

CONTRACT DOCUMENTS AND SPECIFICATIONS

**MUNICIPAL MAINTENANCE
FACILITY IMPROVEMENTS**

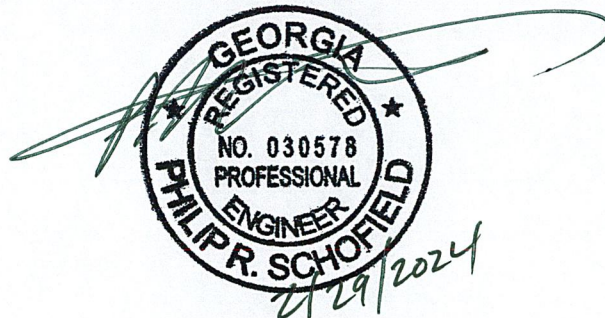


**FORT OGLETHORPE
GEORGIA**

Prepared For
CITY OF FORT OGLETHORPE, GEORGIA

City Council
Jim Childs
Craig Crawford
Rhonda James
Derek Rogers
Paula Stinnett

Earl Gray, Mayor
Molly F. Huhn, City Manager



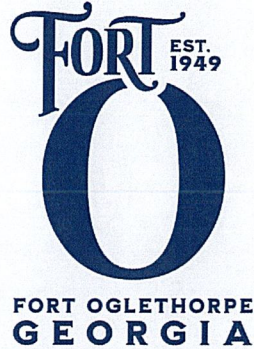
February 2024
CTI Project No. G23010



CTI Engineers, Inc.
1122 Riverfront Parkway
Chattanooga, TN 37402
423.267.7613

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Prepared By

CTI ENGINEERS, INC.
Chattanooga, Tennessee ♦ Catersville, Georgia
Project No. G23010
February 2024

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DIVISION 00

PROCUREMENT AND CONTRACTING
REQUIREMENTS

PROCUREMENT REQUIREMENTS, FORMS, AND SUPPLEMENTS

ADVERTISEMENT FOR BIDS

Owner: City of Fort Oglethorpe, Georgia

Separate sealed Bids for furnishing of all materials, labor, tools, equipment, and appurtenances necessary for the Municipal Maintenance Facility Improvements project will be received by the Owner at the City of Fort Oglethorpe, 500 City Hall Drive, Fort Oglethorpe, GA 30742, until 2:00 p.m., local time, on Thursday, April 4, 2024, and then at said office publicly opened and read aloud.

The Project consists of the following major elements: Construction of a new 40-ft x 80-ft garage, associated repairs of the east garage, and three-office addition in the upstairs area of the Parker Building.

Copies of the Contract Documents and Specifications, including bidding documents and requirements and Contract Drawings may be examined at the offices of the Engineer, CTI Engineers, Inc., 1122 Riverfront Parkway, Chattanooga, TN 37402 (phone 423/267-7613, fax 423/267-0603, www.ctiengr.com). Copies may be obtained there upon payment of \$150 for each set. This payment is not refundable.

Bidders must be listed on Engineer's list of planholders who have purchased the Contract Documents, Specifications, and Drawings.

Engineer shall be provided with the following information: mailing address for U.S. Postal Service, physical delivery address, telephone number, name of contact person, and email address.

A Bid Bond of 5% of the total project cost is to be included in the proposal package. The Successful Bidder will be required to furnish performance and payment bonds with the executed Agreement meeting the requirements of the Contract Documents and executed on the forms attached to the Agreement. The terms and time for payment are set forth in the Agreement.

Surety and insurance companies must have an AM Best rating of A-10 or greater, be listed in the Federal Registry of Companies holding Certificates of Authority and Acceptable Sureties on Federal Bonds, be licensed by the Georgia Insurance Department and the Georgia Secretary of State to do business in the State of Georgia.

Contractor must have minimum Worker's Comp and General Liability Insurance in full force and effect. No proposal will be considered unless it is accompanied by satisfactory evidence that the Bidder holds Georgia State Contractor's License of proper classification and in full force and effect, in compliance with the provisions of O.C.G.A. Sec. 43-14-2 et seq. Pursuant to O.C.G.A. § 13-10-91, all contractors and sub-contractors performing work within the State of Georgia on a contract with a public employer must register and participate in a federal work authorization. Fort Oglethorpe will require certification from contractor that this requirement has been met.

Each Respondent shall submit with its proposal a copy of current Business License and/or Occupational Tax Certificate issued in the state it resides. If bidder cannot prove this license, it will be required to obtain one from Ft. Oglethorpe if it is the Awarded Respondent.

Fort Oglethorpe reserves the right to accept or reject any and all proposals, to waive formalities, technicalities or irregularities and to re-advertise if necessary. The contract between Fort Oglethorpe and the selected responder shall be subject to the payment agreement drawn up between Fort Oglethorpe and the selected responder.

Date: March 6, 2024
March 20, 2024

Fort Oglethorpe, Georgia
/s/ Molly F. Huhn, City Manager

INFORMATION FOR BIDDERS

1. Receipt and Opening of Bids

Walker County, Georgia (herein called the "Owner"), invites Bids on the form attached hereto, all blanks of which must be appropriately filled in. Bids will be received by the Owner at the location and time noted in the Advertisement for Bids.

The Owner may consider informal any Bid not prepared and submitted in accordance with the provisions hereof and may waive any informalities or reject any and all Bids. Any Bid may be withdrawn prior to the above scheduled time for the opening of Bids or authorized postponement thereof. Any Bid received after the time and date specified shall not be considered. No Bidder may withdraw a Bid within 60 days after the actual date of the opening thereof.

2. Preparation of Bid

Each Bid shall be submitted on the Bid forms bound in the Contract Documents. All blank spaces for Bid prices must be filled in, in ink or typewritten. All computations will be checked; and in the event of a discrepancy, the unit price will govern. All required enclosed certifications must be fully completed and executed when submitted.

Each Bid must be submitted in a sealed envelope, addressed to the Owner. Each sealed envelope containing a Bid must be plainly marked on the outside as, "Bid for Municipal Maintenance Facility Improvements."

If forwarded by mail, the sealed envelope containing the Bid must be enclosed in another envelope addressed to the Owner at the City of Fort Oglethorpe, 500 City Hall Drive, Fort Oglethorpe, GA 30742, Attention: Molly F. Huhn, City Manager.

Any and all Bids not meeting the aforementioned criteria for Bid submittal, will be declared nonresponsive, will **not** be opened, and will be returned to the Bidder unopened.

3. Subcontracts

The Bidder is specifically advised that any person, firm, or other party to whom it is proposed to award a subcontract under this Contract must be acceptable to the Owner and funding agencies.

4. Facsimile Modifications

Any Bidder may modify his Bid by facsimile communication at any time prior to the scheduled closing time for receipt of Bids, provided such facsimile communication is received by the Owner prior to the closing time, and, provided further, the Owner is satisfied that a written confirmation of the facsimile modification over the signature of the Bidder was mailed prior to the closing time. The facsimile communication should not reveal the Bid price but should provide the addition or subtraction or other modification so that the final prices or terms will not be known by the Owner until the sealed Bid is opened. If written confirmation is not received within two days from the closing time, no consideration will be given to the facsimile modification.

5. Overhead, Profit, and Revision of Quantities

The unit or lump sum price for each of the several items in the proposal of each Bidder shall include its pro rata share of overhead and profit so that the sum of the products obtained by multiplying the quantity shown for each item by the unit price represents the total Bid. Any Bid not conforming to this requirement may be rejected as informal. The special attention of all Bidders is called to this provision, for should conditions make it necessary to revise the quantities, no limit will be fixed for such increased or decreased quantities nor extra compensation allowed, provided the net monetary value of all such addition or subtraction in quantities of such items of work (i.e., difference in cost) shall not increase or decrease the total original contract price by more than 25 percent, except for work not covered in the Drawings and Detailed Specifications as provided for under General Conditions and Supplemental General Conditions.

6. Qualifications of Bidder

The Owner may make such investigations as deemed necessary to determine the ability of the Bidder to perform the work, and the Bidder shall furnish to the Owner all such information and data for this purpose as the Owner may request. The Owner reserves the right to reject any Bid if the evidence submitted by, or investigation of, such Bidder fails to satisfy the Owner that such Bidder is properly qualified to carry out the obligations of the Contract and to complete the work contemplated therein. Conditional Bids will not be accepted.

A Bidder must purchase a set of Contract Documents (including Bidding Requirements and Documents), Specifications, and Drawings through the Engineer in order to be considered a qualified bidder. Addenda will only be sent to those who have purchased documents and are on the list of planholders maintained by CTI Engineers, Inc.

7. Bid Security

Each Bid must be accompanied by a cashier's check on a duly authorized bank, certified check of the Bidder, or a bid bond prepared on the form of bid bond attached hereto, duly executed by the Bidder as principal and having as security thereon a surety company listed in the latest issue of U.S. Treasury Circular 570, in the amount of 5 percent of the Bid. Certified checks or cashier's checks shall be made payable to the Owner. Such checks or bid bonds will be returned to all except the three lowest Bidders within three days after the opening of Bids; the remaining checks or bid bonds will be returned promptly after the Owner and the accepted Bidder have executed the contract, or, if no award has been made within 60 days after the date of the opening of Bids, upon demand of the Bidder at any time thereafter, so long as he has not been notified of the acceptance of his Bid.

8. Liquidated Damages for Failure to Enter into Contract

The successful Bidder, upon his failure or refusal to execute and deliver the Contract and bonds required within 10 days after he has received notice of the acceptance of his Bid, shall forfeit to the Owner, as liquidated damages for such failure or refusal, the security deposited with his Bid.

9. Time for Completion and Liquidated Damages

Bidder must agree to commence work on or before a date to be specified in a written Notice to Proceed of the Owner and to fully complete the Project within 120 consecutive calendar days thereafter. Bidder must agree also to pay as liquidated damages the sum of \$500 for each consecutive calendar day in default as hereinafter provided in the General Conditions.

10. Conditions of Work

Each Bidder must inform himself fully of the conditions relating to the construction of the Project and the employment of labor thereon. Failure to do so will not relieve a successful Bidder of his obligation to furnish all material and labor necessary to carry out the provision of his Contract. Insofar as possible the Contractor, in carrying out his work, must employ such methods or means as will not cause any interruption of or interference with the work of any other Contractor.

11. Addenda and Interpretations

No interpretation of the meaning of the Drawings, Specifications, or other prebid documents will be made to any Bidder orally.

Every request for such interpretation should be in writing addressed to pschofield@ctiengr.com or Philip R. Schofield, P.E., Project Manager, CTI Engineers, Inc., at 1122 Riverfront Parkway, Chattanooga, Tennessee 37402, and to be given consideration must be received at least five days prior to the date fixed for the opening of Bids. Any and all such interpretations and any supplemental instructions will be in the form of written addenda to the Specifications which, if issued, will be mailed and transmitted by facsimile to all prospective Bidders (at the respective addresses and facsimile numbers furnished for such purposes), not later than three days prior to the date fixed for the opening of Bids. Failure of any Bidder to receive any such addendum or interpretation shall not relieve such Bidder from any obligation under his Bid as submitted. All addenda so issued shall become a part of the Contract Documents.

