare all Shop Drawings and other submittals for all components furnished under this Section.

3. Materials and equipment shall be fully compatible with specified service conditions, and shall be integrated into overall assembly by peristaltic tube metering pumps and appurtenances equipment Supplier.

C. Quality Assurance - This specification is the basis for design for peristaltic pumps. All pumps, whether named as an acceptable supplier or submitted as an equal must, at a minimum, meet the following critical design requirements.

1. Tube pumps shall be 100% integral in design, with the pump head, motor, controls, and pump case being a single unit. All controls, motor, and gear reduction shall be housed in a single, chemically resistant pump case.

2. Hose pumps shall be provided with separate base plates, external gear reduction and/or gear motors, and separate controls and VFDs, as required.

3. Pumps shall be dry self-priming, capable of running dry without damaging affects to the pump or tube.

4. Tube pump drives and pump heads shall be 24 hr continuous duty rated and have a minimum five-year manufacturer's warranty from date of shipment.

5. Hose pump drives and pump heads shall be 24 hr continuous duty rated and have a minimum two-year manufacturer’s warranty from date of shipment.

6. Supplier must provide Certificate of Compliance with Section 1.3.C Quality Assurance with its submittal.

1.04 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

a. Performance curves specific to each pump model with 5 different speeds for the specific chemical being pumped.

b. Complete layout and installation drawings for each feed pump showing mounting details, dimensions, fitting locations, and materials of construction.

c. Wiring diagrams.

d. The manufacturer shall certify in writing that the design application has been reviewed, and that the equipment will thoroughly and efficiently meet the performance requirements of this application.

e. Statement of material compatibility with each specified chemical.

f. Certificate of Compliance with Section 1.3.C Quality Assurance.

g. Manufacturer's literature, catalog cuts, and specifications for skids and accessories, showing dimensions and materials of construction.

2. Product Data:

a. Complete product data for each size and type of pump, motor, and accessories, including manufacturer’s brochure, specifications, weight, performance data, motor speed, turndown, and capacity.

3. Testing Plans:

a. Source quality control testing plan.

b. Field quality control testing plan.

B. Informational Submittals: Submit the following:

1. Certificates:

a. Paint certification.

2. Manufacturer’s Instructions:

a. Setting drawings, templates, and directions for installing anchor bolts and other anchorage devices.

b. Instructions for handling, storing, and installing equipment.

3. Source Quality Control Submittals: Results of source quality control tests and inspections.

4. Field Quality Control Submittals: Results of field quality control tests.

5. Manufacturer’s Reports: Submit a written report of results of each visit to Site by Supplier’s service technician, including purpose and time of visit, tasks performed, and results obtained.

6. Qualifications Statements: When requested by ENGINEER, submit qualifications data for manufacturer.

C. Closeout Submittals:

1. Operation and Maintenance Data:

a. Furnish Operation and Maintenance Manuals specific to the equipment and materials supplied. Annotate any standard charts, tables, or information to clearly identify the equipment and materials supplied. Standard, off the shelf operations and maintenance data that has not been annotated, and does not specify or indicate the key elements of the equipment and materials supplied, will be rejected.

b. Provide an electronic portable document format (PDF) of the approved operation and maintenance manuals.

2. Spare Parts, Extra Stock Materials, and Tools as required in Part 2 of this Specification.

1.05 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling, and Unloading:

1. Deliver materials and equipment to Site to ensure uninterrupted progress of the Work. Deliver anchorage materials to be embedded in concrete in ample time to prevent delaying the Work.

2. Inspect all boxes, crates, and packages upon delivery to the Site and notify OWNER's Representative in writing of loss or damage to products. Promptly remedy loss and damage to new condition in accordance with manufacturer's instructions.

B. Storage and Protection:

1. Keep materials and equipment off ground using pallets, platforms, or other supports. Protect steel, packaged materials, and electronics from corrosion, deterioration, and construction activities that could result in damage. Secure delivered equipment and materials from theft. In flood risk areas, the CONTRACTOR is responsible to protect equipment and materials from damage due to high water, rain, or flooding events.

C. Acceptance at Site:

1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify OWNER's Representative, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

1.06 MAINTENANCE

A. Spare Parts, Extra Stock Materials, and Tools:

1. Spare parts shall be furnished with the equipment by the manufacturer. The following spare parts shall be furnished for each unit furnished under this Section:

a. For each application, two replacement hose/tube elements. Element shall be prepared for long term storage; adequate lubrication for two element changes shall be provided.

b. One quart of touch up paint.

c. Two complete sets of any special tools required for normal maintenance

1.07 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive OWNER of other rights or remedies OWNER may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by CONTRACTOR under the Contract Documents. Obligations of CONTRACTOR under the Contracts Documents shall not be limited in any way by provisions of the specified special warranty.

B. Special Warranty: Provide manufacturer's written warranty, running to the benefit of OWNER, agreeing to correct, or at option of OWNER, remove or replace materials and equipment specified in this Section found to be defective during a period of 1 year after date of Substantial Completion of the Work under this Section.

2.00 PRODUCTS

2.01 MANUFACTURERS

A. Products and Manufacturers: Provide one of the following:

1. Watson-Marlow, Inc.
2. Blue-White Industries, “M” Series.
3. ProMinent Fluid Controls, Inc.

B. Listing as an acceptable manufacturer does not relieve the Manufacturer or Supplier from conforming to the contract documents.

2.02 EQUIPMENT PERFORMANCE

A. General:

1. All wetted surfaces of the pumps and all sealing gaskets shall be suitable for continuous exposure to chemicals listed in the schedule at the end of this document.

B. System Description:

1. Provide peristaltic metering pumps, complete with pump head, flexible extruded tube, motor, controls, and variable speed drive.
2. Tube pumps shall be 100% integral in design, with the pump head, motor, controls, gear reduction and pump case being manufactured by the pump manufacturer themselves.
3. Hose pumps can be provided with base plates, external gear reduction and/or gear motors, and separate controls and VFDs, as required.
4. Provide equipment compatible with specified service conditions, and able to meet the flow and head requirements.

C. Performance Criteria:

1. See the pump schedule at the end of this document.
2. Pump shall be able to put out the minimum flow rate listed in the schedule without the motor speed being turned down below the minimum motor speed listed in the schedule.

2.03 PERISTALTIC PUMP DETAILS OF CONSTRUCTION

A. Pump Head:

1. Pump head shall consist of fixed track with hinged or removable guard door or front cover, adjustable tube retainer mechanism, and roller rotor assembly. A leak sensor shall be provided to signal an alarm and shutdown the pump in the event of leakage.
2. Tubing shall be replaceable with no disassembly of pump head and without using tools.
3. Pump shall be capable of delivering continuous discharge pressure specified in the schedule.
4. Rotor shall be capable of rotating in either direction without damaging pump or tubing.

5. Pump shall be capable of self-priming with suction lift capability of 30 feet of water.
6. Pump shall be able to run dry without damaging pump or tubing.
7. Pump shall not require use of check valves or dynamic seals in contact with pumped fluid. At all times, one roller shall be fully engaged with the hose providing complete compression and preventing back flow or siphoning.

B. Tubing:

1. During normal operation, tubing's inner wall shall be the only surface in contact with pumped fluid.
2. Tubing shall be extruded from material compatible with pumped fluid.
3. Tubing shall be compatible with the pumped fluid and pressures shown in the pump schedule at the end of this document.
4. Tubing shall be NSF-61 approved for use with potable water systems.

C. Drive:

1. Drive: Drive motor shall be reversible, brushless DC gear motor, rated for continuous duty in a NEMA 4X enclosure.
2. Variable Speed Drive:
    a. Tube pumps: integral drive, speed control range of at least 2200:1.
    b. Hose pumps: integral or external with gearing as required, speed control range of at least 1000:1.
    c. Closed loop microprocessor controlled drive with pulse width modulation at speeds above 35 rpm and synchronous mode with magnetic field rotation control below 35 rpm.
    d. Circuitry complete with temperature and load compensation and protection.
3. Pumpheads, gearing, and motors manufactured by third party manufacturers are not acceptable.

D. Electrical Service:

1. Hose pumps shall be suitable for 120 VAC or 230/460, 3-phase, 60 Hz electrical service, as required. Contractor shall coordinate selected equipment with electrical service prior to installation of power for the pumps.
2. Tube pumps shall be suitable for 120V, single-phase, 60 Hz electrical service. Power cord and plug shall be NEMA 5/15 (USA) standard three-prong plug. Provide at least 6 feet of power cord from pump to receptacle.

2.04 APPURTENANCES

A. Leak Detector:

1. Provide float type, electronic sensor type, or capacitance type leak sensor mounted to the drain port of the pump head or the pump cover for leak detection and automatic pump shut down and alarm in the event of a tubing failure.

B. Stand:

1. Provide chemical resistant stand for mounting pumps as shown on Drawings.

    a. Pump height on stand shall be as shown on the drawings, but not lower than 2.5 feet above the finished floor elevation.

2. The pump stand shall support pump skid assemblies as indicated on the Drawings, including but not limited to: isolation valves, check valves, pressure gauges, pressure relief valves, and calibration columns.

C. Nameplate:

1. Provide pump with non-metallic nameplate attached with Type 316 stainless steel screws. Nameplate shall have engraved letters displaying the following minimum information:

    a. Maximum flow rate.

    b. Pressure and temperature rating.

    c. Date of manufacture.

    d. Manufacturer's name.

    e. Serial number.

D. Calibration Columns:

1. Provide calibration columns as shown on the drawings, one per chemical feed point.

2. CONTRACTOR shall provide each calibrator column loose, in a marked plastic storage box, or on the chemical skid as shown on the drawings.

3. Columns shall be supplied in a size as required by the application, and be constructed of clear PVC, with a permanent scale, with a hose connection outlet.

2.05 FINISHING

A. Shop Painting:

1. Surface preparation and painting shall be manufacturer's standard coat.

2. Apply in the shop primer coating to metallic parts (excluding surfaces exempted) of pumps, motors, drives, frames, supports, and appurtenances.

3. Do not paint corrosion-resistant parts such as plastic, fiberglass, and stainless steel.

4. Gears, bearing surfaces, machined surfaces, and other surfaces that are to remain unpainted shall receive heavy application of grease or other rust-resistant coating. Maintain coating during storage and until equipment is placed into operation.

5. Chemical resistant powder coating is acceptable.

2.06 CONTROLS

A. Where possible, provide integral controls on the pump face. For hose pumps provide local wall mounted controllers.

B. Where integral controls are not provided, provide local control panels with the following controls:

1. Local-Off-Remote switch
2. Run light
3. Start/stop switch
4. Fail light
5. Speed adjustment dial
6. Speed indicator

C. Provide for the following signals to/from the control system.

1. Out 4-20 mA speed signal
2. Input pump start/Stop signals
3. Output pump fail signal
4. Output run signal
5. Input high pressure switch or other signals as shown.

2.07 METERING PUMP STANDS

A. Pump stands shall be manufactured to support chemical metering pumps, all necessary piping, valves, fittings, supports, electrical controls, and accessories as specified herein. The stand shall include a perimeter drip lip that will drain leaks to a drain nozzle connection. The CONTRACTOR shall install a 5/8" hose to drain leaks to the floor.

B. The stands shall be constructed of chemical resistant materials such as polypropylene, polyethylene, FRP, or approved equal.

C. Piping shall be secured to the stand in accordance with Section 15055, Pipe Hangers and Supports.

3.00 EXECUTION

3.01 INSPECTION

A. Examine conditions under which products are to be installed and notify the OWNER's Representative in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install materials and equipment in conformance with Laws and Regulations, applicable standards, manufacturer's instructions and recommendations, and the Contract Documents.

B. Anchorages and Base Plates:

1. Provide anchorages for pump stands in concrete walls, as applicable, in accordance with equipment manufacturer's recommendations and the Contract Documents.

C. General:

1. Perform drilling and fitting required for installation. Set equipment accurately in location, alignment, and elevation, plumb, true, and free of rack.
2. Making plate cutouts or openings at the Site is not allowed.
3. Fit exposed connections accurately together to form tight hairline joints.
4. Provide utility connections in accordance with the Contract Documents.
5. Align and adjust equipment including motors, belts, drives, support stands, and appurtenances in presence of ENGINEER.
6. Prior to energizing electric motor drive equipment, rotate drive motor by an external source to demonstrate free operation of all mechanical parts. Do not energize equipment until safety devices are installed, connected, and functional.
7. Install valves in accordance with applicable provisions of Section 40 05 56, Process Valves Four-Inch and Smaller.

D. Conform to Section 01 75 00, Starting and Adjusting.

3.03 FIELD QUALITY CONTROL

A. Site Tests:

1. Following installation, CONTRACTOR and qualified field service representative of Supplier shall conduct operating tests of all equipment, functions, and controls at the Site in presence of ENGINEER.
2. Comply with Section 01 70 00, Execution and Closeout Requirements.
3. Field Operating Test:
    a. Manufacturer to provide calibration curve based on field capacity/speed test.
    b. Field test equipment and its controls in local mode, followed by demonstrating proper operation and controls in automatic mode. Demonstrate that each part individually and all parts together function properly in manner intended. Total duration of testing shall be 48 hours, continuous and uninterrupted, in automatic mode. All testing equipment and labor shall be by CONTRACTOR.
    c. Should tests result in malfunction, make necessary repairs, revisions, and adjustments and restart test from the beginning. Repeat tests and repairs, revisions, and adjustments until, in opinion of ENGINEER, installation is complete and equipment is functioning properly and accurately, and is ready for permanent operation.

B. Manufacturer's Services: Provide a qualified, factory-trained serviceman to perform the following:

1. Instruct CONTRACTOR in installing equipment.
2. Supervise installation of materials and equipment.
3. Inspect, calibrate, adjust, and test equipment after installation and ensure proper operation.

4. Instruct OWNER's personnel in operating and maintaining the equipment.
5. Manufacturer's representative shall make a minimum of three (3) site visits, with minimum of 8 hours at the Site for each visit. First visit shall be for instructing CONTRACTOR and supervising installation of equipment; second visit shall be for checking, adjusting, and calibrating completed installation and starting up the system; third visit shall be to instruct operations and maintenance personnel. Representative shall revisit the Site as often as necessary until installation is acceptable.
6. Training: Furnish services of qualified factory trained specialists from manufacturer to instruct OWNER's operations and maintenance personnel in recommended operation and maintenance of the products. Training requirements, duration of instruction, and other qualifications shall be per Section 01 70 00, Execution and Closeout Requirements.
7. All costs, including expenses for travel, lodging, meals and incidentals, and cost of travel time, for visits to the Site shall be included in the Contract Price.

46 33 44 PUMP SCHEDULE

FEED POINT	INFLUENT	EFFLUENT	INFLUENT	INFLUENT
Chemical	12.5% Sodium Hypochlorite	12.5% Sodium Hypochlorite	38% Liquid Ammonium Sulfate	25% Sodium Hydroxide
Number of Pumps (n+1)	3 (2+1)	3 (2+1)	2 (1+1)	2 (1+1)
Pump I.D.'s	INF-SHP-01 INF-SHP-02 INF-SHP-03	EFF -SHP-01 EFF -SHP-02 EFF -SHP-03	INF-LASP-01 INF-LASP-02	INF-CAP-01 INF-CAP-02
Chemical % Solution	12-12.5%	12-12.5%	38-40%	25%
Specific Gravity of Pumped Fluid at 77 degrees F (25°C)	1.15 - 1.18	1.15 - 1.18	1.24 - 1.28	1.25 - 1.29
Temperature Range of Pumped Fluid (degrees F)	50 - 100	50 - 100	50 - 100	50 - 100
Minimum Flow Rate (gallons per hour)	8.0	8.0	1.5	32.0
Maximum Flow Rate (gallons per hour)	54.0	54.0	11.5	210.0
Max Flow Rate per Pump (GPH)	27.0	27.0	11.5	210.0
Design Pressure (psi)	30	105	30	33
Pump Speed at Max Flow (rpm)	61	61	41	64
Net Positive Inlet Pressure at Max Flow Rate (ft)	8.33	8.33	12.5	5.78
Pump Type	Tube	Tube	Tube	Hose

END OF SECTION

46 41 18 PACKAGED SEWAGE LIFT STATIONS

1.00 GENERAL

1.01 SECTION INCLUDES

A. Packaged sewage lift stations with wet wells, submersible pumps, motors, piping, valves, control equipment, and accessories complete and operational as shown and specified. The package lift station shall be a completely factory-assembled unit, requiring only minor field adjustments and reassembly.

B. B. Coordination:

1. Review installation procedures under other Sections and coordinate with the Work related to this Section.

2. Coordinate pumps, piping, valves, pipe supports and appurtenances with mechanical work as specified in Division 15, Mechanical.

3. Coordinate pumps and motors with instrumentation and controls work as specified in Division 13, Special Construction.

4. Coordinate pumps and motors with electrical work as specified in Division 16, Electrical.

1.02 REFERENCES

A. A. Reference Standards: Comply as a minimum with applicable provisions and recommendations of the following:

1. American Bearing Manufacturers Association, (ABMA)

2. American National Standards Institute (ANSI)

3. American Society for Testing and Materials (ASTM)

4. Anti-Friction Bearing Manufacturers Association (AFBMA)

5. Hydraulic Institute (HI).

6. Institute of Electrical and Electronic Engineers (IEEE)

7. National Electric Code (NEC)

8. National Electrical Manufacturers Association (NEMA)

1.03 PERFORMANCE REQUIREMENTS

A. Furnish and install the package sewage lift stations capable of handling raw sewage in accordance with these Specifications and as shown on the Drawings.

B. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall equipment assembly by the lift station manufacturer.

C. The pump manufacturer shall review and approve or prepare all Shop Drawings and other submittals for all components furnished under this Section.

1.04 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01330 - Submittal Procedures.

B. Submit a list of not less than 5 installations where similar packaged lift stations of the type and approximate size specified has been in successful operation for at least 5 years.

C. Submit locations of the nearest permanent service headquarters of the pump and motor manufacturer for the size of pump and motor submitted.

D. Submit descriptive literature, including a cross-sectional view of each packaged lift station, pump, and motor which indicates materials of construction, weights, principal dimensions and other important details.

E. Submit certified performance data and pump curves showing head capacity, flow rate, brake horsepower, motor horsepower, NPSH requirements, and speed.

F. Setting drawings, templates, and directions for the installation of anchor bolts and other anchorages.

G. Drawings of control panels, furnished in accordance with the requirements of Section 13410, Instrumentation Control Systems and Field Devices.

H. Manufacturer's Certifications:

1. Submit manufacturer's certification that he has carefully examined the Contract Documents in detail, including the arrangement and conditions of proposed electrical, mechanical and structural systems affecting the performance of the pumping equipment units, and the detailed requirements of manufacturing and subsequent installation of the pumping equipment units.

2. Submit manufacturer's certification that there are no omissions, ambiguities or conflicts in the Contract Documents or in the pumping station piping layout that affects the pumping unit, as shown on the Drawings, which have not already been clarified in writing.

3. Submit manufacturer's certification that the running amperes of the motor will not exceed the nameplate rating of the motor under all expected operating conditions.

4. Submit manufacturer’s certification that spare parts, seals, bearings, o-rings and power cable shall be available locally for models to be supplied.

I. Factory Tests: Submit 3 copies of certified test reports to the Owner for review.

1. The pump manufacturer shall perform the following inspections and tests on each package lift station and pump system before shipment:

a. Impeller, motor rating, and electrical connections shall first be checked for compliance to the customer's purchase order.

b. A motor and cable insulation test for moisture content or insulation defects shall be made.

c. Prior to submergence, the pump shall be run dry to establish correct rotation and mechanical integrity.

d. Each pump shall be test run submerged in water.

e. After running pump submerged in water, retest motor and cable insulation.

2. If tests do not meet performance specifications, Contractor shall correct deficiencies to provide the specified performance.

3. A written report stating the foregoing steps have been done must be supplied with each pump at the time of shipment. This report must be approved by the Owner prior to payment.

J. Operation and Maintenance Data: Submit operation and maintenance data under provisions of Section 01782 - Operations and Maintenance Data.

1.05 QUALITY ASSURANCE

A. All materials used shall be new, of high grade, and with properties best suited to the work required.

B. Manufacturer's Qualifications:

1. Lift station structure (wet well, top) and pumping equipment provided under this Section shall be a standard product in regular production by manufacturers whose products have proven reliable in similar service for at least 5 years.

2. Manufacturer shall satisfy the Owner that it is capable of the following:

a. Providing local (within 50 miles of the limits of the City of Houston) factory trained personnel to service the pumps and allied equipment when needed within a 48 hour period.

b. Providing all needed spare parts for the pumps within a 48-hour period.

c. Provide a written manufacturer's certification that spare parts, seals, bearings, o rings and power cable shall be available locally for models to be supplied.

C. Coordination Responsibility

1. In order to ensure equipment compatibility, one manufacturer shall be responsible for providing all lift station equipment including wet well, access hatches, pump and motor, access frame and guides.

2. The Contractor shall name a packaged sewage lift station manufacturer, who will have responsibility for the function of the complete system in accordance with the intent of these Specifications. The named manufacturer shall be experienced in similar work.

3. Contractor shall retain overall responsibility for equipment coordination, installation, testing and operation.

D. Substitution. The engineering design is based on a certain manufacturer's equipment. If the Contractor's choice of equipment is approved but requires modifications to plant, equipment or piping for installation, the Contractor is responsible for submitting revised engineering design and drawings to make the proposed equipment compatible with the project, at no additional cost to the City.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver equipment to site, all store and protect equipment under provisions of Section 01610 - Basic Product Requirement.

B. Store all equipment off the ground in enclosed shelter.

1.07 WARRANTY

A. Provide warranty under provisions of Section 01770 - Closeout Procedures.

B. Packaged sewage lift station manufacturer shall furnish to the Owner a warranty written expressly from the manufacturer to the Owner, covering workmanship and material for 5 years or 10,000 hours of operation under normal use and service. The warranty shall cover 100 percent of parts and labor for at least one full year. The warranty period shall commence on the day of initial operation for Owner's beneficial use. Warranty shall be in printed form and previously published as the manufacturer's Standard Warranty for all similar units manufactured. Pumps repaired under warranty will be returned to the job site freight pre-paid.

1.08 MEASUREMENT AND PAYMENT

A. No separate payment for materials furnished and installed or work performed under this Section. Include cost in Contract price bid for work of which this is a component.

2.00 PRODUCTS

2.01 GENERAL OPERATING REQUIREMENTS

A. The packaged sewage lift station shall be specifically designed, constructed, and installed for the service intended and shall comply with the following minimum service conditions described below and in the Schedule of Service Conditions.

B. The duplex pump lift station shall be a completely factory-assembled unit designed for installation below grade and able to withstand flood level conditions with water levels at least 15 feet above the lift station cover.

C. Schedule of Service Conditions are as follows:

1. Design Conditions

a. Location: WHCRWA Repump Station

b. Equipment Tag: LS #1

c. Number of Pumps: 2

d. Type: Duplex Submersible

e. Pump Operation: Duty - Standby

f. Liquid Pumped: Raw Sewage

g. Solids, (percent): 1-2

h. Max Suction Head, (ft.): Flooded

i. Min. Sphere Diameter Passing, (in.): 3

j. Suction Size, (in.): 3

k. Discharge Size, (in.):4

l. Design Capacity, (gpm): 152

m. Design Head, (ft.): 44

n. Drive: Direct

o. Motor, (Hp): 5

2.02 ACCEPTABLE MANUFACTURERS

A. Through shop drawing submittals, the following named manufacturers will be considered, provided the submitted equipment meets the specified requirements and system operating conditions:

1. ITT Flygt

2. KSB

3. Approved Equal.

B. Listing as an acceptable manufacturer will not relieve the manufacturer from conforming to the Contract Specifications.

2.03 LIFT STATION CONSTRUCTION AND EQUIPMENT

A. The duplex pump lift station and associated equipment shall be a completely factory-assembled unit designed for installation below grade and contain the minimum following components:

1. Discharge Elbow: Gray cast iron, ASTM A48, Class 30, or fabricated steel, with base plate designed to mount directly to wet well floor and to anchor and align guide rails, and ANSI B16.1, Class 125 flange on discharge and a machined mating surface for receiving the self-aligning sliding bracket; epoxy-coated.

2. Guide Rails and Guide Brackets: Type 304 stainless steel; rails of Schedule 40 pipe and designed to mount directly to discharge elbow at the floor and to the upper guide bracket at the top, with intermediate guide brackets provided for rail lengths over 15 feet. The upper guiderail bracket shall be made from ASTM A283D structural steel and align and support the two guiderails at the top of the wet well. It shall bolt directly to the hatch frame or upper guiderail bracket and incorporate beveled stainless steel inserts for secure rail installation.

3. Self-Aligning Sliding Bracket: Mounted on pump discharge; replaceable; ductile iron with a machined mating flange which matches the discharge elbow, and replaceable neoprene seal; epoxy-coated. Sealing of the discharge connection to be accomplished by a simple linear downward motion of the pump, culminating with the entire weight of the pumping unit supported entirely by the discharge elbow.

4. Lifting Cable: The lifting cable shall be 300 series stainless steel with a diameter of at least 3/16" and a nominal breaking strength of at least 2500 pounds consisting of stainless steel braided cable of sufficient length to extend from the pump in the lowest position in the wet well to the top of the wet well. Provide a device at the top of the wet well to attach the cable when not in use. Size cable according to pump weight. Coordinate upper cable end terminating device with requirements for connecting to hoisting equipment to be used.

5. Hoisting Bail: Stainless steel; designed for proper balance of pumps and detachment from discharge connection using a single lift cable.

6. Ventilation: Each wet well shall be ventilated as shown on the drawings.

7. Inlet Hub: A nominal pipe diameter thermoplastic pipe grommet shall be field installed to seal the inlet pipe penetration. The pipe grommet shall provide a mechanical seal and shall not require any secondary sealing materials.

8. Float Bracket: The float bracket shall be fabricated from 300 series stainless steel with compression style cord grips to maintain float level position.

9. Aluminum cover plate: An Aluminum cover plate shall be supplied to cover the wet well with hinged access covers, hold open arms, and safety grating. The cover shall be construction of 0.25 inch thick mill finish aluminum diamond plate with 300 series stainless steel hardware. The access hatch shall have a recessed handle and locking pin. The hatch shall be held open in the vertical position by means of a hold open arm. The cover shall be water tight and mounted to the wet well with at least six stainless steel fasteners.

10. Emergency Bypass Suction: The prefabricated lift station shall include an emergency bypass suction pipe that extends into the wet well as shown and terminates in a flanged

end pipe above the wet well cover. The suction pipe shall match the diameter of the corresponding wet well suction pipe.

11. Anchor bolts and inserts shall be furnished under this Section and shall be sized and installed in accordance with the manufacturer's recommendations.

12. All bolts, nuts, and cap screws shall have hexagon heads, all hardware shall be stainless steel.

B. Wet Well Construction

1. The lift station wet well shall be constructed of fiberglass reinforced plastic; provide dimensions as shown on the Drawings and constructed as follows:

   a. The resins used shall be a commercial grade unsaturated polyester resin.

   b. The reinforcing material shall be commercial grade "E type glass in the form of mat, chopped roving, roving fabric and continuous roving, having a coupling agent that will provide a suitable bond between the glass reinforcement and the resin. Fillers of any type shall not be utilized. Additives, such as thixotropic agents, catalysts, promoters, etc., may be added as required by the specific manufacturing process to be used to meet the requirements of this specification. The resulting reinforced plastic material must meet the requirement of this specification.

   c. The exterior surface shall be a chop-hoop filament wound structural layer. The chopped glass and continuous strand filament wound glass shall be reinforced with one or more layers of unidirectional glass applied at ninety degrees to the filament wound glass. The glass content of the exterior layer shall be 50 to 80 percent by weight. The exterior shall be relatively smooth with no exposed fibers or sharp projections.

   d. The interior liner shall be reinforced by 30% (+ or – 5%) glass by weight of chopped strand glass fiber having fiber lengths averaging 1 ½. The interior surface shall be resin rich with no exposed fibers. The surface shall be free of crazing, delamination, blisters larger than 0.5 in. in diameter, and wrinkles of 0.125 in. or greater in depth.

   e. The basin shall have a pipe stiffness per ASTM standard No. D3753-81, Table 1.

   f. Flexural Strength and Modulus: The flexural strength and modulus of the basin wall in the hoop and axial directions shall be a minimum of 1,000,000 psi. The minimum barcol hardness shall not be less than 90% of the resin manufacturer's minimum value for the cured resin.

   g. Thickness: The basin wall thickness shall be adequate to maintain structural integrity when installed, see Geotechnical Report for soil conditions.

h. h. 3/8” - 16 stainless steel threaded inserts shall be installed in the top flange of basin / wet well to accommodate attachment of cover. The inserts shall be on a 6 bolt pattern.

i. Submersible Pump Construction:

1). Submersible pump shall be a heavy duty centrifugal submersible type, capable of handling unscreened, solids-laden fluids without clogging. Pump shall automatically connect to the discharge elbow permanently installed in the wet well when pump is lowered into place, without the need for nuts or bolts, and without the need of personnel to enter the wet well. Pump shall be guided into place guided by two guide bars extending from the discharge connection to the top of the wet well. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. Sealing of the discharge interface with a diaphragm, O-ring or profile gasket will not be acceptable. No portion of the pump shall bear directly on the sump floor. Each pump shall be fitted with stainless-steel lifting chain. The working load of the lifting system shall be 50% greater than the pump unit weight.

2). The impeller shall be of ASTM A-48, Class 35B grey iron, dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design. The impeller leading edges shall be mechanically self-cleaned automatically upon each rotation as they pass across a spiral groove located on the volute suction. The leading edges of the impeller shall be hardened to Rc 45 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter normally found in wastewater. The impeller shall be locked to the shaft, held by an impeller bolt and shall be coated with alkyd resin primer. No impeller clearance adjustment or wear rings required.

3). Casing: ASTM A48, Class 35B grey iron; removable from motor for full inspection of impeller; discharge designed for receiving self-aligning sliding bracket included as part of pump guide assembly.

4). Stator Housing, Seal Housing, and Bearing Brackets: ASTM A36 structural grade steel or ASTM A48, Class 35B grey iron.

5). Bearings: The pump shaft shall rotate on two bearings. Motor bearings shall be permanently grease lubricated. The upper bearing shall be a single deep groove ball bearing. The lower bearing shall be a two row angular contact bearing to compensate for axial thrust and radial forces. Single row lower bearings are not acceptable. The minimum L10 bearing life shall be 50,000 hours at any usable portion of the pump curve.

6). Shaft: Machined, minimum AISI Type 329 stainless steel. Shaft sleeves are not acceptable. Pump shaft to be an extension of the motor shaft. Couplings are not acceptable.

7). The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable. The assembly shall provide ease of changing the cable when necessary using the same entry seal. The cable entry junction chamber and motor shall be separated by a stator lead sealing gland or terminal board, which shall isolate the interior from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.

8). All bolts, nuts, and cap screws shall have hexagon heads.

9). Stainless steel nameplates giving the manufacturer's model and serial number, rated capacity, head, speed and all other pertinent data shall be attached to the pump.

10). Mechanical Seals: Each pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The seals shall operate in a lubricant reservoir that hydro-dynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal unit, located between the pump and the lubricant chamber, shall contain one stationary and one positively driven rotating, corrosion and abrasion resistant tungsten-carbide ring. The upper, secondary seal unit, located between the lubricant chamber and the motor housing, shall contain one stationary and one positively driven rotating, corrosion and abrasion resistant tungsten-carbide seal ring. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment nor depend on direction of rotation for sealing. The position of both mechanical seals shall depend on the shaft. Mounting of the lower mechanical seal on the impeller hub will not be acceptable. The following seal types shall not be considered acceptable or equal to the dual independent seal specified: shaft seals without positively driven rotating members, or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces. No system requiring a pressure differential to offset pressure and to affect sealing shall be used. Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection

plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. The motor shall be able to operate dry without damage while pumping under load. Where a seal cavity is present in the seal chamber, the area about the exterior of the lower mechanical seal in the cast iron housing shall have cast in an integral concentric spiral groove. This groove shall protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal due to centrifugal action. Seal lubricant shall be FDA Approved, nontoxic.

C. Motors:

1. NEC Division 1 Hazardous Location, Class I, Group C and D, Class II, Group F and G, T3C, 230/460 V, 60 Hz., 3-phase, solid shaft, ball bearing type.

2. Motors shall be in accordance with all current applicable standards of NEMA, IEEE, AFBMA, NEC, and ANSI.

3. Motors shall be normal starting torque, normal slip, squirrel cage induction type.

4. Motors shall be capable of carrying full load current continuously without injurious temperature rise in an ambient temperature of 40°C.

5. Motors shall be provided with a service factor of 1.15.

6. Motors shall be of sufficient size so that there will be no overload on the motor above rated nameplate horsepower under any condition of operation from shut-off to zero head, unless otherwise specifically permitted in this Section.

7. Motor thrust bearings shall be adequate to carry continuous thrust loads under all conditions of pump operation from zero head to shut-off.

8. Locked rotor currents shall be as specified in NEMA standards.

9. Lubrication may be grease or oil type.

10. Motor Sensors

    a. Each pump motor shall be equipped with a minimum of three thermal sensors embedded in the stator windings and wired to the control panel for supplemental motor protection.

    b. Leakage sensor in lower part of stator housing shall be wired to leads in the junction chamber.

11. Motors shall have built-in thermal overload protection.

12. Motor Tests and Data.

a. For each motor from one to ten horsepower in size, furnish an inspection report for the motor or for a previously manufactured electrically duplicate motor which was tested. Provide the following minimum data:

1). Running light current.

2). Locked rotor current.

3). Winding resistance measurement.

4). High potential test.

5). Bearing inspection.

D. E. Control Panel

1. Furnish a common control panel for all pumps.

2. Panel construction shall be NEMA 4X and shall conform to the applicable requirements of Section 16160, Cabinets and Enclosures.

3. Factory test control panel prior to shipment.

4. Furnish a 120 volt, 3 phase, 60 Hz power feeder to the control panel. Include a main disconnect, transformer(s), and circuit breaker load center for all 120 volt panel power requirements.

5. Panel shall contain the following for each unit:

a. "HAND/OFF/AUTOMATIC" selector switch for pump operation.

b. One speed adjusting potentiometer for local speed adjustment of the mechanical speed drive.

c. One "LOCAL/REMOTE" selector switch for acceptance of a remote 4 to 20 mADC speed control signal.

d. One red pilot light for pump "ON" status.

e. One green pilot light for pump "OFF" status.

f. Control relays, if required, to implement the control logic described below.

g. A main 30A, two pole disconnect switch with terminals for incoming 120 VAC, 60 Hz power.