12. Security for Faithful Performance

Simultaneously with his delivery of the executed Contract, the Contractor shall furnish a surety bond or bonds as security for faithful performance of this Contract and for the payment of all persons performing labor on the Project under this Contract and furnishing materials in connection with this Contract, as specified in the General Conditions included herein. Surety companies executing bonds must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the state where the project is located.

13. Power of Attorney

Attorney-in-fact who sign bid bonds or contract bonds must file with each bond a certified and effectively dated copy of their power of attorney.

14. Notice of Special Conditions

Attention is particularly called to those parts of the Contract Documents and Specifications which deal with the following:

- a. Inspection and testing of materials
- b. Insurance requirements
- c. Wage rates (if applicable)
- d. Surveys, permits, and regulations

The federal regulations enclosed or herein referred to supersede all conflicting requirements of the Contract Documents.

15. Laws and Regulations

The Bidder's attention is directed to the fact that all applicable state laws, municipal ordinances, and the rules and regulations of all authorities having jurisdiction over construction of the Project shall apply to the Contract throughout, and they will be deemed to be included in the Contract the same as though herein written out in full.

16. Obligation of Bidder

At the time of the opening of Bids, each Bidder will be presumed to have inspected the site and to have read and to be thoroughly familiar with the Drawings and Contract Documents (including all addenda). The failure or omission of any Bidder to examine any form, instrument, or document shall in no way relieve any Bidder from any obligation in respect of his Bid.

17. Execution of Bid Documents

The Contractor, in signing his Bid on the whole or any portion of the work, shall conform to the following requirements:

- a. Bids which are not signed by individuals making them shall have attached thereto a power of attorney evidencing authority to sign the Bid in the name of the person for whom it is signed.
- b. Bids which are signed for a partnership shall be signed by all of the partners or by an attorney-in-fact. If a Bid is signed by an attorney-in-fact, there should be attached to the Bid a power of attorney executed by the partners evidencing authority to sign the Bid.
- c. Bids which are signed for a corporation shall have the correct corporate name thereof and the signature of the President or other authorized officer of the corporation manually written below the corporate name following the wording "By _____." Corporation seal shall also be affixed to the Bid.

18. Method of Award - Lowest Qualified Bidder

The Contract will be awarded to the responsive, responsible Bidder submitting the lowest Bid complying with the conditions of the Information for Bidders. Award will be made on the basis of the prices given in the base Bid either with or without alternates at the

discretion of the Owner. The Bidder to whom the award is made will be notified at the earliest possible date. The Owner reserves the right to reject any and all Bids and to waive any informality in Bids received whenever such rejection or waiver is in its interest.

A responsive Bidder shall be one who submits his Bid in the proper form without qualification or intent other than as called for in the Specifications and on the Contract Drawings and who binds himself on behalf of his Bid to the Owner with the proper bid bond or certified check completed and attached, and who properly completes all forms required to be completed and submitted at the time of the bidding.

A responsible Bidder shall be one who can fulfill the following requirements:

- a. The Bidder shall maintain a permanent place of business. This requirement applies to the Bidder where the Bidder is a division of a corporation, or where the Bidder is 50 percent or more owned by a person, corporation, or firm.
- b. The Bidder shall demonstrate that he has adequate construction management experience and sufficient equipment resources to properly perform the work under and in conformance with these Contract Documents. This evaluation will be based upon a list of completed or active projects and a list of construction equipment available to the Bidder to perform the work.
- c. The Bidder shall demonstrate that he is familiar with the work under these Contract Documents. This evaluation will be based upon a list of major equipment items the Bidder proposes to furnish and a list of subcontractors the Bidder proposes to use in prosecuting the work.
- d. The Bidder shall demonstrate that he has financial resources of sufficient strength to meet the obligations incident to the performance of the work covered by these Contract Documents. The Bidder shall complete the Statement of Bidder's Qualifications in the Bid forms. The ability to obtain the required Performance and Payment Bonds will not alone demonstrate adequate financial capability.
- e. The Bidder may demonstrate financial capability by submitting a suitable financial statement of an Equity Partner, provided an agreement is executed binding the Bidder and said Equity Partner, jointly and severally, to fulfill all duties, obligations, and responsibilities of the Contractor under these Contract Documents if the Contract is awarded to the Bidder. The agreement shall be submitted with the Bid and shall be satisfactory to the Owner's attorney or the Bid may be declared nonresponsive.
- f. The Bidder shall furnish all data required by these Contract Documents. Failure to do so may result in the Bid being declared nonresponsive. Acceptance of the Bidder's documentation and substantiation or contract award by the Owner does not relieve the Bidder of liability for nonperformance as covered in the Contract Documents, nor will the Bidder be exempted from any other legal recourse the Owner may elect to pursue.

19. Employment of Local Labor

Preference in employment on the Project shall, insofar as practicable, be given to qualified local labor.

20. Bid Envelope

All Bidders doing utility construction covered by OCGA 43-14 must have a Utility Contractor's License issued by the State of Georgia. In compliance with these requirements, the envelope in which the Bid is contained must bear on the outside the following:

- a. Name of Bidder.
- b. Address of the Bidder.
- c. Name of Project for which Bid is Submitted.
- d. Bidder's Utility Contracting License Number.
- e. Bidder's License Expiration Date.

Bid envelopes that do not bear the above information will be returned to the Bidder unopened.

A copy of the form found on the last page of this section properly completed to provide the required information as identified above shall be affixed to the front of the envelope containing the Bidder's proposal.

CONTRACTOR'S IDENTIFICATION

This form shall be attached to the sealed envelope containing the Bid. Failure to provide the following information on the sealed envelope will be considered a non-responsive Bid.

BIDDER:

Name _____

Address _____

Georgia Utility License No. _____

Expiration Date _____

SEALED BID PROPOSAL FOR WALKER COUNTY, GEORGIA

FOR THE CONSTRUCTION OF

MUNICIPAL MAINTENANCE FACILITY IMPROVEMENTS

Bid Date: _____

Bid Time: _____

BID

Project Description: Municipal Maintenance Facility Improvements

Proposal of _____
(hereinafter called "Bidder"), doing business as _____
a corporation, a partnership, an individual

To City of Fort Ogelthorpe (hereinafter called "Owner").

Gentlemen:

The Bidder, in compliance with your Advertisement for Bids for the construction of this project having examined the Drawings and Specifications with related documents and the site of the proposed work, and being familiar with all of the conditions surrounding the construction of the proposed project including the availability of materials and labor, hereby proposes to furnish all labor, materials, and supplies, and to construct the project in accordance with the Contract Documents, within the time set forth therein, and at the price(s) stated below. This price(s) is to cover all expenses including overhead and profit incurred in performing the work required under the Contract Documents, of which this proposal is a part.

Bidder hereby agrees to commence work under this contract on or before a date to be specified in written Notice to Proceed of the Owner and to fully complete the project within 120 consecutive calendar days thereafter as stipulated in the Specifications. Bidder further agrees to pay as liquidated damages, the sum of \$500 for each consecutive calendar day thereafter as hereinafter provided in the General Conditions.

Bidder acknowledges receipt of the following addenda:

Bidder agrees to perform all the construction of the project complete with appurtenant and accessory work described in the Specifications and shown on the plans for the attached price(s).

The attached price(s) shall include all labor, materials, bailing, shoring, removal, overhead, profit, insurance, etc., to cover the finished work of the several kinds called for.

Bidder understands that the Owner reserves the right to reject any or all Bids and to waive any informalities in the bidding.

The Bidder agrees that this Bid shall be good and may not be withdrawn for a period of 60 calendar days after the scheduled closing time for receiving Bids.

Upon receipt of written notice of the acceptance of this Bid, Bidder will execute the formal contract attached within ten days and deliver a surety bond or bonds as required by the General Conditions. The Bid security attached in the sum of 5 percent of the total Bid is to become the property of the Owner in the event the contract and bond are not executed within the time above set forth, as liquidated damages for the delay and additional expense to the Owner caused thereby.

Respectfully submitted:

By _____
Signature

Title _____

Business Address

ATTEST:

Name _____
(Please Type)

Title _____

(SEAL)

Note: Attest for a corporation must be by the corporate secretary; for a partnership by another partner; for an individual by a Notary.

**BID SCHEDULE
MUNICIPAL MAINTENANCE FACILITY IMPROVEMENTS
CITY OF FORT OGLETHORPE, GEORGIA**

Note: Unless otherwise stated, all bid items shall be a complete installation as specified and/or shown on the Drawings.

Item No.	Description	Unit	Est. No. of Units	Unit Price	Item Total
SCHEDULE I - GENERAL CONDITIONS					
00 66 13	Performance and Payment Bonds (Maximum 2% of Bid)	LS	1	\$	\$
00 72 00	General Conditions , Including Project Management, Site Safety, Maintenance, and Supervision	LS	1		
01 11 00	Mobilization (Maximum 2.5% of Bid), Including Shop Drawings and Submittals, Locating and Excavating (Pot-holing) the Existing Utilities, Project Layout and Staking, and General Conditions	LS	1		
TOTAL SCHEDULE I- GENERAL CONDITIONS				\$	
SCHEDULE II - GARAGE BUILDING LUMP SUM BID					
The undersigned bidder has carefully examined the Contract Documents, and having ascertained actual conditions at the site of the work, hereby proposes to furnish all labor, tools, materials, supplies, and equipment necessary to complete the satisfactory construction of a NEW 40-ft x 80-ft GARAGE required for a complete operating installation of said project for a lump sum price:					
II-1	New 40-ft x 80-ft Garage, Complete-in-Place , Including All Materials, Labor, and Equipment to Construct 40' x 80' Garage and All Associated Interior and Exterior Elements (Structural, Carpentry, Utilities, Plumbing, Electrical, Mechanical, HVAC, Roofing), All Interior and Exterior Finishes, Lighting, Fixtures, Walls, Doors, Windows for a Total Lump Sum Bid.	LS	1		
TOTAL SCHEDULE II- GARAGE BUILDING LUMP SUM BID				\$	
SCHEDULE III: GARAGE EXTERIOR SITE ITEMS					
The undersigned bidder has carefully examined the Contract Documents, and having ascertained actual conditions at the site of the work, hereby proposes to furnish all labor, tools, materials, supplies, and equipment necessary to complete the satisfactory construction of EXTERIOR ITEMS not included in Schedule II for the following unit prices:					
01 32 38	Pre-Construction Video Taping of Existing Site Conditions	LS	1		
03 30 00	Cast-In-Place Concrete, Includes All Materials and Labor				
03 30 00a	Class A (4,000 psi) 4-inch Thick Concrete for Sidewalk , Including Excavation, 2-Inch Bedding Stone Minimum, Form Work, Expansion Joints, Finish Rubbing, and Site Restoration, Complete-In-Place.	SF	100		
03 30 00b	Class A (4,000 psi) Concrete for Extruded Curb (If Required) , Including Excavation, Bedding, Form Work, Concrete Mix, Pour and Finish Rubbing, Complete In Place as directed by the Engineer.	LF	100		
03 30 00i	Class B Concrete (3,000 PSI) Areas Not Specified or as Directed by Engineer	CY	100		