6. Pump Operation

a. In the "HAND" position, the pump will run continuously. In the "AUTOMATIC" position, the pump will be started from a remote control station.

b. The seal water solenoid shall be energized to open whenever the pump is running. Solenoid is operated on 120 VAC, single phase power.

7. Pressure Gages

a. Provide pressure indicating gages on the suction and discharge piping or flanges of each pump. Gages shall have a 4 inch diameter aluminum alloy case, and shall be furnished with diaphragm seals (with flush connection) and gage cocks. Factory-mount a cartridge snubber between the gage and the diaphragm seal. Range of the suction gages shall be 30-inches Hg vacuum to 15 psi, and the range of the discharge gages shall be 0 to 200 psi.

b. Pressure gages shall conform to the requirements of Section 13446, Primary Instrumentation Devices.

c. Hard wire a high pressure switch on the pump discharge to the motor controller to shut-down the motor in the event of a high pressure event. High pressure setting shall be field adjustable.

2.04 TOOLS AND SPARE PARTS

A. Manufacturer shall furnish a list of additional recommended spare parts for an operating period of one year. The list shall describe each part, the quantity recommended, and the unit price of the part.

2.05 BOLTS, STUDS AND NUTS

A. All bolts, studs and nuts shall have American National form right-hand machine cut threads which shall be in conformity with the current ANSI B1.1, "Screw Threads", Coarse Thread Series, unless otherwise specified.

B. Bolt heads and nuts shall be semi-finished and shall be in conformity with ANSI B18.2, "Wrench-Head Bolts and Nuts and Wrench Openings", Heavy Series, unless otherwise specified. All nuts shall be hexagonal in shape.

C. Anchor bolts, flange bolts, studs and nuts shall be Type 316 stainless steel in conformity with ASTM A276.

2.06 SHOP PAINTING

A. Pump motor size up to 100 HP.

1. Pump Exterior:

a. Pre-treatment.

b. Primer. One coat of alkyd resin primer, 1.6 mils minimum.

c. Finish. Chloric rubber paint, 2.4 mils minimum.

2. Machine Finished Surfaces:

a. Machined parts are cleaned to remove all dirt and grease.

b. Cleaning is done so as not to affect primer or deteriorate adherence to finish paint.

c. Storage and transport is carried out in such a way that rust attack on machined surfaces does not occur.

d. At assembly, surfaces are coated with a corrosion preventive paint.

3.00 EXECUTION

3.01 3.01 INSTALLATION

A. Installation of the pumping equipment shall conform to the manufacturer's instructions and recommendations and reviewed shop drawings.

B. Manufacturer's representative shall check and approve the installation prior to operation. Manufacturer's representative shall field test and calibrate the equipment to assure that the system operates to the OWNER'S satisfaction.

C. Field Tests:

1. All equipment will be given running tests by CONTRACTOR at the job Site following installation of the equipment and controls. Should the tests indicate any malfunction, CONTRACTOR shall make any necessary repairs and adjustments. Such tests and adjustments shall be repeated until, in the opinion of the OWNER, the installation is complete and the equipment is functioning properly and accurately, and is ready for permanent operation.

2. A factory trained representative shall be provided for installation supervision, start-up and test services and operation and maintenance personnel training services. The representative shall make a minimum of 2 visits, minimum 8 hours on-Site for each visit, to the Site. The first visit shall be for assistance in the installation of equipment. Subsequent visits shall be for checking the completed installation, start-up and training of the system. Manufacturer’s representative shall test operate the system in the presence of the ENGINEER and verify that the equipment conforms to the requirements. Representative shall revisit the Site as often as necessary until all trouble is corrected and the installation is entirely satisfactory

D. Start-up Data: Contractor shall complete and submit the start-up records and maintenance data sheets.

END OF SECTION

OTHER

HOUSTON AND HARRIS COUNTY

STANDARD SPECIFICATIONS

Section 02085

VALVE BOXES, METER BOXES, AND METER VAULTS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Valve boxes for water service.

B. Meter boxes for water service.

C. Meter vaults for water service.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. No separate payment will be made for valve boxes under this Section. Include payment in unit price for Section 02511 - Water Lines.

2. No separate payment will be made for meter boxes under this Section. Include payment in unit price for Section 02512 - Water Tap and Service Line Installation.

3. Payment for each size of meter vaults is on unit price basis per vault. Payment will be made for each vault installed, regardless of depth.

4. Refer to Section 01270 - Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.03 REFERENCES

A. ASTM A 48 - Standard Specification for Gray Iron Castings.

B. ASTM D 256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.

C. ASTM D 638 - Standard Test Method for Tensile Properties of Plastics.

D. ASTM D 648 - Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.

E. ASTM D 790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

F. ASTM D 2240 - Standard Test Method for Rubber Property-Durometer Hardness.

1.04 SUBMITTALS

A. Conform to requirements of Section 01330 - Submittal Procedures.

B. Submit manufacturers' product data for following items for approval:

1. Each type of valve box and lid.

2. Each type of meter box and cover.

3. Each type of meter vault frame and cover.

C. Submit design calculations and shop drawings for precast vault elements, sealed by an Engineer registered in State of Texas.

D. Submit shop drawings for cast-in-place meter vaults for approval if proposed construction varies from City of Houston Detail Drawings.

E. Submit manufacturer's certification that plastic meter boxes meet requirements of Paragraph 2.05, Plastic Meter Boxes.

PART 2 P R O D U C T S

2.01 VALVE BOXES

A. Provide approved Type A, cast-iron/ductile-iron, slide-type, valve boxes. Design of valve box shall minimize stresses on valve imposed by loads on box lid.

B. Cast letter "W" into lid, 1/2 inch in height and raised 3/32 inch, for valves serving potable water lines.

C. Unless otherwise specified, uncoated cast iron.

D. Riser Pipe.

1. Provide 6-inch PVC, DR 18, riser pipes in accordance with Section 02506 - Polyvinyl Chloride Pipe or

2. 6-inch ductile-iron, thickness Class 51 riser pipes in accordance with Section 02501 – Ductile Iron Pipe and Fittings.

3. Provide single section of pipe.

E. Concrete for valve box placement:

1. For locations in new concrete pavement, provide strength and mix design of new pavement.

2. For other locations, provide concrete for sidewalks conforming to requirements of Section 02751 - Concrete Paving.

2.02 METER BOXES

A. Provide meter boxes for 5/8-inch through 1-inch meters of the following materials:

1. Non-traffic bearing locations: Cast iron, concrete or plastic.

2. Traffic bearing locations: Cast iron.

B. Provide meter boxes for 1 1/2-inch and 2-inch meters of cast iron.

C. Provide meter box with reading lid. Provide lids with spring-type latching devices. Lids shall contain sufficient metal that meter box can be easily located with metal detector. Cast words “CITY OF HOUSTON” and "WATER METER" into lid with letters of 1/2-inch height and raised 3/32 inch.

D. Meter box dimensions shall conform to the following approximate dimensions:

1. Length: At top – 15 1/2 inches; at bottom 20 inches

2. Width: At top – 12 1/2 inches; at bottom 14 3/4 inches

3. Height: 12 inches

E. Extensions: Meter box extensions 3 inches and 6 inches in height shall be available from manufacturer as standard item.

2.03 CAST-IRON METER BOXES

A. Cast-Iron Boxes: Clean and free from sand blow-holes or other defects conforming to requirements of ASTM A 48, Class 30B. Bearing surfaces shall be machined so that covers seat evenly in frames.

B. Boxes and lids shall have dipped, coal-tar-pitch, varnish finish.

C. Provide lock-type meter boxes when required by Drawings. Lock mechanisms shall work with ease.

2.04 CONCRETE METER BOXES

A. Concrete Meter Boxes: Made of Class A concrete, with minimum 4000 psi compressive strength, conforming to requirements of Section 03315 - Concrete for Utility Construction. Construct to dimensions shown on Drawings.

B. Castings: Free from fractures, large or deep cracks, blisters or surface roughness or any other defects that may affect serviceability.

2.05 PLASTIC METER BOXES

A. Plastic Meter Boxes: Made of high density polyethylene conforming to the following ASTM standards:

ASTM	REQUIREMENT
D 256	Impact Strength = 1.9 ft.-lb./inch (Izod, Notched)
D 256	Impact Strength = 6.4 ft.-lb./inch (Izod, Un-Notched)
D 638	Tensile Strength (2.0 min.) = 3400 psi
D 648	Deflection Temperature = 170 degrees F
D 2240	Shore D, Hardness, 55-65 Impact Strength, Falling Dart Method, 160 inch-lb.
D 790	Flexural Modulus = 90,000 psi

B. Meter boxes shall meet the following test requirements:

1. Static Load: Not less than 2500 pounds using 6-inch disc with direct compression exerted at center of top of meter box with solid plastic lid.

2. Deflection: Not less than 1000 pounds load required to deflect top edge of meter box 1/8- inch.

C. Meter box body, without lid, shall weigh approximately 7 pounds.

2.06 METER VAULTS

A. Meter vaults may be constructed of precast concrete, cast-in-place concrete to the specified dimensions in the City of Houston Detail Drawings.

B. Concrete for Meter Vaults: Class A concrete, conforming to requirements of Section 03315 - Concrete for Utility Construction with minimum compressive strength of 4000 psi at 28 days.

C. Reinforcing steel for meter vaults: Conform to requirements of Section 03315 Concrete for Utility Construction.

D. Grates and Covers: Conform to requirements of Section 02091 – Non Metallic Frames, Grates, Rings, and Covers.

PART 3 E X E C U T I O N

3.01 EXAMINATION

A. Obtain approval from Project Manager for location of meter vault.

B. Verify lines and grade are correct.

C. Verify compacted subgrade will support loads imposed by vaults.

3.02 VALVE BOXES

A. Install riser pipe with suitable length for depth of cover indicated on Drawings or to accommodate actual finish grade.

1. Install with bell on top of valve

2. Place riser pipe in plumb, vertical position

B. Install valve box and riser piping plumbed in a vertical position. Provide 6-inches telescoping freeboard space between riser pipe top butt end, and interior contact flange of valve box, for vertical movement damping. End of pipe resting on valve shall be notched out sufficiently to provide a snug fit around the valve bonnet and to center valve inside of pipe.

C. Set, align, and adjust valve box so that lid is level with final grade.

D. Paint covers of new valve boxes in fluorescent orange when installed. After completion and acceptance by City, repaint covers black.

3.03 METER BOXES

A. Install cast iron or plastic boxes in accordance with manufacturer's instructions.

B. Construct concrete meter boxes to dimensions shown on City of Houston Detail Drawings.

C. Adjust top of meter boxes to conform to cover elevations specified in Paragraph 3.05, Frame and Cover for Meter Vaults.

D. Do not locate under paved areas unless approved by Project Manager. Use approved traffic-type box with cast iron lid when meter must be located in paved areas.

3.04 METER VAULTS

A. Construct concrete meter vaults to dimensions shown on City of Houston Detail Drawings. Do not cast in presence of water. Make bottom uniform. Verify lines and grades are correct and compacted subgrade will support loads imposed by vaults. Interior meter vault depth is not allowed to exceed more than 4 feet unless approved by OCE.

B. Precast Meter Vaults:

1. Install precast vaults in accordance with manufacturer's recommendations. Set level on a minimum 3-inch-thick bed of sand conforming to requirements of Section 02320 - Utility Backfill Materials.

2. Seal lifting holes with cement-sand mortar or non-shrink grout.

C. Meter Vault Floor Slab:

1. Construct floor slabs of 6-inch-thick reinforced concrete. Slope floor 1/4 inch per foot toward sump. Make sump 12 inches in diameter, or 12 inches square, and 4 inches deep, unless other dimensions are required by Drawings. Install dowels at maximum of 18 inches, center-to-center for keying walls to floor slab.

2. Precast floor slab elements may be used for precast vault construction

D. Cast-in-Place Meter Vault Walls:

1. Key walls to floor slab and form to dimensions shown on Drawings. Minimum wall thickness shall be 4 inches.

2. Cast walls monolithically. One cold joint will be allowed when vault depth exceeds 12 feet.

3. Set frame for cover in concrete

3.05 FRAME AND COVER FOR METER VAULTS

A. Set cast iron frame in a mortar bed and adjust elevation of cover as follows:

1. In unpaved areas, set top of meter box or meter vault cover 2 to 3 inches above natural grade

2. In paved areas, set top of meter box or meter vault cover flush with adjacent concrete but no higher than 1/2-inch

3.06 BACKFILL

A. Provide bank run sand in accordance with Section 02320 - Utility Backfill Materials and backfill and compact in accordance with Section 02317 - Excavation and Backfill for Utilities.

B. In unpaved areas, slope backfill around meter boxes and vaults to provide a uniform slope 1-to-5 slope from top to natural grade.

C. In paved areas, slope concrete down from meter box or vault to meet adjacent paved area.

END OF SECTION

Section 02512

WATER TAP AND SERVICE LINE INSTALLATION

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Tapping existing mains and furnishing and installing new service lines for water.

B. Relocation of existing small water meters.

C. Specifications identify requirements for both small-diameter (less than or equal to 20 inches) water lines and large-diameter (greater than 20 inches) water lines. When specifications for large-diameter water lines differ from those for small- diameter water lines, paragraphs for large-diameter water lines will govern for large-diameter pipe.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. Payment for water taps and copper service lines 3/4 inch through 1 inch is on unit price basis for each installation. Separate measurements will be made for "short side", "long side" and "extra long side" connections as defined in Paragraph 1.04, Definitions.

2. Payment for water taps and service lines 1 1/2 inch through 2 inch is on unit price basis for each installation. Separate measurements will be made for "short side", "long side" and "extra long side" connections as defined in Paragraph 1.04, Definitions.

3. Payment for "short side, "long side" and "extra long side" includes locating water line, tap installation and connection to meter and restoring site.

4. Payment for each small meter includes labor, materials, and equipment to relocate existing small meter.

5. No additional payment will be made for bedding, backfill, compaction, push under pavement, etc.

6. Refer to Section 01270 - Measurement and Payment for unit price procedures

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.03 REFERENCES

A. AWWA C 800 - Standard for Underground Service Line Valves and Fittings.

B. AWWA C 900 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. Through 12 in., for Water Distribution.

C. AWWA C105 – Polyethylene Encasement for Ductile-Iron Pipe Systems.

1.04 DEFINITIONS

A. Short Side Connection: Service line connecting proposed curb stop, located inside water meter box, to water line on same side of street.

B. Long Side Connection: Service line connecting proposed curb stop, located inside water meter box, to water line on opposite side of street or from center of streets where supply line is located in street center such as boulevards and streets with esplanades. Distance not to exceed 60 linear feet (at right angles to water line).

C. Extra Long Side Connection: Service line connecting proposed curb stop, located inside water meter box, to water line on opposite side of street or from center of streets where supply line is located in street center such as boulevards and streets with esplanades. Distance greater than 60 linear feet (at right angles to water line).

PART 2 P R O D U C T S

2.01 MATERIALS

A. Copper Tubing: In accordance with Section 02503 - Copper Tubing. Polybutylene tubing is not permitted.

B. Corporation Stops: AWWA C 800 as modified in this Section:

1. Inlet End: AWWA standard thread.

2. Valve Body: Tapered plug type, O-ring seat ball type, or rubber seat ball type.

3. Outlet End: Flared-copper connection for use with Type K, soft copper or compression type fitting.

C. Provide taps for water line types and sizes in accordance with pipe tapping schedule located at end of this Section.

D. Dual Strap Saddles: Red brass body and straps; ductile-iron; vinyl-coated body and straps; or ductile-iron, vinyl-coated body and stainless-steel straps.

E. Taps for PVC Water Lines: Use dual-strap or single, wide-band strap saddles which provide full support around circumference of pipe and bearing area of sufficient width along axis of pipe, 2 inches minimum, ensuring that pipe will not be distorted when saddle is tightened. Provide approved stainless-steel tapping saddle with AWWA standard thread .

F. Taps for Steel Pipe: Not allowed, unless specifically approved by Project Manager. Use saddle only when tap is approved on steel pipe.

G. Curb Stops and Brass Fittings: AWWA C 800 as modified in this Section.

1. Inlet End: Flared copper connection or compression-type fitting

2. Valve Body: Straight-through or angled, meter-stop design equipped with following:

   a. O-ring seal straight plug type.

   b. Rubber seat ball type.

3. Outlet End: Female, iron-pipe thread or swivel-nut, meter-spud thread on 3/4-inch and 1-inch stops and 2-hole flange on 1 1/2 and 2-inch sizes.

4. Fittings: Provide approved fittings. Use same size open end wrenches and tapping machines as used with respective Mueller fittings.

5. Factory Testing of Brass Fittings:

   a. Submerge in water for 10 seconds at 85 psi with stop in both closed and open positions.

   b. Reject fitting that shows air leakage. Project Manager may confirm tests locally. Entire lot from which samples were taken will be rejected when random sampling discloses unsatisfactory fittings.

H. Angle Stops: In accordance with AWWA C 800; ground-key, stop type with bronze lock-wing head stop cap; inlet and outlet threads conform to application tables of AWWA C 800; and inlets flared connection or compression.

1. Outlet for 3/4-inch and 1-inch size: Meter swivel nut with saddle support.

2. Outlet for 1 1/2-inch through 2-inch size: O-ring sealed meter flange, iron pipe threads.

I. Fittings: In accordance with AWWA C 800 and following:

1. Castings: Smooth, free from burrs, scales, blisters, sand holes, and defects which would make them unfit for intended use.