Item No.	Description	Unit	Est. No. of Units	Unit Price	Item Total
31 20 00	Earthwork				
31 20 00a	Demolition and Removal of Existing Concrete, Including Saw-cutting, Excavation and Disposal of Concrete Debris	SY	100		
31 20 00b	Crushed Stone Backfill in Parking Lots, and Asphalt or Concrete	Tons	10		
31 20 00c	Compacted Crushed Base Stone (GAB) for Pavement Repair, Gravel Repair and Fine Grading.	Tons	20		
31 20 00d	Final Grading and Cleanup - Including Re-grading Existing Vegetated Areas and Ditches to Allow Proper Drainage	LS	1		
31 20 00e	Adjust Existing Storm Sewer Catch Basin Frames and Covers (If Required), Including Coordination with the City of Fort Oglethorpe, Excavation, and Materials to Reset Frame and Cover to New Finish Grade	EA	1		
31 25 00	Erosion Control and Slope Protection				
31 25 00a	Silt Fence, Including Installation of Post, Filter Fabric, Tie Wire, Bracing, Maintenance, and Removal After Site is Stable (Sd1-Ns)	LF	200		
31 25 00b	Construction Exit, Including filter fabric, stone, complete in-place	EA	1		
31 25 00c	Concrete Washout Structure, Including Installation with Stone, Straw Bales, Geotextile Fabric, Maintenance, and Removal	EA	1		
32 10 00	Paving				
32 10 00a	12.5 mm Asphalt Concrete Topping, Hot Mix, 2-Inch Thick, 12.5 mm in One Layer in Accordance with Section 400, as Appropriate, of GDOT Specifications	Ton	20		
32 10 00b	19mm Asphaltic Concrete Binder, Including 4" Thick Asphaltic Concrete with Bituminous Material, H Lime, and Prime Coat	Ton	40		
32 92 19	Seeding				
32 92 19a	Topsoil, Sifted Friable Loam Material Free of Stiff Clay, Hard Clods, Rocks, and Other Debris such as Cement, Asphalt, and Wood. pH range From 5.5 to 7.0 or Approved by Engineer.	CY	40		
32 92 19b	Landscape Repair Allowance	LS	1		
32 92 19c	Fence Relocation, Including Removal, and Relocation of Existing Fence located adjacent to the proposed maintenance building.	LF	100		
32 92 19d	Fence Replacement (If Required), Including Fence Post, Fence Material, and Installation	LF	100		
TOTAL SCHEDULE III-GARAGE EXTERIOR ITEMS				\$	

Item No.	Description	Unit	Est. No. of Units	Unit Price	Item Total
SCHEDULE IV - PARKER BUILDING OFFICE ADDITION					
The undersigned bidder has carefully examined the Contract Documents, and having ascertained actual conditions at the site of the work, hereby proposes to furnish all labor, tools, materials, supplies, and equipment necessary to complete the satisfactory construction of NEW OFFICES within the existing Public Works Administration Building required for a complete operating installation of said project for a lump sum price.					
IV-1	Construction of Three New Offices, Complete-in-Place , Including all Materials, Labor, and Equipment for Interior Carpentry, Utilities (Plumbing, Electrical, HVAC, Communications), Interior Walls, Ceilings, Interior Finishes, Lighting, Fixtures, Exterior Finishes, etc., For a Total Lump Sum Bid.	LS	1		
TOTAL SCHEDULE IV-PARKER BUILDING OFFICE ADDITION				\$	
SCHEDULE V - MISCELLANEOUS REPAIRS TO FIVE MAINTENANCE BUILDINGS					
The following repairs have been identified by an insurance adjuster for damages related to high winds several years ago. Bids will be on a unit price basis in accordance with the insurance documents.					
STORAGE BUILDING REPAIRS - BUILDING 5					
1	Remove and Replace Rafters - 2x10 - 16" OC (3-5/12 Gable, per SF of floor)	SF	729		
2	Mason - Brick / Stone per hour	HR	4		
3	Remove and Replace Exterior door - metal - insulated flush or panel style	EA	1		
4	Remove and Replace Door lockset & deadbolt exterior	EA	1		
5	Remove and Replace Aluminum window - casement, 9-13 sf	EA	1		
6	Remove and Replace Furnace - forced air - 60 - 75,000 BTU	EA	1		
7	Tear off, haul and dispose of comp. shingles - 3 tab	SQ	8		
8	Roofing felt - 15 lb.	SQ	8		
9	3 tab - 25 yr. - comp. shingle roofing - w/out felt	SQ	9		
10	Remove and Replace Sheathing - plywood - 1/2" CDX	SF	800		
MAINTENANCE BUILDING REPAIRS - BUILDING 1					
1	Remove and Replace Roll-up door & hardware - 12' x 12' - 26 gauge	EA	1		
2	Remove and Replace Steel purlins - Z-shape - 8"	LF	20		
3	Remove and Replace Wrap wood door frame & trim with aluminum	LF	36		
4	Remove and Replace Aluminum window, single hung 13-19 sf	EA	2		
5	Single axle dump truck - per load - including dump fees	EA	1		
6	Remove and Replace Rubber roofing - Mechanically attached - 45 mil	SQ	4		
7	Remove and Replace Fiberboard - 1/2"	SF	433		
8	Remove Vinyl floor covering (sheet goods)	SF	420		
9	Vinyl floor covering (sheet goods)	SF	511		
10	Floor preparation for resilient flooring	SF	420		
11	Toilet - Detach & reset	EA	1		
12	Remove and Replace Drip edge/gutter apron	LF	92		

Item No.	Description	Unit	Est. No. of Units	Unit Price	Item Total
13	Water heater - Detach & reset	EA	1		
14	Remove and Replace Steel rake/gable trim - color finish	LF	9		
15	Single axle dump truck - per load - including dump fees	EA	1		
POLE BARN REPAIRS - BUILDING 8					
1	Remove and Replace Siding - steel - Commercial - High grade	SF	256		
2	Remove and Replace Vinyl-faced/laminated insulation - 4"	SF	256		
3	Remove and Replace Gutter / downspout - box - aluminum - 7" to 8"	LF	40		
4	Remove and Replace Steel rake/gable trim - color finish	LF	66		
5	Remove and Replace Steel purlins - Z-shape - 8"	LF	240		
6	Structural Steel - General Laborer - per hour	HR	1		
7	Remove and Replace Wide Flange Beam - 23 7/8"d. x 9"w. x 7/16" thick	LF	64		
8	Breaker panel - 200 to 300 amp - Detach & reset	EA	1		
9	Dumpster load - Approx. 20 yards, 4 tons of debris	EA	1		
10	Remove and Replace Metal roofing - High grade half of front slope	SF	2,955		
11	Remove and Replace Ridge cap - composition shingles	LF	85		
WATER DEPARTMENT OFFICE BUILDING REPAIRS - BUILDING 3					
1	Remove and Replace Siding - steel - Commercial - High grade	SF	380		
2	Remove and Replace Roll-up door & hardware - 12' x 12' - 26 gauge	EA	1		
3	Single axle dump truck - per load - including dump fees	EA	2		
4	Remove and Replace Metal roofing - Standard grade	SF	1,377		
MAIN BUILDING REPAIRS - BUILDING 9					
1	Remove and Replace Siding - steel (29 gauge)	SF	192		
2	Remove and Replace Gutter / downspout - aluminum - 6"	LF	40		
3	Remove and Replace Gutter / downspout - box - aluminum - 7" to 8"	LF	30		
4	Remove and Replace Ridge cap - metal roofing	LF	25		
5	Remove and Replace Steel rake/gable trim - color finish	LF	42		
6	Haul debris - per pickup truck load - including dump fees	EA	1		
TOTAL SCHEDULE V-MISCELLANEOUS REPAIRS TO FIVE MAINTENANCE BUILDINGS				\$	

TOTAL SCHEDULE I- GENERAL CONDITIONS		\$
TOTAL SCHEDULE II- GARAGE BUILDING LUMP SUM BID		\$
TOTAL SCHEDULE III-GARAGE EXTERIOR ITEMS		\$
TOTAL SCHEDULE IV-PARKER BUILDING OFFICE ADDITION		\$
TOTAL SCHEDULE V-MISCELLANEOUS REPAIRS TO FIVE MAINTENANCE BUILDINGS		\$
TOTAL		\$
BIDDER		
		DATE
BY		
		(Signature) TITLE
ADDRESS		
CITY	STATE	ZIP
TELEPHONE		E-MAIL

BID BOND

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned, _____
_____ as Principal, and
_____ as Surety,
are hereby held and firmly bound unto City of Fort Oglethorpe, Georgia as Owner in the penal
sum of five percent of the total Bid which equals _____
_____ for the payment of which, well and truly
to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators,
successors, and assigns.

The condition of the above obligation is such that whereas the Principal has submitted to Walker County a certain Bid, attached hereto and hereby made a part hereof to enter into a contract in writing for the construction of Municipal Maintenance Facility Improvements.

NOW, THEREFORE,

- a. If said Bid shall be rejected, or in the alternate,
- b. If said Bid shall be accepted and the Principal shall execute and deliver a contract in the Form of Contract attached hereto (properly completed in accordance with said Bid) and shall furnish a bond for his faithful performance of said contract, and for the payment of all persons performing labor or furnishing materials in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said Bid,

then this obligation shall be void, otherwise the same shall remain in force and effect; it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall in no event exceed the penal amount of this obligation as herein stated.

The Surety, for value received, hereby stipulates and agrees that the obligations of said Surety and its bond shall be in no way impaired or affected by any extension of the time within which the Owner may accept such Bid; and said Surety does hereby waive notice of any such extension.

IN WITNESS WHEREOF, the Principal and Surety have executed this bond by causing their respective names to be hereunto subscribed and their seals to be hereunto affixed by their duly authorized officers, on this the _____ day of _____, 20__.

CONTRACTOR - PRINCIPAL:

ATTEST:

Name _____
(Please Type)

Title _____

By _____
Name _____
(Please Type)

Title _____

(SEAL)

Note: Attest for a Corporation must be by the corporate secretary; for a partnership by another partner; for an individual by a Notary.

SURETY:

ATTEST:

Name _____
(Please Type)

Title _____

By _____
Name _____
(Please Type)

Title _____
(Attach Power of Attorney)

(SEAL)

Note: Surety companies executing bonds must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the state where the project is located.

BIDDER ACKNOWLEDGMENT OF CONTRACT TIME

By signature below, Bidder acknowledges and agrees that the 120-day contract time for substantial completion of the work included in these Contract Documents is either:

1. Sufficient, barring changed conditions, acts of God, or abnormal weather conditions that would justify time extensions; or
2. Insufficient, in which case the Contractor agrees that the price bid includes an allowance for liquidated damages of adequate magnitude to cover the additional time required to complete the work.

Bidder Name _____

Signature _____

Attest:

STATEMENT OF BIDDER'S QUALIFICATIONS

All questions must be answered and the data given must be clear and comprehensive. This statement must be notarized. If necessary, questions may be answered on separate attached sheets. The Bidder may submit any additional information he desires. Attach all additional sheets to these Contract Documents.

1. Name of Bidder.
2. Permanent main office address.
3. When organized.
4. If a corporation, where incorporated.
5. How many years have you been engaged in the contracting business under your present firm or trade name?
6. Contracts on hand: (Schedule these, showing amount of each contract and the appropriate anticipated dates of completion.)
7. General character of work performed by your company.
8. Have you ever failed to complete any work awarded to you? If so, where and why?
9. Have you ever defaulted on a contract? If so, where and why?
10. List the most important projects recently completed by your company, stating the approximate cost for each, and the month and year completed.
11. List your major equipment available for this project.
12. Experience in construction work similar in importance to this project.

- 13. Background and experience of the principal members of your organization, including officers.
- 14. Credit available: \$_____
- 15. Give bank reference.
- 16. Will you, upon request, fill out a detailed financial statement and furnish any other information that may be required by the Local Public Agency?

The undersigned hereby authorizes and requests any person, firm, or corporation to furnish any information requested by the Local Public Agency in verification of the recitals comprising this Statement of Bidder's Qualifications.

Dated this _____ day of _____, 20__.

Name of Bidder

By _____

Title _____

State of _____

County of _____

_____ being duly sworn deposes and says that he is
_____ of _____
_____ and that the answers to the foregoing
questions and all statements therein contained are true and correct. Subscribed and sworn to
before me this _____ day of _____, 20__.

Notary Public

My Commission Expires:

(Date)

(SEAL)

NONCOLLUSION AFFIDAVIT OF PRIME BIDDER

State of _____)
)ss.
County of _____)

_____, being first duly sworn, deposes and says that:

1. He is _____ of _____
(owner, partner, officer, representative, or agent)
_____, the Bidder that has submitted the attached Bid;
2. He is fully informed respecting the preparation and contents of the attached Bid and of all pertinent circumstances respecting such Bid;
3. Such Bid is genuine and is not a collusive or sham Bid;
4. Neither the said Bidder nor any of its officers, partners, owners, agents, representatives, employees or parties in interest, including this affiant, has in any way colluded, conspired, connived or agreed, directly or indirectly with any other Bidder, firm or person to submit a collusive or sham Bid in connection with the Contract for which the attached Bid has been submitted or to refrain from bidding in connection with such Contract, or has in any manner, directly or indirectly, sought by agreement or collusion or communication or conference with any other Bidder, firm or person to fix the price or prices in the attached Bid or of any other Bidder, or to fix any overhead, profit or cost element of the Bid price or the Bid price of any other Bidder, or to secure through any collusion, conspiracy, connivance or unlawful agreement any advantage against the _____ (Local Public Agency) or any person interested in the proposed Contract; and
5. The price or prices quoted in the attached Bid are fair and proper and are not tainted by any collusion, conspiracy, connivance or unlawful agreement on the part of the Bidder or any of its agents, representatives, owners, employees, or parties in interest, including this affiant.

(Signed) _____

Title

Subscribed and sworn to before me this _____ day of _____, 20 ____.

Title

My commission expires _____
(Date)

(SEAL)

PARTNERSHIP CERTIFICATE

STATE OF _____

COUNTY OF _____

On this _____ day of _____, 20__, before me personally appeared _____
_____, known to me to be the person who executed the
above instrument, who, being by me first duly sworn, did depose and say that he is a general
partner in the firm of _____
and that said firm consists of himself and _____
_____ and that he executed the foregoing instrument
on behalf of said firm for the uses and purposes stated therein, and that no one except the
above named members of the firm have any financial interest whatsoever in said proposed
contract.

Partner

Partner

Partner

Partner

Subscribed and sworn to before me, this _____ day of _____, 20__.

Notary Public

My Commission Expires:

(Date)

(SEAL)

NOTE: If only one partner signs, a power of attorney executed by all other partners authorizing
him to act in the name of the company must be attached; otherwise, all partners must sign.

CORPORATE CERTIFICATE

I, _____, certify that I am the Secretary of the corporation named as Contractor in the foregoing proposal; that _____, who signed said proposal in behalf of the Contractor was then _____ of said corporation; that said proposal was duly signed for and in behalf of said corporation by authority of its Board of Directors, and is within the scope of its corporate powers; that said corporation is organized under the laws of the State of _____.

This _____ day of _____, 20____.

(SEAL)

JOINT VENTURE QUESTIONNAIRE

In the event a joint venture bid is submitted, the following questions shall be answered, submitted with the bid and signed by the owner, partner, officer, representative, or agent of each joint venturer.

1. What is the separate bonding capability of each member of the joint venture?
2. What other work is in progress by the total contract dollar amount and percentage of completion for each joint venturer?
3. Are there any particular risks associated with this Contract which contributed to the decision to joint venture, and if so, what?
4. Has consideration been given to utilization of subcontract as opposed to formation of a joint venture, and if so, why was the joint venture format chosen?
5. Has either member of the joint venture been separately awarded a contract by City of Fort Oglethorpe, and if so, what was the most recent contract awarded to each?
6. What will be the contribution of each participant in the joint venture with respect to personnel, equipment, and other resources of each company allocated to this contract?
7. What will be the specific contribution of each participant of the joint venture for the completion of work to be performed and material to be supplied under this Contract?
8. Will there be separate management for the joint venture? If not, which company will supervise, or how will the contract be supervised?
9. Why will the joint venture be more efficient than the possibility of both companies separately bidding and either company being awarded the contract separately.

10. Does the formation of the joint venture promote competition on this Contract, and if so, how?
11. Has the joint venture, or any participant therein, received any legal advice with respect to the antitrust implications of formation of a joint venture, and if so, from what attorneys?

_____	_____
Name of Joint Venturer	Name of Joint Venturer
By _____	By _____
Title _____	Title _____

State of _____
 County of _____

_____ being duly sworn deposes and says that he is _____ of _____ and _____ being duly sworn deposes and says that he is _____ of _____ and that the answers to the foregoing questions and all statements therein contained are true and correct. Subscribed and sworn to before me this _____ day of _____, 20____.

 Notary Public

My Commission Expires:

 (Date)

(SEAL)

END OF SECTION

STATEMENT OF LICENSE CERTIFICATE

Each contractor bidding shall fill in and sign the following:

This is to certify that _____,
being a bidding contractor on the within and foregoing proposed contract, has fully reviewed the complete Bid Package and all invitations, information, supplemental conditions and addendum or addenda thereto, and has contacted and complied with all of the applicable requirements imposed or stated in writing by the Georgia State Construction Industry Licensing Board laws and rules, or the applicable rules of any other qualifying governing body, agency, or board.

The undersigned contractor further does hereby certify, warrant and represent that such contractor has verified and determined that such contractor is fully licensed to perform all aspects of the contract project within the plans, documents, and specifications, and such license is not in any way suspended, conditional, impaired or revoked.

The Contractor has been issued License or Certificate Number _____
in the name of (contractor's name) _____
by (name of issuing body, agency or board) _____
_____, which License or Certificate expires on
(date of expiration) _____.

Signed _____
Name _____
Title _____

E-VERIFY

Contractor Affidavit under O.C.G.A. § 13-10-91(b)(1)

By executing this affidavit, the undersigned contractor verifies its compliance with O.C.G.A. § 13-10-91, stating affirmatively that the individual, firm or corporation which is engaged in the physical performance of services on behalf of City of Fort Oglethorpe has registered with, is authorized to use and uses the federal work authorization program commonly known as E-Verify, or any subsequent replacement program, in accordance with the applicable provisions and deadlines established in O.C.G.A. § 13-10-91. Furthermore, the undersigned contractor will continue to use the federal work authorization program throughout the contract period and the undersigned contractor will contract for the physical performance of services in satisfaction of such contract only with subcontractors who present an affidavit to the contractor with the information required by O.C.G.A. § 13-10-91(b). Contractor hereby attests that its federal work authorization user identification number and date of authorization are as follows:

Federal Work Authorization User Identification Number

Date of Authorization

Name of Contractor
Municipal Maintenance Facility Improvements
Name of Project

Name of Public Employer

I hereby declare under penalty of perjury that the foregoing is true and correct.

Executed on _____, __, 20__ in _____ (city), _____ (state).

Signature of Authorized Officer or Agent

Printed Name and Title of Authorized Officer or Agent

SUBSCRIBED AND SWORN BEFORE ME
ON THIS THE _____ DAY OF _____, 20__.

NOTARY PUBLIC

My Commission Expires:

CONTRACTING REQUIREMENTS

NOTICE OF AWARD

To: _____

Project Description: The work is located at the City of Fort Oglethorpe municipal building. The project consists of construction of a new 40-ft x 80-ft garage, associated repairs of the east garage, and a three-office addition in the upstairs area of the parker Building.

The Owner has considered the Bid submitted by you for the above described work in response to its Invitation to Bid dated _____, 20__, and Information for Bidders.

You are hereby notified that your bid has been accepted for items in the amount of \$_____.

You are required by the Information for Bidders to execute the Contract and furnish the required Contractor's Performance Bond, Payment Bond and certificates of insurance within ten calendar days from the date of this notice to you.

If you fail to execute said Contract and to furnish said bonds within ten days from the date of this notice, said Owner will be entitled to consider all your rights arising out of the Owner's acceptance of your bid as abandoned and as a forfeiture of your Bid Bond will be entitled to such other rights as may be granted by law.

You are required to return an acknowledged copy of this Notice of Award to the Owner.

Dated this _____ day of _____, 20__

CITY OF FORT OGLETHORPE, GEORGIA

By _____

Name _____

Title _____

ACCEPTANCE OF NOTICE

Receipt of the above Notice of Award is hereby acknowledged by _____
_____, this the _____ day of _____, 20__.

By _____

Name _____

Title _____

CONTRACT

THIS CONTRACT, made this _____ day of _____, 20__, by and between City of Fort Oglethorpe, Georgia, hereinafter called "Owner" and _____
_____ doing business as a _____
_____ corporation, individual, or partnership
hereinafter called "Contractor."

WITNESSETH: That for and in consideration of the payments and agreements hereafter mentioned:

1. The Contractor will commence and complete the construction of Municipal Maintenance Facility Improvements.
2. The Contractor will furnish all of the material, supplies, tools, equipment, labor and other services necessary for the completion of the work described herein.
3. The Contractor will commence the work required by the Contract Documents within 10 calendar days after the contract start date of the written Notice to Proceed and will complete the work within 120-day contract time unless the periods of completion are extended otherwise by the Contract Documents. The Contractor further agrees to pay as liquidated damages, the sum of \$500.00 for each consecutive calendar day in default thereafter as hereinafter provided in the General Conditions.
4. The Contractor agrees to perform all of the Work described in the Contract Documents and comply with the terms therein for the sum of \$ _____, as shown in the Bid Schedule.
5. The term "Contract Documents" means and includes the following:
 - a. Invitation to Bid
 - b. Information for Bidders
 - c. Bid
 - d. Bid Bond
 - e. Contract
 - f. General Conditions
 - g. Supplemental General Conditions
 - h. Payment Bond
 - i. Performance Bond
 - j. Notice of Award
 - k. Notice to Proceed
 - l. Change Order(s)
 - m. Drawings prepared by CTI Engineers, Inc., numbered G-001,C201,C202,G203,S201 through S209, M000,M102,M201,E001,E201, and E202 as listed on the List of Drawings.
 - n. Specifications prepared or issued by CTI Engineers, Inc., dated February 2024
 - o. Addenda:
No. _____, dated _____, 20__
No. _____, dated _____, 20__
No. _____, dated _____, 20__

6. The Owner will pay to the Contractor in the manner and at such times as set forth in the General Conditions such amounts as required by the Contract Documents.
7. This Contract shall be binding upon all parties hereto and their respective heirs, executors, administrators, successors, and assigns.