2. Nuts: Smooth cast and has symmetrical hexagonal wrench flats.

3. Flare-Joint Fittings: Smooth cast. Machine seating surfaces for metal-to-metal seal to proper taper or curve, free from pits or protrusions.

4. Thread fittings, of all types, shall have N.P.T. or AWWA threads, and protect male threaded ends in shipment by plastic coating, or approved equal.

5. Compression tube fittings shall have Buna-N beveled gasket.

6. Stamp of manufacturer's name or trademark and of fitting size on body.

PART 3 E X E C U T I O N

3.01 GENERAL

A. For service lines and lateral connections larger than those allowed in Pipe Tapping Schedule, branch connections and multiple taps may be used. Space corporation stops minimum of 2 feet apart.

B. Tapped collars of appropriate sizes: Approved in new construction only provided they are set at right angles to proposed meter location.

C. Use tapping machine manufactured for pressure tapping purposes for 2-inch and smaller service taps on pressurized water lines.

D. For new meter or when existing meter is in conflict with proposed pavement improvements, locate water meters one foot inside street right-of-way, or when this is not feasible, one foot on curb side of sidewalk. Contact Project Manager when major landscaping or trees conflict with service line and meter box location. No additional payment will be made for work on customer side of meter.

E. New location and installation of existing small meter shall conform to requirements of this Section.

F. Successfully perform hydrostatic and disinfection testing prior to installing service taps and lines.

3.02 SERVICE INSTALLATION

A. Set service taps at right angles to proposed meter location and locate taps in upper pipe segment within 45 degrees of pipe springline.

B. Install service lines in accordance with Section 02317 - Excavation and Backfill for Utilities.

C. Lay service lines with minimum of 30 inches of cover as measured from top of curb or, in absence of curbs, from centerline elevation of crowned streets or roads. Provide minimum of 18 inches of cover below flow line of ditches to service lines.

D. Service lines across existing street (push-unders): Pull service line through prepared hole under paving. Use only full lengths of tubing. Take care not to damage copper tubing when pulling it through hole. Compression-type union is only permitted when span underneath pavement cannot be accomplished with a full standard length of tubing. Use one compression-type union for each full length of tubing.

E. Maintain service lines free of dirt and foreign matter.

F. Install service lines so that top of meter will be 4 to 6 inches below finished grade.

G. Anticipate existing sanitary sewers to have cement stabilized sand backfill to bottom of pavement. Include cost of such crossings in unit price for services.

H. When copper line must be installed in cement stabilized sand use an 8 MIL polyethylene encasement tubing in accordance with AWWA C105.

3.03 CURB STOP INSTALLATION

A. Set curb stops or angle stops at outer end of service line inside of meter box. Secure opening in curb stop to prevent unwanted material from entering. In close quarters, make S-curve in field. Do not flatten tube. In 3/4-inch and 1-inch services, install meter coupling, swivel-nut, or curb stop ahead of meter. Install straight meter coupling on outlet end of meter.

3.04 GALVANIC CORROSION CONTROL

A. For 1 1 /2” and 2” meters utilizing two bolt flanges, install 2.5 ounce sacrificial zinc anode caps meeting ASTM B418-88 requirements on the end of each bolt on both outlet and inlet side of the meter connection.

3.05 SEQUENCE OF OPERATIONS

A. Open trench for proposed service line in accordance with Section 02317 - Excavation and Backfill for Utilities.

B. Install curb stop on meter end of service line.

C. With curb stop open and prior to connecting service line to meter in slack position, open corporation stop and flush service line thoroughly. Close curb stop, leaving corporation stop in full-open position.

D. Check service line for apparent leaks. Repair leaks before proceeding.

E. Schedule inspection with Project Manager prior to backfilling. After inspection, backfill in accordance with Section 02317 - Excavation and Backfill for Utilities.

F. Install meter box centered over meter with top of lid flush with finished grade. Meter box: Refer to Section 02085 - Valve Boxes, Meter Boxes, and Meter Vaults.

Table 02512-1

PIPE TAPPING SCHEDULE				
WATERLINE TYPE AND DIAMETER	SERVICE SIZE			
	3/4"	1"	1-1/2"	2"
4" Cast Iron or Ductile Iron	DSS,WBSS	DSS, WBSS	DSS,WBSS	DSS, WBSS
4" Asbestos Cement	WBSS	WBSS	DSS, WBSS	DSS, WBSS
4" PVC (AWWA C900)	DSS, WBSS	DSS, WBSS	DSS, WBSS	DSS, WBSS
6" and 8" Cast Iron or Ductile Iron	DSS,WBSS	DSS, WBSS	DSS, WBSS	DSS, WBSS
6" and 8" Asbestos Cement	DSS,WBSS	DSS, WBSS	DSS, WBSS	DSS, WBSS
6" and 8" Cast Iron or Ductile Iron	DSS,WBSS	DSS, WBSS	DSS, WBSS	DSS, WBSS
6" and 8" PVC (AWWA C900)	DSS,WBSS	DSS, WBSS	DSS, WBSS	DSS, WBSS
12" Cast Iron or Ductile Iron	DSS,WBSS	DSS, WBSS	DSS, WBSS	DSS, WBSS
12" Asbestos Cement	DSS,WBSS	DSS, WBSS	DSS, WBSS	DSS, WBSS
12" PVC (AWWA C900)	DSS,WBSS	DSS, WBSS	DSS, WBSS	DSS, WBSS
16" and Up Cast Iron or Ductile Iron	DWBSS	DWBSS	DWBSS	DWBSS
16" and Up Asbestos Cement	DWBSS	DWBSS	DWBSS	DWBSS
16" and Up PVC (AWWA C905)	DWBSS	DWBSS	DWBSS	DWBSS

DSS - DUAL STRAP SADDLES
WBSS - WIDE BAND STRAP SADDLES
DWBSS - DUAL WIDE BAND STRAP SADDLES

END OF SECTION

Section 02520

FIRE HYDRANTS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Fire hydrants.

B. Adjustment of fire hydrants and gate valves.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. Payment is on a unit price basis for each fire hydrant assembly, including 6-inch gate valve and box, installed regardless of barrel depth.

2. Payment for fire hydrant branches (leads) is on linear foot basis for each branch installed. Separate pay items are used for open-cut and augured branches.

3. Payment for salvaged fire hydrants is on unit price basis for each fire hydrant removed and returned to City's Maintenance Quadrant Stock yard.

4. Refer to Section 01270 - Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.03 REFERENCES

A. AWWA C 502 – Standard for Dry Barrel fire Hydrants (Latest Edition).

B. AWWA C 550 - Standard for Protective Epoxy Interior Coatings for Valves and Hydrants

C. SSPC SP2 - Hand Tool Cleaning

D. SSPC SP3 - Power Tool Cleaning

E. SSPC SP10 - Near-White Blast Cleaning

F. SSPC SP11 - Power Tool Cleaning to Bare Metal

G. SSPC 42 – Epoxy Polyamide/Polyamidoamine Primer, performance based

H. SSPC 36 – Two-Component Weatherable Aliphatic Polyurethane Topcoat, performance based

1.04 SUBMITTALS

A. Conform to requirements of Section 01330 - Submittal Procedures.

B. Submit name of hydrant manufacturer, type of bonnet paint, and engineering control drawing number for hydrant proposed for use.

PART 2 P R O D U C T S

2.01 HYDRANTS

A. Provide fire hydrants in conformance with AWWA C 502, Standard for Dry Barrel Fire Hydrants (Latest Edition). Hydrants are approved by the City for issuance of a Certificate of Responsibility. Only hydrants with current Certification of Responsibility will be allowed in City of Houston projects. Approved fire hydrants are listed under City's Approved Water Product List.
https://edocs.publicworks.houstontx.gov/engineering-and-construction/approved-products-and-product-approval-committee/approved-water-products.html

B. The Project Manager may, at any time prior to or during installation of hydrants, randomly select furnished hydrant for disassembly and laboratory inspection, at City expense, to verify compliance with Specifications. When hydrant is found to be non-compliant, replace, at Contractor's expense, hydrants, with hydrants that comply with Specifications.

C. Provide lower hydrant barrel fabricated from Ductile Iron Pipe as single piece, connected to upper hydrant barrel by means of joint coupling that will provide three hundred sixty degree (360) rotation of upper barrel.

2.02 LEADS

A. Branches (Leads): Conform to requirements of Section 02501 - Ductile Iron Pipe and Fittings, Section 02502 - Steel Pipe and Fittings, and Section 02506 - Polyvinyl Chloride Pipe.

2.03 HYDRANT PAINTING

A. New hydrants and refurbished hydrants shall be shop coated as specified herein.

B. Exterior Above Traffic Flange (Including Bolts & Nuts). Bolts and nuts (both above and below ground) shall conform to AWWA C-502 Section 4.11 and shall be stainless steel, cadmium plated, or zinc coated.

1. Surface preparation to be in accordance with SSPC-SP 10 (NACE 2) near white blast cleaned surface.

2. Coat with a liquid or powder epoxy primer and two part polyurethane or TGIC polyester top coat system with total dry film thickness (DFT) of not to exceed 20 mils as follows:

a. Prime Coat - Liquid or powder epoxy primer with a total dry film thickness (DFT) of 4-6 mils, OR cathodic epoxy electro-coat (e-coat) with a (DFT) of 0.5-1.0 mils.

b. Intermediate Coat – Intermediate coat not required.

c. Finish Coat - Two part polyurethane enamel to be in general conformance with SSPC Paint Specification No. 36 or TGIC polyester system, with a total dry film thickness (DFT) 1.5-3.0 mils. Install color coded finish coating of bonnet in field.

d. Bonnet Paint - Field apply finish coat of Silicone Alkyd Resin Enamel to be in general conformance with SSPC Paint Specification No. 21. Dry film thickness of 2 - 3 mils. Bonnet colors are to be as specified in Paragraph 3.01 to designate the appropriate size of water supply line.

3. Colors - Primer: Manufacturer’s standard color. Finish coat of hydrant body: Federal Standard Color #15187 (Blue) or equivalent. Bonnet and Connection caps: Finished coated white. Paint white band of finish coat two (2) inches in width on hydrant body approximately six inches (6") above and parallel to traffic flange.

C. Field Maintenance Painting (Exterior Above Traffic Flange)

1. Surface Preparation to be in accordance with SSPC - SP2, Hand Tool Cleaning, or SSPC - SP3, Power Tool Cleaning, depending on condition of existing paint and extent of corrosion. It is not necessary to remove tightly adhered mill scale, rust, and paint. Mill scale, rust and paint are considered tightly adherent when they cannot be removed with dull putty knife. In some severe cases where it is necessary to remove majority of existing paint, surface should be cleaned in accordance with SSPC -SP11, Power Tool Cleaning to Bare Metal.

2. When surface is cleaned to bare metal (SSPC - SP11), coat hydrant with three coat Alkyd/Silicone Alkyd system in accordance with Paragraph 2.03.B.2 as for new

hydrants. When surface is cleaned to SSPC - SP2 or SSPC - SP3, coat hydrant with Silicone Alkyd Resin Enamel in general conformance with SSPC Paint Specification No. 21. Total dry film thickness of 3-6 mils.

Field coating should be conducted in accordance to the individual coatings manufacturer's recommendations.

D. Exterior Below Traffic Flange (including lower barrel extensions).

1. Surface preparation in accordance with SSPC- SP10 (NACE 2) Near White Blast Cleaned Surface.

2. Primer: One or two coats of modified or equal polyamide epoxy primer, to be in general conformance with SSPC Paint Specification No. 42 or approved equal with a total dry film thickness (DFT) of 20 mils. Exterior below traffic flange should be the same color as the above traffic flange, i.e., blue. (Federal Standard Color #15187 (Blue) or equivalent.)

E. Interior Surfaces Above and Below Water Line Valve (including lower barrel extensions)

1. Material used for internal coating of hydrant interior ferrous surfaces must be NSF certified as suitable for contact with potable water as required by Chapter 290, Rules and Regulations for Public Water Systems, Texas Commission on Environmental Quality.

2. Coating shall be liquid or powder epoxy system in accordance with AWWA Standard C - 550 (latest revision). Coating may be applied in two or three coats, according to manufacturer's recommendations, for total dry film thickness not to exceed 20 mils.

PART 3 E X E C U T I O N

3.01 INSTALLATION

A. Set fire hydrant plumb and brace at locations and grades as shown on Drawings. When barrel of hydrant passes through concrete slab, place 1-inch-thick piece of standard sidewalk expansion joint material around section of barrel passing through concrete.
B. Locate nozzle center line minimum 18 inches above finish grade.
C. Place 12-inch by 12-inch yellow indicators (plastic, sheet metal, plywood, or other material approved by Project Manager) on pumper nozzles of new or relocated fire hydrants installed on new water lines not in service. Remove indicators after new water line is tested and approved by Project Manager.

D. Do not cover drain ports when placing concrete thrust block.

E. Obtain Project Manager's approval in writing prior to installation of hydrants which require changes in bury depth due to obstructions not shown on Drawings. Unit price adjustments will not be allowed for changes in water line flow line or fire hydrant barrel length caused by obstructions.

F. Plug branch lines to valves and fire hydrants shown on Drawings to be removed. Deliver fire hydrants designated for salvage to nearest Utility Maintenance Quadrant Facility.

G. Install branches (leads) in accordance with Section 02511 - Water Lines.

H. Coating Requirements:

1. Apply coatings in strict accordance with manufacturer's recommendations. No requirements of this specification shall cancel or supersede written directions and recommendations of specific manufacturer so as to jeopardize integrity of applied system.

2. Furnish affidavit of compliance that coatings furnished complies with requirements of this specification and referenced standards, as applicable.

I. Use following color code for field coating of hydrant bonnet to indicate size of water line supplying hydrant:

Supply Water Line Diameter (inches)	**Bonnet Color**
6	Yellow
8	White
12-20	Green
24 and larger	Orange

J. Remove and dispose of unsuitable materials and debris in accordance with requirements of Section 01576 - Waste Material Disposal.

END OF SECTION

Section 02526

WATER METERS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Water meters, submeters, and fire service meters.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices

1. Measurement for water meters is on unit price basis for installation of each meter type and size.

2. Payment includes vault, piping and appurtenances necessary for complete installation of meter.

3. Measurement for relocating and reinstalling meter with new box is on unit price basis for each meter relocated and reinstalled.

4. No separate payment for adjustment of meter or meter box unless otherwise shown in Drawings.

5. Refer to Section 01270 - Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work is in this Section is included in total Stipulated Price.

1.03 REFERENCES

A. ASME B 16.1 - Cast-Iron Pipe Flanges and Flanged Fittings.

B. AWWA C 510 - Standard for Double Check Valve Backflow - Prevention Assembly.

C. AWWA C 700 - Standard for Cold-Water Meters - Displacement Type.

D. AWWA C 701 - Standard for Cold-Water Meters - Turbine Type for Customer Service.

E. AWWA C 702 - Standard for Cold-Water Meters - Compound Type.

F. AWWA C 703 - Standard for Cold-Water Meters - Fire Service Type.

G. AWWA Manual M6 - Water Meters - Selection, Installation, Testing, and Maintenance.

1.04 SUBMITTALS

A. Conform to requirements of Section 01330 - Submittal Procedures.

B. Submit written certification of calibration and test results.

C. Submit manufacturer's certification that meters meet applicable requirements of this Specification Section.

D. Submit accuracy registration test certification from manufacturer for each 3-inch through 10-inch diameter meter.

1.05 QUALITY CONTROL

A. Submit manufacturer's warranty against defects in materials and workmanship for one year from date of Substantial Completion.

B. Provide vendor's unconditional guarantee that performance of each meter meets applicable AWWA standards and AWWA Manual M6 as follows:

1. Displacement type: 10 years from installation or register registration shown below, whichever comes first.

Size (inch)	Registration (million gallons)
5/8, 3/4	1.5
1	2.5
1-1/2	5.0
2	10.5

2. Turbine type: 1 year from date of installation.

3. Compound type: 1 year from date of installation.

4. Fire service type: 1 year from date of installation.

Operations of hermetically sealed register, 5/8-inch to 2-inch diameter, shall be unconditionally guaranteed for 15 years.

C. Provide manufacturer's unconditional guarantee for each sealed register against leakage, fogging, discoloration and stoppage for 15 years from date of installation.

D. Vendor may replace meters that become defective within guarantee period with meters that comply with this Specification. City will return defective meters to vendor at expense. Meters

repaired or replaced under this guarantee must meet accuracy limits for new meters upon receipt and accuracy limits for remaining period of initial guarantee.

1.06 EASEMENT REQUIREMENTS

A. Install 2-inch and smaller water meters and shut-off valves (stop boxes) in right-of-way when possible. Otherwise, install in a minimum 5 foot by 5 foot separate water meter easement contiguous with public right-of-way.

B. Install 3-inch to 6-inch water meters in a minimum of 10 foot by 20 foot separate water meter easement contiguous with public right-of-way.

C. Install 8-inch and larger water meters in a minimum of 10-foot by 25-foot separate water meter easement contiguous with public right-of-way.

D. Locate water meter easements contiguous with public right-of-way unless approved by Project Manager. Provide minimum fifteen foot wide access easement when not contiguous with public right-of-way.

PART 2 P R O D U C T S

2.01 GENERAL

A. Provide meters of type and size as indicated on Drawings, unless otherwise indicated.

B. Provide bolted split casings. Main casings of meters and external fasteners: Copper alloy with minimum 75 percent copper for 5/8 inch to 2 inches, bronze or cast iron, hot-dipped galvanized or epoxy coating for 3 inches and larger.