IN WITNESS WHEREOF, the parties hereto have executed, or caused to be executed by their duly authorized officials, this Contract in four (4) copies each of which shall be deemed an original on the date first above written.

OWNER:
CITY OF FORT OGLETHORPE, GEORGIA

By _____

Name _____
(Please Print or Type)

Title _____

WITNESS:

Name _____
(Please Print or Type)

Title _____

(SEAL)

CONTRACTOR:

By _____

Name _____
(Please Print or Type)

Address _____

ATTEST:

Name _____
(Please Print or Type)

Title _____

(SEAL)

Note: Attest for a corporation must be by the corporate secretary; for a partnership by another partner; for an individual by a Notary.

NOTICE TO PROCEED

To: _____

Project Description: The work is located at the City of Fort Oglethorpe municipal building. The project consists of construction of a new 40-ft x 80-ft garage, associated repairs of the east garage, and a three-office addition in the upstairs area of the parker Building.

You are hereby notified to commence work in accordance with the Contract dated _____, 20__, on or before _____, 20__, and you are to complete the work within the 120-day contract time. The date of completion of all work is therefore _____, 20__.

Dated this _____ day of _____, 20__.

CITY OF FORT OGLETHORPE, GEORGIA

By _____

Name _____

Title _____

ACCEPTANCE OF NOTICE

Receipt of the above Notice to Proceed is hereby acknowledged by _____, this the _____ day of _____, 20__.

By _____

Name _____

Title _____

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS: that _____

Name and Address of Contractor

_____ of the State of _____,
a Corporation, a Partnership, or an Individual

the "Principal," and _____,
_____ the "Surety,"

Name and Address of Surety

are held and firmly bound unto City of Oglethorpe, the "Owner," existing under and by virtue
of the laws of the State of Georgia, in the sum of _____

_____ (\$ _____)

in lawful money of the United States, for the payment of which sum in lawful money of the
United States well and truly to be made we do hereby bind ourselves, our heirs, executors,
administrators, successors, and assigns jointly and severally.

The condition of this obligation is such that whereas Principal has entered into a certain
Contract with the Owner, dated as of the _____ day of _____, 20____, which is by
reference incorporated in and made a part hereof as fully as if copied here verbatim, for the
construction of Municipal Maintenance Facility Improvements.

NOW, THEREFORE, if the Principal shall in all respects comply with and perform all the
terms and conditions of the Contract (which includes the Drawings, Specifications, and Contract
Documents) and such alterations as may be made in said contract as the documents therein
provide for, during the original term thereof and any extensions thereof which may be granted
by the Owner, with or without notice to Surety, and during the one-year warranty period, and
if Principal shall satisfy all claims and demands and shall indemnify and save harmless the
Owner against and from all costs, expenses, damages, injury, or conduct, want of care, skill,
negligence, or default, including compliance with performance guarantees and patent
infringement by the Principal, then this obligation shall be void; otherwise Principal and Surety
jointly and severally agree to pay to Owner any difference between the sum to which the
Principal would be entitled on completion of the contract and that which the Owner may be
obliged to pay for the completion of the work by contract or otherwise, together with any
damages, direct or indirect, or consequential, which Owner may sustain on account of such
work, or on account of the failure of the Principal to keep and execute all provisions of the
Contract.

Principal and Surety further bind themselves, their heirs, executors, administrators, and
assigns, jointly and severally, that if the Principal shall keep and perform its agreement to repair
or replace defective work or equipment during the warranty period of one (1) year as provided,
then this paragraph shall be void; but if default shall be made by Principal in the performance
of its contract to so repair or replace said work, then this paragraph shall be in effect and

WITNESS:

Name _____
(Please Print or Type)

Title _____

SURETY:

By _____

Name _____
(Please Print or Type)

Title _____
(Attach Power of Attorney)

(SEAL)

Note: Surety companies executing Bonds must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the state where the project is located.

PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS: that _____

Name and Address of Contractor

_____ of the State of _____,
a Corporation, a Partnership, or an Individual

the "Principal," and _____,
_____ the "Surety,"

Name and Address of Surety

are held and firmly bound unto City of Fort Oglethorpe, the "Owner," existing under and by
virtue of the laws of the State of Georgia, in the sum of _____

_____ (\$ _____)

in lawful money of the United States, for the payment of which sum in lawful money of the
United States well and truly to be made we do hereby bind ourselves, our heirs, executors,
administrators, successors, and assigns jointly and severally.

The condition of this obligation is such that whereas Principal has entered into a certain
Contract with the Owner, dated as of the _____ day of _____, 20____, which is by
reference incorporated in and made a part hereof as fully as if copied here verbatim, for the
construction of Municipal Maintenance Facility Improvements.

NOW, THEREFORE, if the Principal shall fully pay for all the labor and materials used by
said Principal or any immediate or remote subcontractor or furnisher of labor or materials under
him in the performance of the work in lawful money of the United States as the same shall
become due, including all amounts due for materials, lubricants, oil, gasoline, electricity, coal
and coke, repairs on machinery, equipment, and tools, consumed or used in connection with
performance of the work and all insurance premiums and other charges incurred under said
contract, then this obligation shall be void; otherwise to remain in full force and effect.

Principal and Surety further bind themselves, their heirs, executors, administrators, and
assigns, jointly and severally, that they shall promptly make payments of all taxes, licenses,
assessments, contributions, penalties, and interest thereon, when, and if, the same may be
lawfully due the State of Georgia, or any County, Municipality, or political subdivision thereof
by reason of and directly connected with the performance of the Contract, or any part thereof.

And the Surety, for value received, hereby stipulates and agrees that the obligations of the
Surety and this Bond shall in no way be impaired or affected by any extension of time,
modification, omission, addition, or change in or to the contract, the work to be performed
thereunder, or by any payment thereunder before the time required therein, or by any waiver
of any provision thereof, or by any assignment subletting or other transfer thereof, or of any
part thereof, of any work to be performed, or of any moneys due to become due thereunder;
and the said Surety does hereby waive notice of any and all such extensions, modifications,

omissions, additions, changes, payments, waivers, assignments, subcontracts, and transfer, and hereby stipulates and agrees that any and all things done and omitted to be done by and in relation to executors, administrators, successors, assignees, subcontractors, and other transferees shall have the same effect as to said Surety as though done or omitted to be done by and in relation to the Principal.

IN WITNESS WHEREOF, the Principal and Surety have executed this Bond by causing their respective names to be hereunto subscribed and their seals to be hereunto affixed by their duly authorized officers, on this the _____ day of _____, 20__.

<p>ATTEST:</p> <p>_____</p> <p>Name _____</p> <p style="text-align: center;">(Please Print or Type)</p> <p>Title _____</p>	<p>CONTRACTOR - PRINCIPAL:</p> <p>_____</p> <p>By _____</p> <p>Name _____</p> <p style="text-align: center;">(Please Print or Type)</p> <p>Title _____</p>
--	--

(SEAL)

Note: Attest for a corporation must be by the corporate secretary; for a partnership by another partner; for an individual by a Notary.

<p>WITNESS:</p> <p>By _____</p> <p>Name _____</p> <p style="text-align: center;">(Please Print or Type)</p> <p>Title _____</p>	<p>SURETY:</p> <p>_____</p> <p>By _____</p> <p>Name _____</p> <p style="text-align: center;">(Please Print or Type)</p> <p>Title _____</p> <p>(Attach Power of Attorney)</p>
--	--

(SEAL)

Note: Surety companies executing Bonds must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the state where the project is located.

CHANGE ORDER

Order No. _____

Date: _____

Agreement Date: _____

NAME OF PROJECT: MUNICIPAL MAINTENANCE FACILITY IMPROVEMENTS

OWNER: CITY OF FORT OGLETHORPE

CONTRACTOR: _____

The following changes are hereby made to the Contract Documents:

Change to Contract Price

Original Contract Price \$ _____

Current Contract Price adjusted by previous Change Order \$ _____

The Contract Price due to this Change Order will be increased/decreased by: \$ _____

The new Contract Price including this Change Order will be \$ _____

Change to Contract Time

The Contract Time will be increased/decreased by _____ calendar days.

The date for completion of all work will be _____ (date).

Justification

Approvals Required

To be effective this Order must be approved by the Federal agency if it changes the scope or objective of the Project, or as may otherwise be required by the Supplemental General Conditions.

Accepted by: _____ (Contractor)

Recommended by: _____ CTI Engineers, Inc.

Ordered by: _____ City of Fort Oglethorpe, Georgia

Federal Agency Approval (where applicable): _____

CERTIFICATE OF OWNER'S ATTORNEY

I, the undersigned, _____, the duly authorized and acting legal representative of City of Fort Oglethorpe, Georgia, do hereby certify as follows:

I have examined the attached contract(s) and performance and payment bond(s) and the manner of execution thereof, and I am of the opinion that each of the aforesaid agreements are adequate and have been duly executed by the proper parties thereto acting through their duly authorized representatives; that said representatives have full power and authority to execute said agreements on behalf of the respective parties named thereon; and that the foregoing agreements constitute valid and legally binding obligations upon the parties executing the same in accordance with terms, conditions, and provisions thereof.

Date: _____

NOTE: Delete phrase "performance and payment bonds" when not applicable.

PROJECT CLOSEOUT

CERTIFICATE OF SUBSTANTIAL COMPLETION

Project: Municipal Maintenance Facility Improvements

Agreement Date: _____

Contractor: _____

Owner: City of Fort Oglethorpe
500 City Hall Drive
Fort Oglethorpe, GA 30742

Engineer: CTI Engineers, Inc.
1122 Riverfront Parkway
Chattanooga, Tennessee 37402

A walk-through inspection of the project was conducted on _____, 20____, with representatives of the Contractor, Owner, and Engineer participating. A final Punch List of work remaining to be completed or deficiencies noted was prepared.

ENGINEER: The work performed under this contract has been reviewed and found to the Engineer's best knowledge, information, and belief to be substantially complete as of _____.

By: _____ Title: _____ Date: _____

CONTRACTOR: The Contractor will complete or correct all work noted on the list of remaining work items dated _____, and supplements issued thereto within ___ days of the substantial completion date unless time is extended by Owner. The failure to include any items on the list does not alter the responsibility of the Contractor to complete all work in accordance with the Contract Documents.

By: _____ Title: _____ Date: _____

OWNER: The Owner accepts the work as substantially complete and accepts full possession thereof including the responsibilities for security, maintenance, and insurance.

By: _____ Title: _____ Date: _____

PROJECT CLOSE OUT FORMS

The following forms must be fully filled out by the Contractor and properly executed prior to release of final payment:

1. Affidavit of Payment
2. Affidavit of Release of Liens
3. Consent of Surety for Final Payment
4. Final Waiver of Lien
(To be executed by each and every subcontractor and supplier of materials.)