C. Straightening Vanes: Non-corrosive material compatible with case material.

D. Intermediate gear train shall not come into contact with water and shall operate in suitable lubricant.

E. Registers: Automatic Meter Reading (AMR) type that provides pulse, contact closure, piezo switch or encoder generated output signal, compatible with City's radio and telephone AMR systems. Provide minimum 12-foot wire when permanently connected to register. Lens: impact resistant. Register box: tamper resistant by means of tamper screw or plug: Register: permanently sealed, straight-reading, center-sweep test hand, magnetic driven, U.S. gallons. Digits: 6, black in color, with lowest registering 3 digits (below 1,000-gallon registration) having contrasting digit and background color. Register capacity of meters: 9.99 million gallons for 5/8 inch to 2 inches and 999.999 million gallons for 3 inches and larger.

F. Connections: 5/8 inch to 1 inch: threads at each end; 1-1/2 to 2 inches: 2-bolt oval flanges each end; 3 inches and larger: flange at each end.

G. Stamp manufacturer's meter serial number on outer case. Stamp manufacturer's meter serial number on outside of register lid when provided. Manufacturer's serial numbers shall be individual and not duplicated.

H. Meters: Provide approved meters equip with AMR type register to connect to City of Houston's AMR system.

I. Manufacturing Quality Control shall permit successful interchangeability from one meter to another of same size including registers, measuring chambers and units, discs or pistons as units, change gears, bolts, nuts, and washers without affecting accuracy of new meter.

J. For water meter vaults provide:

1. 1/4-inch steel or aluminum with stainless steel hinge pins. Door shall open to 90 degrees and automatically lock in that position.

2. Provide approved meter vault covers.

2.02 METER APPLICATIONS

A. Meter type requirements to usage application

1. All meters must be compatible with the City of Houston automated meter reading (AMR) System and /or automated metering infrastructure (AMI) system

2. Sizes 5/8-inch to 2-inch Meters: Displacement type excluding application exceptions notes in paragraph 2.02 A.3

3. Exceptions

a. Meter types for sizes 1-inch to 2-inch NFPA 13-D, 13-R applications require prior approval by the City of Houston. (Displacement meters are not allowed for these applications).

b. Applications where constant flow is required a 2-inch turbine type meter may be substituted.

B. Sizes 3-inch and above Meters:

1. Turbines:

Processing plants
Manufacturing facilities
Lawn sprinkler systems
Effluent water in treatment plants

Booster (pump) stations
Level controlled tank filling operations
Fire hydrants (transients)
Inter-systems sale or transfer
Sewer credit/sub-meter

2. Compounds:

Multi-family dwellings
Motels and hotels
Hospitals
Schools
Restaurants
Office buildings
Dormitories, nursing homes, department stores, shopping malls, and other commercial establishments

3. Fire Rated Turbines:

Open systems feeding directly from a tank

4. Fire Rated Compounds:

Combination domestic and fire services
Open system not feeding directly from a tank

5. Electromagnetic Meters:

Inter-system sale or transfer
Raw water
Basement or inside structure installations
Contract water
Above ground applications in potential hazardous chemical environs Meters larger than 10-inch.

C. Meter size requirements to flow considerations

Meter flow range is dependent on amount of pressure and slightly varies with manufacture.

Flow Range	Max. Continuous Flow	Meter Size
¼ - 25 GPM	15 GPM	5/8” Positive Displacement
¾ - 70 GPM	50 GPM	1” Positive Displacement
1 ¼ - 120 GPM	80 GPM	1 ½” Positive Displacement
1 ½ - 170 GPM	100 GPM	2” Positive Displacement

Flow Range	Max. Continuous Flow	Meter Size
5 – 550 GPM	450 GPM	3” Turbine
15 – 1250 GPM	1000 GPM	4” Turbine
20 – 2500 GPM	2000 GPM	6” Turbine
30 – 4500 GPM	3500 GPM	8” Turbine
50 – 7000 GPM	5500 GPM	10” Turbine

Flow Range	Max. Continuous Flow	Meter Size
½ - 450 GPM	350 GPM	3” Domestic Compound
¾ - 1250 GPM	1000 GPM	4” Domestic Compound
1 – 2000 GPM	1400 GPM	6” Domestic Compound
3/4 - 1200 GPM	1200 GPM	4” Fire Compound
1 ½ - 2500 GPM	2500 GPM	6” Fire Compound
2 – 4000 GPM	4000 GPM	8” Fire Compound
2 – 6500 GPM	6500 GPM	10” Fire Compound

D. Meter location preference hierarchy for 3” and Larger applications
Outline by order of preference for Meter Easement location. Any installation other than “D1.” requires approval from the Office of the City Engineer (OCE).

1. Adjacent to Public ROW
2. Not adjacent to Public ROW with water line easement.
3. Parking garage
4. Mechanical room area of basement
5. Public ROW
6. Above ground meter installations are required on potential hazardous chemical environs, and meters larger than 10”.

Note: Per chapter 7 of the City Of Houston Design Manual,
Install separate tap and service lead for each domestic meter. Irrigation meters are to be branched off the domestic service.

Eligibility Requirements for Meter Easement Locations
Acronym Definition:
P.A.E.- Permanent Access Easement.
A.D.A.- American’s with Disabilities Act.
ROW- Right Of Way.

Meter Location	Meter Easement	Water line Easement	P.A.E.	A.D.A. Requirements	Electric and Phone service	Encroachment permit	Min. Utility Spacing	Special Meter Vault, or Meter Setup Requirements
Grade Level Easement Adjacent to ROW	YES	NO	NO	NO	NO	NO	NO	NO
Grade Level Easement Not Adjacent to ROW	YES	YES	NO	NO	NO	NO	NO	NO
Parking Garage	YES	**NO	YES	NO	YES	NO*	NO	YES
Mechanical Room in Basement	YES	**NO	NO	NO	YES	NO*	NO	YES
Public ROW	NO	NO	NO	YES	NO	YES	YES	YES
Above Ground Installations	YES	**NO	YES	NO	YES	NO	NO	YES

* Provided structure does not encroach ROW

** Provided meter is set adjacent to ROW

2.03 MATERIALS

A. Cold-Water Meters:

1. Displacement Type: AWWA C 700; sizes 5/8 inch up to and including 2 inches; oscillating disc or piston of magnetic drive type; bolted split-case design, with either being removable.

2. Turbine Type: AWWA C 701; Class II; sizes $1^{1/2}$ inches through 10 inches; flanged; straight-through measuring chamber; rotor construction: polypropylene or similar non-rubber material with specific gravity of approximately 1.0, equipped with near frictionless replaceable bearings in turbine working against rotor shaft positioned thrust bearing. Transient/Fire Hydrant Meter Inlet: Female fitting for attachment to hose nozzle with National Standard Fire hose thread. Outlet: 2-inch nipple with

National Pipe Thread. Include restriction plate to limit flow through meter to 400 gpm at 65 psi. $1^{1/2}$ inches through 8 inches are to be furnished with test plugs in the outlet port of the meter for field testing.

3. Compound Type: AWWA C 702; sizes 2 inches through 6 inches. Measuring chambers: For use in continuous operation; separate units of copper alloy (minimum 84 percent copper) or approved polymer material, inert in corrosive potable water; with centering device for proper positioning. Measuring pistons: Non-pilot type with division plates of rubber covering vulcanized to stainless steel or other approved material of sufficient thickness to provide minimum piston oscillation noise. Measuring discs: Flat or conical type, one piece, mounted on monel or 316 stainless steel spindle. Measuring chamber strainer screen area: Twice area of main case inlet.

4. Fire-Service Type: sizes 4 inches through 10 inches; turbine-type, compound type, proportional type; AWWA C 703, with separate check valve conforming to AWWA C 510. Determine size of fire meter by adding fire flow and domestic flow.

2.04 STRAINERS

A. Displacement Potable Water Meters 5/8 inch through 2 inches: Self-straining by means of annular space between measuring chamber and external case or with strainer screens installed in meter. Provide rigid screens which fit snugly, are easy to remove, with effective straining area at least double that of main case inlet.

B. Potable Water Meters 2-inch diameter and larger: Equip with separate external strainer with bronze body for diameters less than 8 inches. 8-inch diameter and larger may be cast iron, hot-dipped galvanized or epoxy coating. Strainers: Bolted to inlet side of meter, detachable from meter, easily removable lid. Strainer screen: Made of rounded cast bronze, stainless steel wire, having nominal screen size of 3-1/2 mesh-per-inch (U.S. Series) not less than 45 percent clear area.

C. Provide separate approved external strainers (when required by meter manufacturer) approved for use in fire service metered connections by Underwriters Laboratories. Bodies: Cast iron or copper alloy. Ends: Flanged in accordance with ASME B 16.1, Class 125. Provide stainless steel basket. Strainers shall be detachable from meter.

2.05 CONNECTIONS AND FITTINGS

A. Provide pipe for connections in accordance with Section 02501 - Ductile Iron Pipe and Fittings and Section 02506 - Polyvinyl Chloride Pipe. Use restrained joints and flanged joints only.

B. Fittings:

1. For meters 2 inches and smaller: Same type of fittings as Outlet End fittings for Curb Stop in accordance with Section 02512 - Water Tap and Service Line Installation.

2. For meters 3 inches and larger: Restrained ductile iron; push-on bell joints or mechanical joint fittings between water line and meter vault; Class 125 flanged inside meter vaults; cement mortar lined and sealed.

2.06 LAYING LENGTHS

A. Minimum laying lengths for meter and standard strainer shall be as shown on Drawings.

PART 3 E X E C U T I O N

3.01 TAPPING AND METER SERVICE INSTALLATION

A. Refer to Section 02525 - Tapping Sleeves and Valves for tapping requirements.

B. Meter Service Line:

1. Use pipe and fittings conforming to requirements of Section 02501 - Ductile Iron Pipe and Fittings, or Section 02506 - Polyvinyl Chloride Pipe.

2. Limit pulling and deflecting of joints to limits recommended by manufacturer.

3. Make vertical adjustments with offset bends where room will permit. Minimize number of bends as shown on detail drawings.

4. Provide minimum of ten pipe diameters of straight pipe length upstream and downstream of meter vault.

3.02 METER FITTING HOOKUP

A. Support meter piping and meter, level and plumb, during installation. Support meters 3 inches and larger with concrete at minimum of two locations.

B. Use round flanged fittings inside meter box or vault except for mechanical joint to flange adapter. Provide full-face 1/8-inch black neoprene or red rubber gasket material on flanged joints. Provide bolts and nuts made from approved corrosion-resistant material.

C. Tighten bolts in proper sequence and to correct torque.

D. Visually check for leaks under normal operating pressure following installation. Repair or replace leaking components.

3.03 METER BOX AND VAULT INSTALLATION

A. Conform to requirements of Section 02085 - Valve Boxes, Meter Boxes, and Meter Vaults.

B. Perform adjustment to existing meter in accordance with Section 02085 - Valve Boxes, Meter Boxes, and Meter Vaults.

3.04 BASEMENT INSTALLATIONS FOR METERS

A. All piping within meter easement inside the building in basement must be welded steel to conform to section 02502 or restrained Ductile Iron to conform to section 02501. All transitions from PVC to Steel or Ductile iron must be made on the exterior side of the basement wall. All materials must be on the City approved list of materials.

1. The meter piping must conform to the City of Houston detail drawings for typical meter piping arrangement.

2. All pipes must be installed straight into the building.

B. 3" and larger meter installations for basements must be the Utility Customer Service approved for billing electromagnetic meter from the City Of Houston approved products list.

C. The customer must provide a NEMA type 4 enclosure 20"H x 16"W x 10"D for the mounting and containment of the meter electronics. The 120AC receptacle and phone jack must be installed in the enclosure

D. The customer must provide and maintain 120AC power and phone line within five feet of the meter location.

1. The 120AC power must terminate with a GFI protected receptacle and be connected to the structures emergency back up power.

E. The customer must provide a phone line which can be a shared phone line.

1. Phone line must terminate with a phone jack inside the service rack enclosure.

F. The customer will be required to give the City of Houston the appropriate size meter easement to conform to the City of Houston Design Manual, with a minimum 8 feet clearance between floor and ceiling.

1. Meters installed in an interior room must be fitted with double doors for easy equipment access. A floor drain must be installed within the meter easement for water drainage.

2. The meter must be placed on the same floor level that the service line enters the structure. The service line must enter through the wall of the building. Use link seal method for pipe penetration thru wall as shown in City of Houston Detail Drawing.

3. The customer or property owner shall keep the space occupied by the meter free from rubbish or obstruction of any kind, and provide access in accordance to City of Houston Ordinance Chapter 47.

G. No signal from the meter will be shared, duplicated, or split for the customers use. Once the meter is installed and accepted by the City of Houston the meter, instruments, and all attachments becomes the sole property of the City of Houston.

3.05 CONTRACT METER INSTALLATIONS

A. All contract potable water and raw water accounts are required to install the Utility Customer Service approved for billing electromagnetic meter from the City Of Houston approved product list.

1. With exception of Emergency Backup System meters EBS which will be the approved mechanical type meter for the application.

B. All meter vaults must be designed to the City Of Houston standard detail drawings.

1. Meter installations larger than 10” that cannot be installed within the standard City vault, or meter installations in potential hazardous chemical environs must be installed above ground.

2. The City Of Houston Engineer’s office and the Meter Shop must approve an above ground meter installation.

3. All above ground meter installations must be painted to City of Houston specifications section 02527 and have freeze protection.

4. Above ground meter installations must have an 8’tall perimeter fence with a gate when it is not inside a water plant facility.

C. All meter installations require meter easements and require a water line easement when meter easement is not adjacent to the City of Houston Right of Way.

1. All meters that are not located adjacent to the Public Right of Way must have an all weather hard surface road to the meter location.

D. All contract account customers must supply 120 AC voltage with a GFI receptacle and phone service with phone jack to be terminated in a NEMA type 4 enclosure 20”H x 16”W x 10”D at the meter location.

1. Electrical service to the City Of Houston meter station must be connected to the back up generator when installed within the districts plant facility.

2. 1" PVC electrical conduit must be installed from the enclosure to the meter for the meter electronics.

Note: **No customer will be allowed to share, spilt, duplicate, or disrupt any signal generated from the City Of Houston meter**.

3.06 TESTING

A. Accuracy registration tests will be conducted in accordance with latest revision of AWWA standard for type and size of meter.

1. Tests will be run by City of Houston on meters prior to installation at City's meter repair shop. Meters 2 inches and smaller will be tested at random at City's discretion. All 3 inches and larger meters will be tested.

2. Accuracy of displacement meters during guarantee period shall be as follows:

a. Initial period: of 18 months from date of shipment or 12 months from date of installation: 98.5% to 101.5% at standard and minimum flow rates; 98% to 101% at low flow rates.

b. Second period: AWWA new meter accuracy as tested below.

	GUARANTEE PERIOD			TEST FLOW RATE
Meter Size (inches)	Age of Meter Years	Or	Million* Gallons	Minimum Rate (gpm)
5/8	>1 to <5		0.5	1/4
1	>1 to <5		1.0	3/4
1-1/2	>1 to <5		2.5	1-1/2
2	>1 to <5		5.5	2

* Total registration.

c. Third period: AWWA new meter accuracy for standard flow rates and AWWA repair meter accuracy for minimum flow rate as tested below.

	GUARANTEE PERIOD			TEST FLOW RATE		
Meter Size (inches)	Age of Meter Years	or	Million* Gallons	Standard Flow Rates (gpm)	and	Minimum Rate (gpm)
5/8	>5 to <10		1.5	2-15		1/4
1	>5 to <10		2.5	4-40		3/4
1-1/2	>5 to <10		5.0	8-50		1-1/2
2	>5 to <10		10.0	15-100		2

* Total registration.

3. Minimal acceptable accuracy in percent of low flow registration for turbine meters:

Meter Size (inches)	Minimum Flow (gpm)	% Accuracy Required
2	3	95
3	5	95
4	15	95
6	20	95
8	20	95
10	30	95

END OF SECTION

Section 02532

SANITARY SEWER FORCE MAINS

PART 1 G E N E R A L

1.01 SECTION INCLUDES

A. Sanitary sewer force mains.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. Payment for installation of force main pipe by open-cut, augered with or without casing, or within limits of Potentially Petroleum Contaminated Area (PPCA) is on linear foot basis. Measurement will be taken along center line of pipe from end to end. Payment will be made for each foot of force main installed, complete in place including pipe, excavation, bedding, backfill and special backfill, shoring, earthwork, connections to existing manholes, acceptance testing, and pipe and accessories.

2. Payment for installation of force main pipe at a bayou crossing is on a lump sum basis.

3. The Unit Price item identifies line segments between stations as shown on Drawings.

4. Refer to Section 01270 - Measurement and Payment for unit price procedures.

B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.03 REFERENCE STANDARDS

A. ACI 318 - ACI Building Code and Commentary.

B. ASTM D 696 - Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 C and 30 C with a Vitreous Silica Dilatometer.

C. ASTM D 2310 - Standard Classification for Machine-Made “Fiberglass” (Glass-Fiber-Reinforced- Thermosetting-Resin) Pipe.

D. ASTM D 2992 - Standard Practice for Obtaining Hydrostatic or Pressure Design Basis for “Fiberglass” (Glass-Fiber Reinforced Thermosetting-Resin) Pipe and Fittings.

E. ASTM D 2996 - Standard Specification for Filament-Wound “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.

F. Uni-Bell UNI-B-3 Polyvinyl Chloride (PVC) Pressure Pipe (complying with AWWA C 900).

1.04 SUBMITTALS

A. Conform to requirements of Section 01330 - Submittal Procedures.

B. Submit proposed methods, equipment, materials, and sequence of operations for force main construction. Plan operations to minimize disruption of utilities to occupied facilities or adjacent property.

C. Force mains 24 inches in diameter and larger: Submit shop drawings and design calculations for joint restraint systems using reinforced concrete encasement of pressure pipe and fittings.

D. Submit qualifications, proposed methods, equipment, materials, and sequence for acceptance testing of pipeline. Submit evidence of experience with pipeline proving by pigging for at least three projects of equal or greater scope; project list shall include dates, size and length of pipe, location, owner name, contact person, and telephone number. Provide certificate of training by manufacturer of pigging equipment being used.

E. Submit test reports as specified in Part 3 of this Section.

PART 2 P R O D U C T S

2.01 PIPE FITTING MATERIAL SCHEDULE

A. Unless otherwise shown on Drawings, use pipe materials that conform to requirements specified in one or more of the following Sections:

1. Section 02501 - Ductile-Iron Pipe and Fittings.

2. Section 02504 - Fiberglass Reinforced Pipe.

3. Section 02505 - High Density Polyethylene Solid and Profile Wall Pipe (HDPE).

4. Section 02506 - Polyvinyl Chloride Pipe. Provide Lined Ductile-Iron Fittings in Accordance with Section 02501 - Ductile-Iron Pipe and Fittings.

5. Section 02509 – Fiberglass Reinforced Pipe for Pressure Mains.

B. Pipe shall be color coded green.

2.02 THRUST RESTRAINT

A. Unless otherwise shown on Drawings, provide concrete thrust blocking for force mains up to 12-inches in diameter, to prevent movement of buried lines under pressure at bends, tees, caps, valves and hydrants. Blocking shall be Portland cement concrete, as specified in Section 03315 - Concrete for Utility Construction. Place concrete in accordance with details on Drawings. Place thrust blocks between undisturbed ground and fittings. Anchor fittings to thrust blocks so that pipe and fitting joints are accessible for repairs. Concrete shall extend from 6 inches below pipe or fitting to 12 inches above.

B. For force mains larger than 12 inches in diameter, and where indicated on Drawings, provide restrained joints conforming to requirements of force main pipe material specifications. Install restrained joints for length of pipe on both sides of each bend or fitting for full length shown on Drawings.

C. Horizontal and vertical bends between zero and 10 degrees deflection angle will not require thrust blocks or harnessed or restrained joints.

D. Horizontal and vertical bends between 10 degrees and 90 degrees deflection angle shall have thrust restraint as shown on Drawings.

E. Provide thrust restraint at tees, plugs, blowoff drains, valves, and caps, as indicated.

F. Reinforced concrete encasement of force main pipe and fittings may be used in lieu of manufactured joint restraint systems. Alternate joint restraint systems using reinforced concrete encasement shall conform to following design requirements.

1. Design calculations shall be performed and sealed by Professional Engineer licensed in State of Texas.

2. Base design calculations upon soil parameters quantified in geotechnical report for site where alternative thrust restraint system is to be installed. When data is not available for site, use parameters recommended by geotechnical engineer.

3. The design system pressure shall be specified test pressure.

4. The following safety factors shall be used in sizing restraint system:

   a. Apply factor of safety equal to 1.5 for passive soil resistance.

   b. Apply factor of safety equal to 2.0 for soil friction.

5. Contain encasement entirely within standard trench width and terminate on both ends at pipe bell or coupling.

6. Concrete encasement reinforcement steel shall be designed for all loads, including internal pressure and longitudinal forces. Concrete design shall be in accordance with ACI 318.

PART 3 E X E C U T I O N

3.01 PIPE INSTALLATION BY OPEN-CUT

A. Perform excavation, bedding, and backfill in accordance with Section 02317 - Excavation and Backfill for Utilities.

B. Wrap ductile-iron pipe and fittings with polyethylene wrap in accordance with requirements of Section 02528 - Polyethylene Wrap. Do not install polyethylene wrap on ductile iron pipe protected by cathodic protection system or fusion bonded or polyurethane coated fittings.

C. Install pipe in accordance with pipe manufacturer's recommendations and as specified in following paragraphs.

D. Install pipe only after excavation is completed, bottom of trench is fine graded, bedding material is installed, and trench has been approved by Project Manager.

E. Install pipe to line and grade indicated. Place pipe so that it has continuous bearing of barrel on bedding material and is laid in trench so interior surfaces of pipe follow grades and alignment indicated. Provide bell holes where necessary.

F. Install pipe with spigot ends toward direction of flow. Form concentric joint with each section of adjoining pipe so as to prevent offsets.

G. Keep interior of pipe clean as installation progresses. Where cleaning after laying pipe is difficult because of small pipe size, use suitable swab or drag in pipe and pull it forward past each joint immediately after joint has been completed. Remove foreign material and debris from pipe.

H. Provide lubricant, place and drive home newly-laid sections with come-a-long winches so as to eliminate damage to sections. Install pipe to “home” mark where provided. Use of back hoes or similar powered equipment will not be allowed unless protective measures are provided and approved in advance by Project Manager.

I. Keep excavations free of water during construction and until final inspection.

J. When work is not in progress, cover exposed ends of pipes with approved plug to prevent foreign material from entering pipe.

K. Where sanitary sewer force main is to be installed under existing water line with separation distance of less than 2 feet, install one full joint length of pipe, minimum 18 foot length, centered on water line and maintain minimum 6-inch separation distance.

3.02 PIPE INSTALLATION OTHER THAN OPEN-CUT

A. For installation of pipe by augering, jacking, or tunneling, conform to requirements of specification section of augering or tunneling work.

3.03 HYDROSTATIC TESTING

A. After pipe and appurtenance have been installed, test line and drain. Prevent damage to Work or adjacent areas. Use clean water to perform tests.

B. Project Manager may direct tests of relatively short sections of completed lines to minimize traffic problems or potential public hazards.

C. Test pipe in presence of Project Manager.

D. Test pipe at 150 psig or 1.5 times design pressure of pipe, whichever is greater. Design pressure of force main shall be rated total dynamic head of lift station pump.

E. Test pipe at required pressure for minimum of 4 hours.

F. Maximum allowable leakage shall be as calculated by following formula:

$$L = (S)\,(D)\,(P^{0.5}) / 155{,}400$$

Where:	L	=	Leakage in gallons per hour per 1,000 feet of pipe.
	S	=	Length of pipe in feet.
	D	=	Inside diameter of pipe in inches.
	P	=	Test pressure in pounds per square inch.

G. Correct defects, cracks, or leakage by replacement of defective items or by repairs as approved by Project Manager.

H. Plug openings in force main after testing and flushing. Use cast iron plugs or blind flanges to prevent debris from entering tested pipeline.

3.04 PIGGING TEST

A. After completion of hydrostatic testing and prior to final acceptance, test force mains longer than 200 feet by pigging to ensure piping is free of obstructions.

B. Pigs: Provide proving pigs manufactured of open-cell polyurethane foam body, without coating or abrasives which would scratch or otherwise damage interior pipe wall surface or lining. Pigs shall be able to pass through reductions of up to 65 percent of nominal cross-sectional area of pipe. Pigs shall be able to pass through standard fittings such as 45-degree and 90-degree elbows, crosses, tees, wyes, gate valves, or plug valves, as applicable to force main being tested.

C. Test Execution: Conduct pigging test in presence of Project Manager. Provide at least 48-hours notice of scheduled pigging of force main prior to commencing test.

END OF SECTION

FOR PROJECTS INITIATED
AFTER SEPTEMBER 1, 2017
REVISION 10

ITEM 460

REINFORCED CONCRETE PIPE

460.1 Description. This Item shall govern for the furnishing and installing of reinforced concrete pipe.

460.2 Materials. Except as modified herein, materials, manufacture and design of pipe shall conform to ASTM C76 “Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe”, Class III, for circular pipe, ASTM C506 “Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe” for arch pipe or ASTM C507 “Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe” for elliptical pipe. All pipe shall be machine made or cast by a process which will provide for uniform placement of the concrete in the form and compaction by mechanical devices which will assure a dense concrete. Concrete shall be mixed in a central batch plant or other approved batching facility from which the quality and uniformity of the concrete can be assured. Transit mixed concrete will not be acceptable for use in precast concrete pipe.

In the manufacture of concrete pipe, the supplier has the option of using portland cement or portland cement plus fly ash, as defined herein. Cement plus fly ash shall be composed of portland cement and 20-30 percent fly ash, by weight. Fly ash shall be Class C or Class F, conforming to the requirements of ASTM C618 "Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.”

Joint seal shall be a rubber gasket meeting the requirements of ASTM C443 “Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.” The rubber gasket shall be applied using lubricants of flax soap or equal. Mineral lubricants are not permitted.

Rubber gasket substitution shall not be permitted without written approval from the Design Engineer.

460.3 Submittals. Submit certification from the fabricator that the pipe has been tested and meets the requirements of this Item. The joint material data sheets shall be submitted for approval, by the Design Engineer.

460.4 Installation. Unless otherwise specified, the following method shall govern:

Jointing Rubber Gasket Pipe:

Lay pipe section in trench to true alignment and grade. Exceptional care shall be taken in placing pipe and making field joints. Avoid bumping the pipe in the trench. Place rubber gasket on dry spigot end of pipe. Properly lubricate spigot, with rubber gasket in place, with specified lubricants. Do not twist, roll, cut, crimp or otherwise injure gaskets or force them out of position during closure of joints. Pull or push the pipe home for closure of the joint. Correct joint rebound before backfilling the pipe. Remove foreign matter or dirt from pipe and keep clean during and after laying.

Install reinforced concrete pipe in accordance with Item 430 “Construction of Underground Utilities”, and all related drawings/plans.

Unless otherwise shown on the plans, not more than two holes may be placed in the top section of the pipe for lifting and placing. The holes may be cast, cut, or drilled in the wall of the pipe. The holes shall not exceed 3 inches in diameter at the inside surface of the pipe wall. Not more than one longitudinal wire or two circumferential wires may be cut per layer of reinforcing steel when locating lift holes in the pipe wall.

All lifting holes shall be sealed to the satisfaction of the Engineer. Tapered lifting plugs shall be used, and sealed externally and internally with an acceptable cement grout. Additionally, lifting plugs shall not protrude from the pipe greater than one-half of an inch.

460.5 Quality Assurance. Concrete pipe 54 inches and smaller in diameter shall be tested in accordance with ASTM C497 “Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile” using the method outlined by Part 4. "External Load Crushing Strength Test by the Three-Edge Bearing Method". The pipe shall be tested at a frequency of three pipe joints for each 100 joints cast, for each pipe size.

Concrete pipe 60 inches and larger shall also be tested in accordance with ASTM C497 using the method outlined by Part 6. "Core Strength Test". However, where the manufacture of the pipe is witnessed by the Engineer, tests using concrete cylinders in accordance with ASTM C39 "Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens", shall be acceptable. All test specimens and testing shall be done by the producer of the concrete pipe.

Pipe previously approved and stamped by a Texas Department of Transportation (TxDOT) approved fabricator with specific stamp, which must state: “Certifies Specification Compliance” (i.e. compliance with TxDOT’s DMS - 7310 “Reinforced Concrete Pipe and Machine-Made Precast Concrete Box Culvert Fabrication and Plant Qualification” requirements) will be accepted by all laboratories and by Harris County.

For pipes that are stamped by the fabricator as stated above, copies of test results (D-loads and compressive strengths) shall be submitted to the Engineer.

Random Inspection and Testing. Harris County reserves the right to inspect, sample, and test reinforced concrete pipe at any time to ensure compliance with this Item. The pipe manufacturing plant shall provide facilities, equipment, and access to allow for inspection regarding: the quality of materials, the process for manufacturing, and the finished pipe at the plant; in addition to the inspection that is done of the finished pipe at the site before and during the installation.

460.6 Acceptance Requirements. Variations in diameter, size, shape, wall thickness, reinforcement placing, laying length, and permissible underrun of length shall be in accordance with the applicable ASTM Standard for each type of pipe as referred in Section 460.2.

Pipe shall be free from fractures, all cracks and surface roughness. The ends of the pipe shall be normal to the walls and centerline of the pipe. Pipe shall be cured in accordance with the applicable ASTM Standard for each type of pipe as referred to herein.

The following information shall be clearly marked on each section of pipe:

A. The class and ASTM or D-Load of pipe.

B. The date of manufacture.

C. The name or trademark of the manufacturer and plant location.

D. Designated manufacturer's certifying stamp.

E. One end of each elliptical section of pipe shall be clearly marked on the inside and outside to show the location of the top and bottom of pipe.

F. Clearly mark pipe to be used for jacking and boring (when applicable).

G. Pipe meeting sulfate-resistant concrete plan requirements (when applicable).

Marking shall be indented on the pipe section or painted thereon with waterproof paint.

Pipe shall be subject to rejection for failure to conform to any of the specification requirements. Individual sections of the pipe may be rejected because of any of the following:

A. Fractures or cracks passing through the shell/wall of pipe with exception of a single crack that does not exceed the depth of the joint.

B. Defects that indicate imperfect proportioning, mixing and molding.

C. Surface defects indicating honeycombed or open texture.

D. Damaged ends, when such damage would prevent making a satisfactory joint.

E. Any continuous crack having a surface width of 0.01 inch or more and extending for a length of 12 inches or more.

The painting of pipe shall not be allowed prior to delivery on the project.

460.7 Measurement & Payment. Gravity pipelines (R.C.P.) shall be measured by the linear foot of pipe actually laid, at finished grade, along pipe of size and at depth installed, in accordance with Item 430 “Construction of Underground Utilities”. Measure depth at manholes, at intervals not to exceed 50 feet between manholes, and at breaks in profile of natural ground from flow line of pipe to natural ground surface over center of pipe. Payment for gravity pipeline, furnished, installed and measured as stated shall be at the contract unit price bid for the size, type, (and depth, if shown on the proposal) measured under their respective bid line codes.

If the depth of cut is not shown on the proposal, no consideration shall be made for depth at which the pipe is installed.

Pipe installed by tunneling shall be paid for in accordance with Item 431 “Jacking, Boring and Tunneling Pipe” or Item 432 “Tunnel Construction”.

No separate payment shall be made for ordinary bedding and select backfill, unless so indicated on the bid form.

No separate payment shall be made for hauling and storing suitable excavated trench material for other uses or for disposal of excess or unsuitable materials.

No separate payment shall be made for any bedding and backfill installed in accordance with these Standard Specifications and the drawings.

Well Pointing shall be measured and paid for in accordance with the Item 436 “Well Pointing.”

There are line code(s), description(s), and unit(s) for this Item.

NOTE: This Item requires other Standard Specifications

Item 430 “Construction of Underground Utilities”
Item 431 “Jacking, Boring or Tunneling Pipe”
Item 432 “Tunnel Construction”
Item 436 “Well Pointing”

END OF ITEM 460

FOR PROJECTS INITIATED
AFTER MAY 1, 2014
REVISION 6

ITEM 463

SAFETY END TREATMENT

463.1 Description. This Item shall govern for the materials to be furnished and for the construction of Safety End Treatment (S.E.T.) for drainage structures at the designated locations, in accordance with this Item and as shown on the construction drawings.

463.2 Materials. Unless otherwise shown on the drawings, materials shall conform to the following:

Item 420 "Concrete Structures"
Item 421 "Structural Concrete"
Item 440 "Reinforcing Steel"
Item 460 "Reinforced Concrete Pipe"
Item 461 "Corrugated Metal Pipe"
Item 480 "Precast Reinforced Concrete Box Sewers"

Pipe Runners - ASTM A53 “Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless”, Grade B or equivalent strength pipe

Plates and Angles - ASTM A36 “Standard Specification for Carbon Structural Steel”

Bolts and Nuts - ASTM A307 “Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength”

Unless otherwise shown on the drawings, all metal pipe, plates, angles, nuts and bolts shall be galvanized in accordance with ASTM A123 “Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products” or ASTM A153 “Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware”, whichever is pertinent.

463.3 Types of Safety End Treatment

A. Parallel Drainage Safety Pipe Runners (PD-SPR) PD-SPR Type I S.E.T. shall be used on single or multiple reinforced concrete box culvert (RCB), either precast or cast-in-place, or Type II S.E.T. shall be used on reinforced concrete pipe (RCP) or corrugated metal pipe (CMP) with the ends tapered to the proper slope as shown in the Latest Edition of the Texas Department of Transportation (TxDOT) standard drawing, unless shown otherwise in the contract documents.

B. Cross Drainage Safety Pipe Runners (CD-SPR) CD-SPR Type I S.E.T. shall be used on single or multiple reinforced concrete box culvert (RCB), either precast or cast-in-place, or Type II S.E.T. shall be used on reinforced concrete pipe (RCP) or corrugated metal pipe (CMP) with the ends tapered to the proper slope as shown in the Latest Edition of the Texas Department of Transportation (TxDOT) standard drawing, unless shown otherwise in the contract documents.

Unless otherwise shown on the drawings, when CMP or RCP is specified for the pipe structure, the Contractor shall have the option of providing prefabricated metal end sections or precast S.E.T. units in lieu of mitered CMP or RCP.

463.4 Construction. Construction shall be in accordance with the details shown on the drawings and in accordance with the construction and installation methods of Standard Specification Items 420, 430, 433, 461, and 480, whichever apply.