AFFIDAVIT OF PAYMENT

To: _____
(Owner)

WHEREAS, the undersigned has been employed by _____
_____ to furnish labor and
materials for _____
_____ work, under a contract
_____ for the improvement of the
property described as _____

_____ in the City of Fort Oglethorpe, County of Catoosa, State of Georgia of which City of Fort Oglethorpe is the Owner.

NOW, THEREFORE, this _____ day of _____, 20____.
The undersigned, as the Contractor for the above-named Contract pursuant to the Conditions of the Contract hereby certifies that, except as listed below, he has paid in full or has otherwise satisfied all obligations for all materials and equipment furnished, for all work, labor, and services performed, and for all known indebtedness and claims against the Contractor for damages arising in any manner in connection with the performance of the Contract referenced above for which the Owner or his property might in any way be held responsible.

EXCEPTIONS: (If none, write "None." If required by the Owner, the Contractor shall furnish bond satisfactory to the Owner for each exception.)

ATTACHMENTS:

- 1. Consent of Surety to Final Payment. (Whenever Surety is involved, Consent of Surety is required.)
- 2. Contractor's Release or Waiver of Liens, conditional upon receipt of final payment.
- 3. Separate Releases or Waivers of Liens from Subcontractors and material and equipment suppliers.
- 4. Contractor's Affidavit of Release of Liens.

CONTRACTOR (Name of sole ownership, corporation or partnership)

(Signature of Authorized Representative)

(Affix corporate seal here)

TITLE: _____

AFFIDAVIT OF RELEASE OF LIENS

To: _____
(Owner)

WHEREAS, the undersigned has been employed by _____

to furnish labor and materials for _____
_____ work,
under a contract _____
for the improvement of the property described as _____
_____ in the
City of Fort Oglethorpe, County of Catoosa, State of Georgia of which City of Fort Oglethorpe
is the Owner.

NOW, THEREFORE, this _____ day of _____, 20____.
The undersigned, as the Contractor for the above-named Contract pursuant to the conditions
of the Contract hereby certifies that to the best of his knowledge, information and belief, except
as listed below, the Releases or Waivers of Lien attached hereto include the Contractor, all
subcontractors, all suppliers of materials and equipment, and all performers of Work, labor or
services, who have or may have liens against any property of the Owner arising in any manner
out of the performance of the Contract referenced above.

EXCEPTIONS: (If none, write "None." If required by the Owner, the Contractor shall furnish
bond satisfactory to the Owner for each exception.)

ATTACHMENTS:

- 1. Contractor's Release or Waiver of Liens, conditional upon receipt of final payment.
- 2. Separate Releases or Waivers of Liens from Subcontractors and material and equipment
suppliers.

_____(SEAL)
CONTRACTOR (Name of sole ownership, corporation or partnership)

(Affix corporate
seal here)

_____(SEAL)
(Signature of Authorized Representative)

TITLE: _____

CONSENT OF SURETY FOR FINAL PAYMENT

Project: Municipal Maintenance Facility Improvements

Location: City of Fort Oglethorpe

Project: _____ Contract No. G23010

Type of Contract _____

Amount of Contract _____

In accordance with the provisions of the above-named contract between the Owner and the Contractor, the following named surety:

on the Payment Bond of the following named Contractor:

hereby approves of final payment to the Contractor, and further agrees that said final payment to the Contractor shall not relieve the surety company named herein of any of its obligations to the following named Owner: as set forth in said surety company's bond:

IN WITNESS WHEREOF, the surety company has hereunto set its hand and seal this _____ day of _____, 20__.

(Name of Surety Company)

(Affix corporate seal here)

(Signature of Authorized Representative)

Title: _____

FINAL WAIVER OF LIEN

To: _____
(Owner)

WHEREAS, the undersigned has been employed by (A) _____

to furnish labor and materials for (B) _____
_____ work,
under a contract (C) _____
for the improvement of the premises described as (D) _____

in the City of Fort Oglethorpe, County of Catoosa, State of Georgia of which City of Fort Oglethorpe is the Owner.

NOW, THEREFORE, this _____ day of _____ 20____, for
and in consideration of the sum of (E) _____
Dollars paid simultaneously herewith, the receipt whereof is hereby acknowledged by the undersigned, the undersigned does hereby waive and release any lien rights to, or claim of lien with respect to and on said above-described premises, and the improvements thereon, and on the monies or other considerations due or to become due from the Owner, or account of labor, services, material, fixtures, apparatus or machinery heretofore or which may hereafter be furnished by the undersigned to or for the above-described premises by virtue of said contract.

(F) _____ (SEAL)
Name of sole ownership, corporation or partnership)

(Affix corporate seal here)

_____ (SEAL)
(Signature of Authorized Representative)

TITLE: _____

INSTRUCTIONS FOR FINAL WAIVER

- (A) Person or firm with whom you agreed to furnish either labor, or services, or materials.
- (B) Fill in nature and extent of work; strike the word labor or the word materials if not in your contract.
- (C) If you have more than one contract on the same premises, describe the contract by number if available, date, and extent of work.
- (D) Furnish an accurate enough description of the improvement and location of the premises so that it can be distinguished from any other property.
- (E) Amount shown should be the amount actually received and equal to that amount of contract as adjusted.
- (F) If waiver is for a corporation, corporate name should be used, corporate seal affixed and title of officer signing waiver should be set forth; if waiver is for a partnership, the partnership name should be used, partner should sign and designate himself as partner.

CONDITIONS OF THE CONTRACT

Section 00 72 00

GENERAL CONDITIONS

1. Definitions
2. Additional Instructions and Detail Drawings
3. Schedules, Reports and Records
4. Drawings and Specifications
5. Shop Drawings
6. Materials, Services and Facilities
7. Inspection and Testing
8. Substitutions
9. Patents
10. Surveys, Permits, Regulations
11. Protection of Work, Property and Persons
12. Supervision by Contractor
13. Changes in the Work
14. Changes in Contract Price
15. Time for Completion and Liquidated Damages
16. Correction of Work
17. Subsurface Conditions
18. Suspension of Work, Termination and Delay
19. Payments to Contractor
20. Acceptance of Final Payment as Release
21. Insurance
22. Contract Security
23. Assignments
24. Indemnification
25. Separate Contracts
26. Subcontracting
27. Engineer's Authority
28. Land and Rights-of-Way
29. Guaranty
30. Disputes
31. Taxes

1. DEFINITIONS

1.1 Wherever used in the CONTRACT DOCUMENTS, the following terms shall have the meanings indicated which shall be applicable to both the singular and plural thereof:

1.2 ADDENDA - Written or graphic instruments issued prior to the execution of the Agreement which modify or interpret the CONTRACT DOCUMENTS, DRAWINGS, AND SPECIFICATIONS by additions, deletions, clarifications or corrections.

1.3 BID - The offer or proposal of the BIDDER submitted on the prescribed form setting forth the prices for the Work to be performed.

1.4 BIDDER - Any person, firm or corporation submitting a BID for the WORK.

1.5 BONDS - Bid, Performance, and Payment Bonds and other instruments of security, furnished by the CONTRACTOR and his surety in accordance with the CONTRACT DOCUMENTS.

1.6 CHANGE ORDER - A written order to the CONTRACTOR authorizing an addition, deletion or revision in the WORK within the general scope of the CONTRACT DOCUMENTS, or authorizing an adjustment in the CONTRACT PRICE OR CONTRACT TIME.

1.7 CONTRACT DOCUMENTS - The contract, including Advertisement For Bids, Information For Bidders, BID, Bid Bond, Agreement, Payment Bond, Performance Bond, NOTICE OF AWARD, NOTICE TO PROCEED, CHANGE ORDER, DRAWINGS, SPECIFICATIONS, and ADDENDA.

1.8 CONTRACT PRICE - The total monies payable to the CONTRACTOR under the terms and conditions of the CONTRACT DOCUMENTS.

1.9 CONTRACT TIME - The number of calendar days stated in the CONTRACT DOCUMENTS for the completion of the WORK.

1.10 CONTRACTOR - The person, firm, or corporation with whom the OWNER has executed the Agreement.

1.11 DRAWINGS - The part of the CONTRACT DOCUMENTS which show the characteristics and scope of the WORK to be performed and which have been prepared or approved by the ENGINEER.

1.12 ENGINEER - The person, firm, or corporation named as such in the CONTRACT DOCUMENTS.

1.13 FIELD ORDER - A written order effecting a change in the WORK not involving an

adjustment in the CONTRACT PRICE or an extension of the CONTRACTOR during construction.

1.14 NOTICE OF AWARD - The written notice of the acceptance of the BID from the OWNER to the successful BIDDER.

1.15 NOTICE TO PROCEED - Written communication issued by the OWNER to the CONTRACTOR authorizing him to proceed with the WORK and establishing the date of commencement of the WORK.

1.16 OWNER - A public or quasi-public body or authority, corporation, association, partnership, or individual for whom the WORK is to be performed.

1.17 PROJECT - The undertaking to be performed as provided in the CONTRACT DOCUMENTS.

1.18 RESIDENT PROJECT REPRESENTATIVE - The authorized representative of the OWNER who is assigned to the PROJECT site or any part thereof.

1.19 SHOP DRAWINGS - All drawings, diagrams, illustrations, brochures, schedules, and other data which are prepared by the CONTRACTOR, a SUBCONTRACTOR, manufacturer, SUPPLIER, or distributor, which illustrate how specific portions of the WORK shall be fabricated or installed.

1.20 SPECIFICATIONS - A part of the CONTRACT DOCUMENTS consisting of written descriptions of a technical nature of materials, equipment, construction systems, standards, and workmanship.

1.21 SUBCONTRACTOR - An individual, firm or corporation having a direct contract with the CONTRACTOR or with any other SUBCONTRACTOR for the performance of a part of the WORK at the site.

1.22 SUBSTANTIAL COMPLETION - That date as certified by the ENGINEER when the construction of the PROJECT or a specified part thereof is sufficiently completed, in accordance with the CONTRACT DOCUMENTS, so that the PROJECT or specified part can be utilized for the purposes for which it is intended.

1.23 SUPPLEMENTAL GENERAL CONDITIONS - Modifications to General Conditions

required by a Federal agency for participation in the PROJECT and approved by the agency in writing prior to inclusion in the CONTRACT DOCUMENTS, or such requirements that may be imposed by applicable state laws.

1.24 SUPPLIER - Any person or organization who supplies materials or equipment for the WORK, including that fabricated to a specific design, but who does not perform labor at the site.

1.25 WORK - All labor necessary to produce the construction required by the CONTRACT DOCUMENTS, and all materials and equipment incorporated or to be incorporated in the PROJECT.

1.26 WRITTEN NOTICE - Any notice to any party of the Agreement relative to any part of this Agreement in writing and considered delivered and the service thereof completed, when posted by certified or registered mail to the said party at his last given address or delivered in person to said party or his authorized representative on the WORK.

2. ADDITIONAL INSTRUCTIONS AND DETAIL DRAWING

2.1 The CONTRACTOR may be furnished additional instructions and detail drawings, by the ENGINEER, as necessary to carry out the WORK required by the CONTRACT DOCUMENTS.