Damaged galvanizing shall be repaired by the Contractor in accordance with Item 461 “Corrugated Metal Pipe”.

When required riprap, slope paving headwall or collars are to be installed. They shall be in accordance with Item 491 "Reinforced Concrete Slope Paving".

Any required structural excavation shall be in accordance with Item 400 "Structural Excavation and Backfill". Removal of portions of in-place structures when required, shall be in accordance with Item 495 "Removing Old Structures". The extension of concrete structures, when required, will be in accordance with Item 424 "Extending Concrete Structures".

463.5 Measurement. S.E.T. will be measured by each unit of size specified with or without PD-SPR or CD-SPR.

Structural excavation and any slope paving headwalls or collars required by the drawing will not be measured but will be considered subsidiary to this Item.

463.6 Payment. Payment for S.E.T. will be paid for at the unit price bid for each for the particular size as measured herein. The following shall be specified for each S.E.T.:

S.E.T. (Type I)(Height)(Slope) or
S.E.T. (Type I)(Height)(Slope)(Pipe Runner Orientation);
S.E.T. (Type II)(Pipe Size)(Pipe Material)(Slope) or
S.E.T. (Type II)(Pipe Size)(Pipe Material)(Slope)(Pipe Runner Orientation)

This payment shall be full compensation for the breaking and removing of all concrete, when required, removing a portion of in-place structures and extending concrete structures, when required, for all concrete, reinforcing steel, CMP, RCP, RCB slope paving, toe wall, concrete aprons, pipe runners, collars, nuts, riprap, bolts, plates and angles as may be required, for all structural excavation, galvanizing, for all labor, tools, equipment, for construction or furnishing and installing S.E.T. units and incidentals necessary to complete the work. If the S.E.T. is specifically to be precast, it shall be noted as such.

There are line code(s), description(s), and unit(s) for this Item.

NOTE: This Item requires drawings (TxDOT Standards) that shall be incorporated into the contract documents.

NOTE: This Item requires other Standard Specifications

Item 400 "Structural Excavation and Backfill"
Item 420 "Concrete Structures"
Item 421 "Structural Concrete"
Item 424 "Extending Concrete Structures"
Item 430 "Construction of Underground Utilities"
Item 433 "Cement Stabilized Sand Bedding and Backfill Material"
Item 440 "Reinforcing Steel"
Item 460 "Reinforced Concrete Pipe"
Item 461 "Corrugated Metal Pipe"
Item 480 "Precast Reinforced Concrete Box Sewers"
Item 491 "Reinforced Concrete Slope Paving"
Item 495 "Removing Old Structures"

END OF ITEM 463

FOR PROJECTS INITIATED
AFTER SEPTEMBER 1, 2017
REVISION 10

ITEM 471

PRECAST CONCRETE MANHOLES AND JUNCTION BOXES

471.1 Description. This Item shall govern for the manufacture and construction of precast concrete manholes, including the materials used therein and the furnishing of frames, grade rings and covers.

471.2 Design Loads. Design loads shall consist of dead load, live load, impact and in addition loads due to water table and any other loads which may be imposed on the structure. Manholes and junction boxes shall be designed in accordance with the AASHTO LRFD Bridge Design Specifications, Latest Edition.

471.3 Materials. Reinforcing steel shall conform to the Item 440 "Reinforcing Steel" and concrete shall conform to the Item 421 "Structural Concrete". The concrete mix shall contain sufficient cementitious material to produce a minimum compressive strength of 4,000 psi in 28 days.

Cement mortar shall conform to ASTM C270 “Standard Specification for Mortar for Unit Masonry”, Type M. Aggregate for mortar shall conform to ASTM C144 “Standard Specification for Aggregate for Masonry Mortar.”

Cast iron shall conform to ASTM A48 “Standard Specification for Gray Iron Castings”, Class 35B - Cast iron manhole frames and covers shall be heavy duty and shall be manufactured to the dimensions shown on the Standard Civil Drawing. As-cast dimensions may vary in accordance with AASHTO M306, “Drainage, Sewer, Utility and Related Castings”. Casting shall be free from sand or blow holes and other defects. Holes in cover shall be free from plugs and burrs. Frames and covers shall have machined bearing surfaces and conform to the Standard Civil Drawing.

471.4 Manufacture. Precast concrete manholes shall be manufactured in accordance with ASTM C478, "Standard Specification for Circular Precast Reinforced Concrete Manhole Sections."

471.5 Submittals.

Product Data. For standard or special precast manholes, the Contractor shall submit the manufacturer’s product data showing the dimensions, location and size of steel reinforcement and certify that the manholes and all accessories meet or exceed the applicable requirements listed in this Item. The manufacturer shall certify that such products and all accessories meet ASTM Specifications.

Shop Drawings. The Contractor shall submit shop drawings for special precast manholes for approval by the Engineer prior to fabrication of the units. These drawings shall show complete design installation including dimensions, steel reinforcement size/placement as well as supporting engineering design calculations.

471.6 Quality Assurance.

Plant Testing. The Contractor shall notify the Engineer in advance of the date and plant location so that an independent testing laboratory can monitor the manufacturing of the units.

471.7 Installation. The Contractor shall prepare a hole large enough to accommodate the outside dimensions of the manhole. Prior to setting, the Contractor shall provide a 6 inch thick base of cement stabilized sand, per Item 433 “Cement Stabilized Sand Bedding and Backfill Material” suitable to receive the manhole, unless otherwise shown on the drawings. The base material shall be compacted and graded level at proper elevation to receive the manhole in relation to the conduit grade.

Sealants used between the joints of the manhole are to be as recommended by the precast manufacturer. If grout is used, it shall be a non-shrink grout. The grout shall be poured in a water soaked groove and filled to the top of the groove in the previously set section. Grade rings where used shall have 1/2 inch thick non-shrink grout coat inside and outside, or the grade rings shall be installed with non-shrink grout to provide a sealed grade ring area. Alternately, the grade rings may be sealed from outside with Infi-Shield Uniband or approved equal.

After the installation of the precast manhole sections to the proper elevation, the cast iron manhole frame shall be set in a full mortar bed. Alternatively, the Contractor may set precast manhole cover slab in full mortar bed and adjust to the required elevation. Unless otherwise shown on the drawings, the top of cast iron frame and cover is to be flush with adjacent finished surface or to the elevation established by the Engineer. Manhole frame and cover should be located outside of the traffic wheel path.

The inverts of the sewer line or several sewer lines entering the manhole at or near the flow line elevation of the manhole shall be shaped and routed across the floor of the manhole using mortar to obtain the proper contour.

Where the main sewer (lowest line) passes straight through the manhole or the degrees of deflection of the main sewer is less than 5 degrees, and no other line or stub out is shown entering the manhole below the

centerline of the main sewer, lay the sewer continuously through the manhole. After the precast manhole sections have been installed above the top of the sewer, breakout and remove the top half of the barrel of the sewer pipe that was previously laid through the manhole. Use concrete with a 1 inch thick mortar topping and construct the invert as shown in the Standard Civil Drawing.

Where the main sewer (lowest line) alignment deflects greater than 5 degrees at manhole or where another sewer or stub out enters at or below the centerline of the main sewer, terminate main sewer pipe, by laying it in such a manner that pipe ends flush at the inside of the manhole. Construct the invert with concrete and top with 1 inch of mortar. Shape invert for smooth flow across floor of manhole and slope the sides as shown to obtain proper contour.

When installing precast square or rectangular manhole structures, construct invert channels to provide smooth flow transition waterway with no disruption of flow at pipe-manhole connections. Slope of invert bench shall be 1 inch per foot minimum, or 1-1/2 inches per foot maximum.

Before inserting the pipe into the wall opening, apply non-shrink grout on the inside curvature of the wall centered at the bottom 25 percent of the wall opening of the manhole.

Use non-shrink grout (applied per manufacturers recommendations) to attain a water tight seal at the opening of the manhole wall with the pipe. For box culverts and arch pipe (all non-circular applications) use non-shrink grout to ensure a water tight seal.

Stub outs shall be installed, where shown, to the lines and grades. Use one full joint of pipe, of the size indicated, for stub out. Seal stub out with plug. Install the plug in such a manner as to prevent seepage or leakage through stub outs. The plugs shall be installed so that they may be easily removed in the future, without damaging the end of the stub out. When inlet leads, lateral sewer pipe, stub outs and drop connections enter manholes, cut off ends of protruding pipe flush with inside of manhole wall. Point up any irregularities with mortar.

Backfill around manholes shall be placed immediately after mortar and concrete has set, and in accordance with Item 430 “Construction of Underground Utilities.” Where proposed sewer lines connect to existing manholes at grade, reshape invert of existing manhole, so that no turbulence is created in the manhole as a result of the connection.

471.8 Submittal Required. Submit certification from the foundry that the frame and cover have been tested, inspected and found to meet the requirements of this Item and the applicable ASTM Standards.

Submit certification from the manufacturer that the manhole has been tested and meets this Item requirements. Sealants used between the joints of the manhole are to be as recommended by the precast manufacturer, and approved by the Engineer.

471.9 Marking. Each individual casting shall be identified by the foundry showing the following:

A. Name of producing foundry.

B. AASHTO or ASTM number.

C. Class by a number followed by a letter indicating the minimum tensile strength and size of test bar.

D. Casting as required by the drawings.

471.10 Measurement. Manhole depths shall be measured by the linear foot of vertical distance from flow line of manhole to top of manhole casting and shall be classified per each manhole TYPE as follows:

A. Shallow manhole - a manhole with depth less than 5 feet.

B. Standard manhole - a manhole with depth equal to or greater than 5 feet and/or less than or equal to 10 feet.

C. Extra depth manhole - a manhole with a depth greater than 10 feet.

471.11 Payment. Payment for complete precast concrete manholes, as shown on the plans, will be made at the unit price bid per each TYPE of manhole at various depths, complete in place. Payment, as provided, shall be full compensation for furnishing all reinforcing steel, concrete, jointing, grade rings, frames and covers, cement stabilized sand, non-shrink grout, and all other materials, including bedding, tools, equipment, and incidentals required to complete the installation.

There are line code(s), description(s) and unit(s) for this Item.

NOTE: This Item requires Standard Civil Drawings that shall be incorporated into the contract documents.

NOTE**:** This Item requires other Standard Specifications.

Item 430 “Construction of Underground Utilities”
Item 433 “Cement Stabilized Sand Bedding and Backfill Material”

END OF ITEM 471

FOR PROJECTS INITIATED
AFTER SEPTEMBER 1, 2017
REVISION 1

ITEM 480

PRECAST REINFORCED CONCRETE BOX SECTIONS

480.1 Description. This Item shall govern for the furnishing and installing of precast reinforced concrete box sections of the size, type and configuration installed to the lines and grades established by the drawings.

Precast reinforced concrete box sections (RCB) shall be one of the following:

A. Conventional tongue and groove joints with preformed flexible butyl rubber (FBR) sealant. Conventional RCB has squared shoulders on both the tongue and groove ends of the section at the corners.

B. Rubber gasketed tongue and groove joints with rubber gasket seals. The rubber gasketed RCB has rounded shoulders on both the tongue and groove ends of the section at the corners. Please note, when rubber gasket RCB is selected, no external seal strip shall be required.

It is permissible to use both types of box sections within the same project as may be needed due to product supply issues, but any continuous run of RCB between structures must have the same joint type for that entire run.

480.2 Material. Precast reinforced concrete box sections shall be manufactured in accordance with the ASTM C1433 “Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers.”

In the manufacture of concrete box sections, the supplier has the option of using portland cement or portland cement plus fly ash, as defined herein. Cement plus fly ash shall be composed of portland cement and 20-30 percent fly ash, by weight. Fly ash shall be Class C or Class F, conforming to the requirements of ASTM C618 "Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete."

Conventional Joints with Flexible Butyl Rubber Joint Sealant

The sealant for conventional tongue and groove joints shall be preformed flexible butyl rubber meeting the requirements of ASTM C990 “Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box

Sections Using Preformed Flexible Joint Sealants" Section 6.2 "Butyl Rubber Sealant." The sealant shall be one of the following:

A. "RU106 - RUBR-NEK", manufactured by Henry Company, or

B. "CS-102" manufactured by ConSeal Concrete Sealants, Inc., or

C. an approved equal.

The sealant width and thickness shall conform to its manufacturer's recommendations, and be large enough to properly seal the entire perimeter of the tongue and groove joint.

In addition, joints shall be sealed externally with a continuous 12" wide minimum seal strip along and over the entire joint. The seal strip shall be centered on the joint and wrapped around all four sides completely covering the exposed surface of the joint. The seal strip shall conform to ASTM C877 "Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections", Types II or III. It shall have a rubberized mastic sealer with woven polypropylene reinforcing, and heavy polyethylene backing. The seal strip shall be one of the following:

A. "MacWrap", which is manufactured by Mar-Mac Construction Products, Co.; or

B. "ConWrap CS-212", which is manufactured by Concrete Sealants, Inc.; or

C. an approved equal.

The external seal strip shall be installed per its manufacturer's recommendations.

Rubber Gasketed Joints

Joint seal shall be a rubber gasket meeting the requirements of ASTM C1677 "Standard Specification for Joints for Concrete Box, Using Rubber Gaskets" for the design of the gaskets and permissible variations in dimensions.

The rubber profile gaskets are glued in place by the manufacturer against the offset on the tongue end of the box sections. The rubber gasket is pre-lubricated on its inner surface. DO NOT LUBRICATE THE JOINT OR GASKET.

480.3 Submittals.

For Box Sections with Flexible Butyl Rubber Sealants –

A. Provide dimensional data for the box section barrel and joint by size.

B. Provide sealant composition data, sealant material width and thickness by box section size, and manufacturer's installation instructions.

C. If used, joint primer type, manufacturer and installation instructions.

D. External joint seal strip manufacturer, model/type and installation instructions.

For Box Sections utilizing Rubber Gasket Joints –

A. Provide dimensional data for the box section barrel and joint by size.

B. Provide gasket composition data and dimensional data by box section size.

C. Provide joint assembly instructions.

480.4 Installation. Trenches shall be excavated with suitable type equipment such as ladder type trenching machines or trench hoes or other equipment that may be approved by the Engineer. Trenches for precast box sections shall have a width below the top of the box of not less than the outside width of the box plus 18 inches clear on both sides and shall be wide enough to permit making up the joints.

No box sewer shall be laid in a trench in the presence of water. All water shall be removed from the trench sufficiently ahead of the sewer placing operation to insure a dry, firm bed on which to place the sewer, and if necessary, the trench will continue to be dewatered until after the sewer is bedded and backfilled as directed by the Engineer. Removal of water may be accomplished by pumping, or pumping in connection with the well point installation as the particular situation may warrant. The well point installation shall be in accordance with the Item 436 "Well Pointing". When well pointing is used for dewatering, then the seal slab shall be installed. Where available, Harris County will provide the Contractor with soils data; however, Harris County does not guarantee the adequacy or accuracy of the information as compared to actual field conditions at the time of construction. The Contractor may elect to do soil borings on his own, if he so desires.

Where necessary, to comply with OSHA Regulation 1926.650, the side of the trench or other excavation shall be braced and rendered secure. The bracing shall be in accordance with the Item 429 "Trench Safety System".

In the event that excavation cannot be dewatered to the point where the precast box sewer trench bottom elevation is free of mud, excessive wet soil, sandy silt or clay with water, a seal slab shall be used in the trench bottom. Such seal slab shall be in accordance with Item 421 “Structural Concrete”. The 7 inch thick cast-in-place seal slab shall be Class “D”, 5 sacks of cement per cubic yard with a minimum compressive strength of 1,750 P.S.I. at 7 days and 2,500 P.S.I. at 28 days. The seal slab shall have minimum #4 rebar at 18 inch on centers, in each direction. A precast seal slab, minimum 6 inch thick, may be used, provided that the joints of the seal slab do not occur at the joint of the precast box sewer. Contractor shall have an option of using a three day cylinder test break at no expense to Harris County.

All surplus excavated material shall be disposed of by the Contractor outside the limits of the right of way, in a legal manner.

After the trench has been excavated to its bottom, the trench shall be fine graded to the required trench bottom elevations. Any over-excavation of the subgrade shall be filled with 1.5 sack per ton of cement stabilized sand. Cement stabilized sand shall be in accordance with the Item 433 "Cement Stabilized Sand Bedding and Backfill Material", at the Contractor’s expense. The Contractor shall establish the grade line in the trench from either grade stakes or by use of lasers. The Contractor shall maintain this grade control for a minimum of 100 feet behind and ahead of the box laying operation. The Contractor shall, at his expense, furnish and place in position all necessary stakes, grade and batter boards for establishing and maintaining correct elevation and alignment.

Following trench excavation, the Contractor shall place cement stabilized sand bedding a minimum of 6 inches thick in such a manner that once the box sections are laid, the invert elevation of the box section shall conform to the drawing elevations. Cement stabilized sand shall be installed in accordance with Item 433 "Cement Stabilized Sand Bedding and Backfill Material". Laboratory tests will be performed as the backfill proceeds.

The precast box sections shall be so laid in the trench that, after the storm sewer is completely installed, the interior surface shall conform accurately to the grade and alignment as shown on the drawings or as established and given by the Engineer. All box sections must be laid in a straight line with the tongue end of the box section pointed downstream and pulled fully home into the grooved end of the previously laid box section.

Caution shall be taken to not drag cement stabilized sand or earth into the annular space. Box sections shall be fitted together so that the finished storm sewer has a smooth and uniform invert.