2.2 The additional drawings and instruction thus supplied will become a part of the CONTRACT DOCUMENTS. The CONTRACTOR shall carry out the WORK in accordance with the additional detail drawings and instructions.

3. SCHEDULES, REPORTS, AND RECORDS

3.1 The CONTRACTOR shall submit to the OWNER such schedule of quantities and costs, progress schedules, payrolls, reports, estimates, records and other data where applicable as are required by the CONTRACT DOCUMENTS for the WORK to be performed.

3.2 Prior to the first partial payment estimate the CONTRACTOR shall submit construction progress schedules showing the order in which he proposes to carry on the WORK, including dates at which he will start the various parts of the WORK, estimated date of completion of

each part and, as applicable:

3.2.1 The dates at which special detail drawings will be required; and

3.2.2 Respective dates for submission of SHOP DRAWINGS, the beginning of manufacture, the testing and the installation of materials, supplies and equipment.

3.3 The CONTRACTOR shall also submit a schedule of payments that he anticipates he will earn during the course of the WORK.

4. DRAWINGS AND SPECIFICATIONS

4.1 The intent of the DRAWINGS and SPECIFICATIONS is that the CONTRACTOR shall furnish all labor, materials, tools, equipment, and transportation necessary for the proper execution of the WORK in accordance with the CONTRACT DOCUMENTS and all incidental work necessary to complete the PROJECT in an acceptable manner, ready for use, occupancy or operation by the OWNER.

4.2 In case of conflict between the DRAWINGS and SPECIFICATIONS, the SPECIFICATIONS shall govern. Figure dimensions on DRAWINGS shall govern over scale dimensions, and detailed DRAWINGS shall govern over general DRAWINGS.

4.3 Any discrepancies found between the DRAWINGS and SPECIFICATIONS and site conditions or any inconsistencies or ambiguities in the DRAWINGS or SPECIFICATIONS shall be immediately reported to the ENGINEER, in writing, who shall promptly correct such inconsistencies or ambiguities in writing. WORK done by the CONTRACTOR after his discovery of such discrepancies, inconsistencies or ambiguities shall be done at the CONTRACTOR'S risk.

5. SHOP DRAWINGS

5.1 The CONTRACTOR shall provide SHOP DRAWINGS as may be necessary for the prosecution of the WORK as required by the CONTRACT DOCUMENTS. The ENGINEER shall promptly review all SHOP DRAWINGS. The ENGINEER'S approval of any SHOP DRAWING shall not release the CONTRACTOR from responsibility for deviations from the CONTRACT DOCUMENTS. The approval of any SHOP DRAWING which substantially deviates from the requirement of the CON-

TRACT DOCUMENTS shall be evidenced by a CHANGE ORDER.

5.2 When submitted for the ENGINEER'S review, SHOP DRAWINGS shall bear the CONTRACTOR'S certification that he has reviewed, checked, and approved the SHOP DRAWINGS and that they are in conformance with the requirements of the CONTRACT DOCUMENTS.

5.3 Portions of the WORK requiring a SHOP DRAWING or sample submission shall not begin until the SHOP DRAWING or submission has been approved by the ENGINEER. A copy of each approved SHOP DRAWING and each approved sample shall be kept in good order by the CONTRACTOR at the site and shall be available to the ENGINEER.

6. MATERIALS, SERVICES AND FACILITIES

6.1 It is understood that, except as otherwise specifically stated in the CONTRACT DOCUMENTS, the CONTRACTOR shall provide and pay for all materials, labor, tools, equipment, water, light, power, transportation, supervision, temporary construction of any nature, and all other services and facilities of any nature whatsoever necessary to execute, complete, and deliver the WORK within the specified time.

6.2 Materials and equipment shall be so stored as to insure the preservation of their quality and fitness for the WORK. Stored materials and equipment to be incorporated in the WORK shall be located so as to facilitate prompt inspection.

6.3 Manufactured supplies, materials, and equipment shall be applied, installed, connected, erected, used, cleaned, and conditioned as directed by the manufacturer.

6.4 Material, supplies, and equipment shall be in accordance with samples submitted by the CONTRACTOR and approved by the ENGINEER.

6.5 Materials, supplies, or equipment to be incorporated into the WORK shall not be purchased by the CONTRACTOR or the SUBCONTRACTOR subject to a chattel mortgage or under a conditional sale contract or other agreement by which an interest is retained by the seller.

7. INSPECTION AND TESTING

7.1 All materials and equipment used in the construction of the PROJECT shall be subject to adequate inspection and testing in accordance with generally accepted standards, as required and defined in the CONTRACT DOCUMENTS.

7.2 The OWNER shall provide all inspection and testing services not required by the CONTRACT DOCUMENTS.

7.3 The CONTRACTOR shall provide at his expense the testing and inspection services required by the CONTRACT DOCUMENTS.

7.4 If the CONTRACT DOCUMENTS, laws ordinances, rules, regulations, or orders of any public authority having jurisdiction require any WORK to specifically be inspected, tested, or approved by someone other than the CONTRACTOR, the CONTRACTOR will give the ENGINEER timely notice of readiness. The CONTRACTOR will then furnish the ENGINEER the required certificates of inspection, testing, or approval.

7.5 Inspections, tests, or approvals by the ENGINEER or others shall not relieve the CONTRACTOR from his obligations to perform the WORK in accordance with the requirements of the CONTRACT DOCUMENTS.

7.6 The ENGINEER and his representatives will at all times have access to the WORK. In addition, authorized representatives and agents of any participating Federal or state agency shall be permitted to inspect all work, materials, payrolls, records of personnel, invoices of materials, and other relevant data and records. The CONTRACTOR will provide proper facilities for such access and observation of the WORK and also for any inspection or testing thereof.

7.7 If any WORK is covered contrary to the written instructions of the ENGINEER it must, if requested by the ENGINEER, be uncovered for his observation and replaced at the CONTRACTOR'S expense.

7.8 If the ENGINEER considers it necessary or advisable that covered WORK be inspected or tested by others, the CONTRACTOR, at the ENGINEER'S request will uncover, expose, or otherwise make available for observation, inspection or testing as the ENGINEER may require, that portion of the WORK in question, furnishing all necessary labor, materials, tools,

and equipment. If it is found that such WORK is defective, the CONTRACTOR will bear all the expenses of such uncovering, exposure, observation, inspection, and testing and of satisfactory reconstruction. If, however, such WORK is not found to be defective, the CONTRACTOR will be allowed an increase in the CONTRACT PRICE or an extension of the CONTRACT TIME, or both, directly attributable to such uncovering, exposure, observation, inspection, testing and reconstruction, and an appropriate CHANGE ORDER shall be issued.

8. SUBSTITUTIONS

8.1 Whenever a material, article, or piece of equipment is identified on the DRAWINGS or SPECIFICATIONS by reference to brand name or catalogue number, it shall be understood that this is referenced for the purpose of defining the performance or other salient requirements and that other products of equal capacities, quality, and function shall be considered. The CONTRACTOR may recommend the substitution of a material, article, or piece of equipment of equal substance and function for those referred to in the CONTRACT DOCUMENTS by reference to brand name or catalogue number, and if, in the opinion of the ENGINEER, such material, article, or piece of equipment is of equal substance and function to that specified, the ENGINEER may approve its substitution and use by the CONTRACTOR. Any cost differential shall be deductible from the CONTRACT PRICE and the CONTRACT DOCUMENTS shall be appropriately modified by CHANGE ORDER. The CONTRACTOR warrants that if substitutes are approved, no major changes in the function or general design of the PROJECT will result. Incidental changes or extra component parts required to accommodate the substitute will be made by the CONTRACTOR without a change in the CONTRACT PRICE or CONTRACT TIME.

9. PATENTS

9.1 The CONTRACTOR shall pay all applicable royalties and license fees. He shall defend all suits or claims for infringement of any patent rights and save the OWNER harmless from loss on account thereof. Except that the OWNER shall be responsible for any such loss when a particular process, design, or the product of a particular manufacturer or manufacturers is specified, however, if the CONTRACTOR has reason to believe that the

design process or product specified is an infringement of a patent, he shall be responsible for such loss unless he promptly gives such information to the ENGINEER.

10. SURVEYS, PERMITS, REGULATIONS

10.1 The OWNER shall furnish all boundary surveys and establish all base lines for locating the principal component parts of the WORK together with a suitable number of bench marks adjacent to the WORK as shown in the CONTRACT DOCUMENTS. From the information provided by the OWNER, unless otherwise specified in the CONTRACT DOCUMENTS, the CONTRACTOR shall develop and make all detail surveys needed for construction such as slope stakes, batter boards, stakes for pile locations and other working points, lines, elevations, and cut sheets.

10.2 The CONTRACTOR shall carefully preserve bench marks, reference points and stakes and, in case of willful or careless destruction, he shall be charged with the resulting expense and shall be responsible for any mistakes that may be caused by their unnecessary loss or disturbance.

10.3 Permits and licenses of a temporary nature necessary for the prosecution of the WORK shall be secured and paid for by the CONTRACTOR unless otherwise stated in the SUPPLEMENTAL GENERAL CONDITIONS. Permits, licenses, and easements for permanent structures or permanent changes in existing facilities shall be secured and paid for by the OWNER, unless otherwise specified. The CONTRACTOR shall give all notices and comply with all laws, ordinances, rules, and regulations bearing on the conduct of the WORK as drawn and specified. If the CONTRACTOR observes that the CONTRACT DOCUMENTS are at variance therewith, he shall promptly notify the ENGINEER in writing and any necessary changes shall be adjusted as provided in Section 13. CHANGES IN THE WORK.

11. PROTECTION OF WORK, PROPERTY AND PERSONS

11.1 The CONTRACTOR will be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the WORK. He will take all necessary precautions for the safety of, and will provide the necessary protection to prevent damage, injury

or loss to all employees on the WORK and other persons who may be affected thereby, all the WORK and all materials or equipment to be incorporated therein, whether in storage on or off the site, and other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation or replacement in the course of construction.

11.2 The CONTRACTOR will comply with all applicable laws, ordinances, rules, regulations and orders of any public body having jurisdiction. He will erect and maintain, as required by the conditions and progress of the WORK, all necessary safeguards for safety and protection. He will notify owners of adjacent utilities when prosecution of the WORK may affect them. The CONTRACTOR will remedy all damage, injury, or loss to any property caused, directly or indirectly, in whole or in part, by the CONTRACTOR, any SUBCONTRACTOR or anyone directly or indirectly employed by any of them or anyone for whose acts any of them be liable, except damage or loss attributable to the fault of the CONTRACT DOCUMENTS or to the acts or omissions of the OWNER or the ENGINEER or anyone employed by either of them or anyone for whose acts either of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of the CONTRACTOR.

11.3 In emergencies affecting the safety of persons or the WORK or property at the site or adjacent thereto, the CONTRACTOR, without special instruction or authorization from the ENGINEER or OWNER, shall act to prevent threatened damage, injury, or loss. He will give the ENGINEER prompt WRITTEN NOTICE of any significant changes in the WORK or deviations from the CONTRACT DOCUMENTS caused thereby, and a CHANGE ORDER shall be issued covering the changes and deviations involved.