All lifting holes shall be sealed to the satisfaction of the Engineer. Tapered lift hole plugs shall be used, and sealed both externally and internally with non-shrink grout. Additionally, lift hole plugs shall not protrude above the top exterior surface of the box nor below the soffit of the box by more than one-half inch.

Conventional Joints with Flexible Butyl Rubber Joint Sealant

A. If required, tongue and groove ends shall be primed immediately before installation of sealant. Primer shall be used as recommended by the sealant manufacturer. When the atmospheric temperature is below 40ºF, priming the concrete joint will improve the bonding action with the joint sealant. Primer should be applied both to the tongue end of the upstream box and the groove end of the downstream box, so that both sides of the flexible butyl rubber sealant are in contact with the primer when the joint is pulled home. The sealant shall then be applied to box section joints.

B. If required by the sealant manufacturer, lubricant shall be applied by the Contractor immediately prior to placing each box section in the trench, and then followed by joining with the previously laid box section.

C. The flexible butyl rubber sealant will come in either coils or strips with paper on both sides of the sealant.

D. Before laying the box section in the trench, the paper wrapper shall be removed from one side only of the sealant. The sealant shall then be pressed firmly to the clean, dry box section joint surface. The sealant material shall be placed around the entire perimeter of the tapered tongue near the shoulder of each box section joint in accordance with the sealant manufacturer’s instructions.

E. The paper wrapper on the other side of the sealant shall not be removed until immediately before pulling each box section into its final position.

F. When the tongue is correctly aligned with the flare of the groove, the remaining paper wrapper on the joint sealant shall be removed and the box section shall be pulled (do not push box home with backhoe bucket) with sufficient force and power (using tuggers) to cause evidence of squeeze-out of the sealant on either the inside

or outside around the complete box section joint perimeter. In no case shall a joint be wider than one inch, after having been pulled home. Any sealant that extends into the interior of the box section shall be removed. Each box section shall be pulled home in a straight line with all parts of the box section on line and grade at all times.

G. The external joint seal wrap, as previously described in the materials section, shall be placed around the complete external surface of the joint, with a twelve inch overlap, and installed per the seal strip manufacturer's instructions.

Rubber Gasketed Joints:

A. When the tongue is correctly aligned with the flare of the groove, the box section shall be pulled home (using tuggers) with sufficient force to fully home the tongue into the groove. Each box section shall be pulled home in a straight line with all parts of the box section on line and grade at all times.

When installing concrete box sections in a trench condition, backfill shall consist of material in the "Storm Sewer Construction Detail" shown on the Standard Civil Drawing. All backfill not meeting the requirements of the detail shall be removed and recompacted at no cost to Harris County.

When installing concrete box culverts in an existing channel, ditch, or gully, all bedding and backfill material shall be placed in accordance with the drawing details provided by the design Consultant.

Final backfill over box sections will be permitted as installation proceeds. Final backfill shall conform to the requirements of Item 132 "Embankment". Prior to backfilling, the Contractor shall remove all steel sheeting and/or cut off all timber sheeting a minimum of 3 feet below finished grade or as shown by the plans. Backfill shall consist of material excavated on the site and deemed adequate by the Engineer or suitable materials obtained from a borrow site.

480.5 Quality Assurance.

If production of box sections is not witnessed by the Engineer, selected box sections shall be cored in accordance with ASTM C1433, Section 10.3 and tested in accordance with ASTM C42 "Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete", (wet method). All test specimens and testing shall be done by the producer of the concrete box sewer.

Box sections previously approved and stamped by a Texas Department of Transportation (TxDOT) approved fabricator with specific stamp, which must state: "Certifies Specification Compliance" (i.e. compliance with TxDOT's DMS - 7310 "Reinforced Concrete Pipe and Machine-Made Precast Concrete Box Culvert Fabrication and Plant Qualification" requirements) will be accepted by all laboratories and by Harris County.

The Testing Laboratory's representative will determine the moisture density relationship in accordance with ASTM D698 "Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))" on material secured from the trench excavation.

The Testing Laboratory's representative will determine the in-place density in accordance with ASTM D6938 "Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)" or ASTM D1556 "Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method." The minimum level of testing will consist of at least one test for each 50 linear feet of trench for bedding and per lift of backfill, or as directed by the Engineer.

480.6 Acceptance Requirements. The average compressive strength of all cylinders tested shall be equal to or greater than the design concrete strength and no cylinder tested shall have a compressive strength less than eighty percent of the design concrete strength. Any lot which complies with all of these requirements will be considered acceptable with regard to concrete strength. Any lot which does not meet all of these requirements will be subject to further testing by cores of hardened concrete in accordance with ASTM C1433.

Box sections which meet all the dimensional tolerances given in ASTM C1433 or further defined in this Item will be considered acceptable provided that the box sections have met the compressive strength requirement outlined above. Repaired box sections will only be acceptable if the repaired portions are visible and areas repaired were within the limitations given in this Item and ASTM C1433.

480.7 Measurement. All box sections installed in accordance with the above specifications and accepted by the Engineer shall be measured by the linear foot of the size installed. Longitudinal measurements shall be made along the centerline of the box sewer from the interior wall face of the downstream junction box to the interior wall face of the upstream junction box.

Seal slabs shall be measured by the square yard installed, along the

centerline of the RCB sewer.

480.8 Payment. All box sections installed in accordance with this Item and accepted by the Engineer shall be paid for at the unit price bid by the Contractor, complete in place, for the type, size and depth constructed. The unit price bid shall be full compensation for furnishing all material, including joint materials, equipment and labor for all excavation, shaping of trench bottom, jointing, laying, normal dewatering, sheeting, bracing, bedding, backfilling, and specials necessary to install the box sections in accordance with this Item.

Payment for seal slab shall be made at the unit price bid per square yard for class “D” concrete seal slab and shall include the price of all labor, materials and equipment necessary to complete this Item.

Payment for a well point system, when used for dewatering, shall be made in accordance with the Item 436 “Well Pointing”.

There are line code(s), description(s), and unit(s), for this Item.

NOTE**:** This Item requires other Standard Specifications:

Item 132 “Embankment”
Item 421 “Structural Concrete”
Item 429 "Trench Safety System"
Item 433 "Cement Stabilized Sand Bedding and Backfill Material"
Item 436 “Well Pointing”

END OF ITEM 480

FOR PROJECTS INITIATED
AFTER NOVEMBER 1, 2008
REVISION 2

ITEM 493

RIPRAP

493.1 Description. This Item shall govern for furnishing and installing of concrete or stone riprap for common erosion protection applications in open channels.

493.2 Materials. The storage area shall be kept clean, firm, and smooth and well drained in order that the riprap can be recovered free from dirt and other foreign matter.

The riprap shall be stockpiled and handled so as not to cause undue segregation of particle sizes either in the stockpile, or while loading, hauling and handling.

The riprap shall consist of broken concrete or stone blocks and shall be dense, durable and hard material free from cracks, seams and other defects which would tend to increase deterioration from handling and natural causes.

Where broken concrete is used, all exposed metal, including rebar and wire mesh, shall be cut off flush with the surface of the block prior to placing.

Spalls, fragments and chips shall not exceed 5 percent by weight. The dimension and shape limitations do not apply to this portion of the riprap.

Riprap blocks shall be provided in cubic form, rather than elongated (flat) shapes.

The minimum thickness of each block shall be 6 inches.

No more than 25 percent of the blocks may have a length greater than 2-1/2 times the width or thickness. No length of block shall exceed 3 times the width or thickness.

The riprap shall be well graded and shall conform to the following tables unless specifically noted otherwise on the drawings:

TABLE 1 - RIPRAP GRADATION NO. 1

PERCENT LIGHTER BY WEIGHT	STONE WEIGHT (Lbs.)		VOLUME CUBIC FOOT (2)		CUBICAL SHAPE (Ea. Side, ft.)		SPHERICAL SHAPE (Dia., ft.)	
	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit
100	180	265	1.20	1.77	1.06	1.21	1.31	1.50
50	80	110	0.53	0.73	0.81	0.90	1.01	1.12
15	40	60	0.27	0.40	0.64	0.74	0.80	0.91

NOTES: The theoretical cube and sphere size is presented in the table for guidance only. The previous size and shape specifications shall govern.

Volume is based on 150 pcf, unit weight.

This gradation is to be used in normal applications, and may be noted on the drawings as standard riprap, riprap, 18 inch thick riprap mats, or other similar designations.

TABLE 2 - RIPRAP GRADATION NO. 2

PERCENT LIGHTER BY WEIGHT	STONE WEIGHT (Lbs.)		VOLUME CUBIC FOOT (2)		CUBICAL SHAPE (Ea. Side, ft.)		SPHERICAL SHAPE (Dia., ft.)	
	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit
100	260	640	1.73	4.27	1.20	1.62	1.49	2.01
50	130	200	0.87	1.33	0.95	1.10	1.18	1.37
15	40	150	0.27	1.00	0.64	1.00	0.80	1.24

NOTES: Provide a 24 inch thick mat, minimum, for Riprap Gradation No. 2.

The theoretical cube and sphere size is presented in the table for guidance only. The previous size and shape specifications shall govern.

Volume is based on 150 pcf, unit weight.

The gradation is to be used only where specifically noted on the drawings as “Riprap Gradation No. 2”.

For special applications, gradation, thickness, and other special requirements shall be as shown in the plans.

493.3 Construction Methods. The riprap shall meet the gradation and quality requirements prior to placing.

The riprap shall be placed to the slopes, lines, and grades as shown on the drawings, to provide a well-graded mass of riprap without voids.

Thickness of the riprap mat shall be as shown on the drawings, with a minimum mat thickness as shown on the gradation tables.

The riprap shall be placed in one course (lift) across the channel bottom, then up the channel side slopes. Place the riprap carefully in such a manner to avoid displacement or damage to the prepared surface or geotextile and in such a manner to avoid segregation of particle sizes. Place riprap as close to final position as feasible.

The riprap blocks are to be in close contact, well-graded, and free from pockets of small stones or clusters of large stones. Elongated riprap blocks shall be well distributed throughout the riprap mat. Individual oversized blocks will not be permitted. These shall be broken to acceptable size or removed and replaced with riprap within the gradation limits. Surface irregularities shall be minimal.

Do not drop riprap from such a height to cause breakage or to damage the geotextile (if used).

Prevent mixture or incorporation of dirt or other materials with the riprap during placing operation.

Placing of riprap by any method, machine or hand, will be permitted as long as specified requirements are obtained.

Fill spaces between larger riprap blocks with spalls and smaller blocks of the largest feasible size to form a compact mass. Do not place spalls and small blocks in place of larger size blocks.

493.4 Measurement. Riprap shall be measured by the square yard or by the ton of riprap material, as noted on the bid sheets. Riprap Gradation No. 1 when measured by the square yard shall be for a minimum specified thickness of 18 inches, complete in place. Riprap Gradation No. 2 when

measured by the square yard shall be for a minimum specified thickness of 24 inches, complete in place.

Channel excavation to the top of riprap (finish grade) is measured as shown on the bid sheets.

Excavation for the placement of Riprap Gradation No. 1 to 18 inches beyond the finish grade shall be considered incidental to placement of riprap.

Excavation for the placement of Riprap Gradation No. 2 to 24 inches beyond the finish grade shall be considered incidental to placement of riprap.

Channel fill to the top of riprap (finish grade) is measured as shown on the Bid Sheets. Channel fill, not approved by the Engineer, shall not be measured.

Geotextile under the riprap, where required (as shown on the drawings), shall not be measured and shall be considered incidental to riprap.

493.5 Payment. Payment for riprap shall be based on the unit price per square yard or the price per ton for riprap placed, as shown on the plans. Payment shall be full compensation for providing all labor, materials, geotextile, excavation and equipment necessary to complete the riprap installation.

Excavation for the placement of riprap is considered incidental.

Payment for Channel Excavation to the top of riprap (finish grade) is paid for as shown on the Bid Sheets.

Fill, as approved by the Engineer, to the top of riprap (finish grade) is paid for as shown on the Bid Sheets.

There are line code(s), description(s) and unit(s) for this Item.

NOTE: This Item requires other Standard Specification

Item 494 “Geotextiles”

END OF ITEM 493

FOR PROJECTS INITIATED
AFTER MARCH 1, 2012
REVISION 2

ITEM 494

GEOTEXTILES

494.1 Description. This Item shall govern for geotextile fabric to be used in pavements or erosion control as herein specified or as called for on the drawings or as directed by the Engineer.

494.2 Material. The Geotextile fabric and the threads used in joining Geotextiles by sewing shall be manmade long-chain synthetic polymer fibers, composed of at least 95 percent by weight of polyolefins or polyesters that form a durable woven or non-woven mat of uniform quality such that the filaments or yarns retain their dimensional stability relative to each other, including selvages. They provide separation, water proofing and stress relieving membrane within the pavement structure.

There are three classes of geotextile fabric:

A. Class 1 is specified for more severe or harsh installation conditions where there is a greater potential damage

B. Class 2 and 3 are specified for less severe conditions

General Requirements:

A. Fabric fibers are continuous and randomly oriented throughout the fabric.

B. The fabric is mildew resistant and rot-proof and it is satisfactory for use in a wet soil and aggregate environment.

Geotextiles used for separation, stabilization, subsurface drainage, temporary silt fence, paving fabric and permanent erosion control shall satisfy AASHTO M288-00 “Geotextile Specification for Highway Applications” requirements, and shall meet the following minimum physical property values:

PROPERTIES	TEST METHOD	VALUE					
		Class 1		Class 2		Class 3	
		Elongation <50%	Elongation ≥50%	Elongation <50%	Elongation ≥50%	Elongation <50%	Elongation ≥50%
Ultra-Violet Stability (Strength Retained)	ASTM D4355	50% after 500 h of exposure		50% after 500 h of exposure		50% after 500 h of exposure	

PROPERTIES	TEST METHOD	VALUE					
		Class 1		Class 2		Class 3	
		Elongation <50%	Elongation ≥50%	Elongation <50%	Elongation ≥50%	Elongation <50%	Elongation ≥50%
Trapezoid Tear (N)	ASTM D4533	500	350	400	250	300	180
Grab Tensile Strength (N)**	ASTM D4632	1400	900	1100	700	800	500
Puncture Resistant (N)	ASTM D4833	500	350	400	250	300	180
Sewn Seam Strength (N)	ASTM D4884	1260	810	990	630	720	450
Permittivity (sec^{-1})	ASTM D4491	0.05		0.02-0.7*			
Melting Point***	ASTM D276						
Ultimate Elongation %***	ASTM D4632						
Apparent Opening Size**	ASTM D4751						
Mass per Unit Area***	ASTM D5261						
Asphalt Retention***	ASTM D6140						

* Permittivity shall be as specified in the bid documents in accordance with tables 2, 3, 4, 5 and 6 of AASHTO M288-00 as per the requirements of various applications.

** Opening size shall be as specified in the bid documents in accordance with tables 2, 3, 4, 5 and 6 of AASHTO M288-00 as per the requirements of various applications.

*** These shall be as specified in the bid documents/construction notes in accordance with tables 1 and 7 of AASHTO M288-00 as per the requirements of various applications.

NOTES:

1. Conformance to specification property requirements shall be based on ASTM D4759 Standard Practice for Determining the Specification Conformance of Geosynthetics."

2. All numeric values represent the minimum average roll values (i.e. the average of test results from any sample roll in a lot shall equal or exceed the minimum values). Lots shall be sampled according to ASTM D4354 "Standard Practice for Sampling of Geosynthetics and Rolled Erosion Control Products(RECPs) for Testing."

494.3 Packaging Requirements:

A. Provide fabric in the length and width specified on the plans or in the bid documents.

B. Wind fabric onto suitable cylindrical forms or cores to aid in handling and unrolling.

C. Package fabric individually in a suitable container to protect the geotextile from damage due to ultraviolet light and moisture during normal storage and handling.

D. Identify each roll with a tag or label affixed to the outside or the roll on one end the following information: unique roll number, serially designated; manufacturer's lot number or control numbers, if any; name of fabric manufacturer; brand name of the product; manufacturer's style or catalog designation of the fabric, if any; roll width (inches); roll length (feet).

494.4 Submittal Requirement. When requested by the Engineer, the Contractor shall provide samples of the geosynthetics for testing. The test results will be used to verify that the physical properties specified in this Item have been met. The cost of the testing will be paid for by Harris County. The Contractor shall also submit manufacturer's recommended installation method for geotextile installation based on its designated application.

494.5 Quality Assurance/Quality Control. Should any individual sample selected at random from 100 rolls, or fraction thereof, fail to meet any specification requirement, then that roll will be rejected. Two additional samples will be taken, one from each of two other rolls selected at random from the same 100 roll lot, or fraction thereof. If either of these two additional samples fails to comply with any portion of the specification, then the entire quantity of rolls selected by that sample will be rejected.

494.6 Placing. The geotextile shall be placed in accordance with the specifications of the various applications.

494.7 Measurement. The geotextile fabric shall be measured in place by the square yard of material, furnished and placed as shown in the plans. Waste and overlap shall not be included in this measurement.

494.8 Payment.

A. Payment for geotextile, complete in place shall be made at the contract unit price of the specified class per square yard, which price shall include all costs of materials, and labor to place it in position.

B. Where the bid sheet specifies FOB the job, the materials shall be transported to the job site specified on the bid sheet and paid for by the square yard.

C. When the Project Manual, plans or other specifications indicate the use of geotextile as incidental to another pay item, no direct payment for the material will be made.

There are line code(s), description(s) and unit(s) for this Item.

END OF ITEM 494