12. SUPERVISION BY CONTRACTOR

12.1 The CONTRACTOR will supervise and direct the WORK. He will be solely responsible for the means, methods, techniques, sequences and procedures of construction. The CONTRACTOR will employ and maintain on the WORK a qualified supervisor or superintendent who shall have been designated in writing by the CONTRACTOR as the CONTRACTOR'S representative at the site. The supervisor shall have full authority to act on behalf of the CON-

TRACTOR and all communications given to the supervisor shall be as binding as if given to the CONTRACTOR. The supervisor shall be present on the site at all times as required to perform adequate supervision and coordination of the WORK.

13. CHANGES IN THE WORK

13.1 The OWNER may at any time, as the need arises, order changes within the scope of the WORK without invalidating the Agreement. If such changes increase or decrease the amount due under the CONTRACT DOCUMENTS, or in the time required for performance of the WORK, an equitable adjustment shall be authorized by CHANGE ORDER.

13.2 The ENGINEER, also, may at any time, by issuing a FIELD ORDER, make changes in the details of the WORK. The CONTRACTOR shall proceed with the performance of any changes in the WORK so ordered by the ENGINEER unless the CONTRACTOR believes that such FIELD ORDER entitles him to a change in CONTRACT PRICE or TIME, or both, in which event he shall give the ENGINEER WRITTEN NOTICE thereof within seven (7) days after the receipt of the ordered change. Thereafter the CONTRACTOR shall document the basis for the change in CONTRACT PRICE or TIME within thirty (30) days. The CONTRACTOR shall not execute such changes pending the receipt of an executed CHANGE ORDER or further instruction from the OWNER.

14. CHANGES IN CONTRACT PRICE

14.1 The CONTRACT PRICE may be changed only by a CHANGE ORDER. The value of any WORK covered by a CHANGE ORDER or of any claim for increase or decrease in the CONTRACT PRICE shall be determined by one or more of the following methods in the order of precedence listed below:

- (a) Unit prices previously approved.
- (b) An agreed lump sum.
- (c) The actual cost for labor, direct overhead, materials, supplies, equipment, and other services necessary to complete the work.

In addition there shall be added an amount to be agreed upon but not to exceed fifteen (15) percent of the actual cost of the WORK to cover the cost of general overhead and profit.

15. TIME FOR COMPLETION AND LIQUIDATED DAMAGES

15.1 The date of beginning and the time for completion of the WORK are essential conditions of the CONTRACT DOCUMENTS and the WORK embraced shall be commenced on a date specified in the NOTICE TO PROCEED.

15.2 The CONTRACTOR will proceed with the WORK at such rate of progress to insure full completion within the CONTRACT TIME. It is expressly understood and agreed, by and between the CONTRACTOR and the OWNER, that the CONTRACT TIME for the completion of the WORK described herein is a reasonable time, taking into consideration the average climatic and economic conditions and other factors prevailing in the locality of the WORK.

15.3 If the CONTRACTOR shall fail to complete the WORK within the CONTRACT TIME, or extension of time granted by the OWNER, then the CONTRACTOR will pay to the OWNER the amount for liquidated damages as specified in the BID for each calendar day that the CONTRACTOR shall be in default after the time stipulated in the CONTRACT DOCUMENTS.

15.4 The CONTRACTOR shall not be charged with liquidated damages or any excess cost when the delay in completion of the WORK is due to the following, and the CONTRACTOR has promptly given WRITTEN NOTICE of such delay to the OWNER or ENGINEER.

15.4.1 To any preference, priority, or allocation order duly issued by the OWNER.

15.4.2 To unforeseeable causes beyond the control and without the fault or negligence of the CONTRACTOR, including but not restricted to, acts of God or of the public enemy, acts of the OWNER, acts of another CONTRACTOR in the performance of a CONTRACT with the OWNER, fires, floods, epidemics, quarantine, restrictions, strikes, freight embargoes, and abnormal and unforeseeable weather; and

15.4.3 To any delays of SUB-CONTRACTORS occasioned by any of the causes specified in paragraphs 15.4.1 and 15.4.2 of this article.

16. CORRECTION OF WORK

16.1 The CONTRACTOR shall promptly remove from the premises all WORK rejected by the ENGINEER for failure to comply with the

CONTRACT DOCUMENTS, whether incorporated in the construction or not and the CONTRACTOR shall promptly replace and re-execute the WORK in accordance with the CONTRACT DOCUMENTS and without expense to the OWNER and shall bear the expense of making good all WORK of other CONTRACTORS destroyed or damaged by such removal or replacement.

16.2 All removal and replacement WORK shall be done at the CONTRACTOR'S expense. If the CONTRACTOR does not take action to remove such rejected WORK within ten (10) days after receipt of WRITTEN NOTICE, the OWNER may remove such WORK and store the materials at the expense of the CONTRACTOR.

17. SUBSURFACE CONDITIONS

17.1 The CONTRACTOR shall promptly, and before such conditions are disturbed, except in the event of an emergency, notify the OWNER by WRITTEN NOTICE of:

17.1.1 Subsurface or latent physical conditions at the site differing materially from those indicated in the CONTRACT DOCUMENTS; or

17.1.2 Unknown physical conditions at the site, of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in WORK of the character provided for in the CONTRACT DOCUMENTS.

17.2 The OWNER shall promptly investigate the conditions, and if he finds that such conditions do so materially differ and cause an increase or decrease in the cost of, or in the time required for, performance of the WORK, an equitable adjustment shall be made and the CONTRACT DOCUMENTS shall be modified by a CHANGE ORDER. Any claim of the CONTRACTOR for adjustment hereunder shall not be allowed unless he has given the required WRITTEN NOTICE: provided that the OWNER may, if he determines the facts so justify, consider and adjust any such claims asserted before the date of final payment.

18. SUSPENSION OF WORK, TERMINATION AND DELAY

18.1 The OWNER may suspend the WORK or any portion thereof for a period of not more than

ninety days or such further time as agreed upon by the CONTRACTOR, by WRITTEN NOTICE to the CONTRACTOR and the ENGINEER which notice shall fix the date on which WORK shall be resumed. The CONTRACTOR will resume that WORK on the date so fixed. The CONTRACTOR will be allowed an increase in the CONTRACT PRICE or an extension of the CONTRACT TIME, or both, directly attributable to any suspension.

18.2 If the CONTRACTOR is adjudged a bankrupt or insolvent, or if he makes a general assignment for the benefit of his creditors, or if a trustee or receiver is appointed for the CONTRACTOR or for any of his property, or if he files a petition to take advantage of any debtor's act, or to reorganized under the bankruptcy or applicable laws, or if he repeatedly fails to supply sufficient skilled workmen or suitable materials or equipment, or if he repeatedly fails to make prompt payments to SUBCONTRACTORS or for labor, materials, or equipment or if he disregards laws, ordinances, rules, regulations, or orders of any public body having jurisdiction of the WORK or if he disregards the authority of the ENGINEER, or if he otherwise violates any provision of the CONTRACT DOCUMENTS, then the OWNER may, without prejudice to any other right or remedy and after giving the CONTRACTOR and his surety a minimum of ten (10) days from delivery of a WRITTEN NOTICE, terminate the services of the CONTRACTOR and take possession of the PROJECT and of all materials, equipment, tools, construction equipment, and machinery thereon owned by the CONTRACTOR, and finish the WORK by whatever method he may deem expedient. In such case the CONTRACTOR shall not be entitled to receive any further payment until the WORK is finished. If the unpaid balance of the CONTRACT PRICE exceeds the direct and indirect costs of completing the PROJECT, including compensation for additional professional services, such excess SHALL BE PAID TO THE CONTRACTOR. If such costs exceed such unpaid balance, the CONTRACTOR will pay the difference to the OWNER. Such costs incurred by the OWNER will be determined by the ENGINEER and incorporated in a CHANGE ORDER.

18.3 Where the CONTRACTOR'S services have been so terminated by the OWNER, said termination shall not affect any right of the OWNER against the CONTRACTOR then existing or which may thereafter accrue. Any

retention or payment of monies by the OWNER due the CONTRACTOR will not release the CONTRACTOR from compliance with the CONTRACT DOCUMENTS.

18.4 After ten (10) days from delivery of a WRITTEN NOTICE to the CONTRACTOR and the ENGINEER, the OWNER may without cause and without prejudice to any other right or remedy, elect to abandon the PROJECT and terminate the Contract. In such case, the CONTRACTOR shall be paid for all WORK executed and any expense sustained plus reasonable profit.

18.5 If, through no act or fault of the CONTRACTOR, the WORK is suspended for a period of more than ninety (90) days by the OWNER or under an order of court or other public authority, or the ENGINEER fails to act on any request for payment within thirty (30) days after it is submitted, or the OWNER fails to pay the CONTRACTOR substantially the sum approved by the ENGINEER or awarded by arbitrators within thirty (30) days of its approval and presentation, then the CONTRACTOR may, after ten (10) days from delivery of a WRITTEN NOTICE to the OWNER and the ENGINEER, terminate the CONTRACT and recover from the OWNER payment for all WORK executed and all expenses sustained. In addition, and in lieu of terminating the CONTRACT, if the ENGINEER has failed to act on a request for payment or if the OWNER has failed to make any payment as aforesaid, the CONTRACTOR may upon then (10) days WRITTEN NOTICE to the OWNER and the ENGINEER stop the WORK until he has been paid all amounts then due, in which event and upon resumption of the WORK, CHANGE ORDERS shall be issued for adjusting the CONTRACT PRICE or extending the CONTRACT TIME or both to compensate for the costs and delays attributable to the stoppage of the WORK.

18.6 If the performance of all or any portion of the WORK is suspended, delayed, or interrupted as a result of a failure of the OWNER or ENGINEER to act within the time specified in the CONTRACT DOCUMENTS, or if no time is specified, within a reasonable time, an adjustment in the CONTRACT PRICE or an extension of the CONTRACT TIME, or both, shall be made by CHANGE ORDER to compensate the CONTRACTOR for the costs and delays necessarily caused by the failure of the OWNER or ENGINEER.

19. PAYMENTS TO CONTRACTOR

19.1 At least ten (10) days before each progress payment falls due (but not more often than once a month), the CONTRACTOR will submit to the ENGINEER a partial payment estimate filled out and signed by the CONTRACTOR covering the WORK performed during the period covered by the partial payment estimate and supported by such data as the ENGINEER may reasonably require. If payment is requested on the basis of materials and equipment not incorporated in the WORK but delivered and suitably stored at or near the site, the partial payment estimate shall also be accompanied by such supporting data, satisfactory to the OWNER, as will establish the OWNER'S title to the material and equipment and protect his interest therein, including applicable insurance. The ENGINEER will, within ten (10) days after receipt of each partial payment estimate, either indicate in writing his approval of payment and present the partial payment estimate to the OWNER, or return the partial payment estimate to the CONTRACTOR indicating in writing his reasons for refusing to approve payment. In the latter case, the CONTRACTOR may make the necessary corrections and resubmit the partial payment estimate. The OWNER will, within ten (10) days of presentation to him of an approved partial payment estimate, pay the CONTRACTOR a progress payment on the basis of the approved partial payment estimate. The OWNER shall retain ten (10) percent of the amount of each payment until final completion and acceptance of all work covered by the CONTRACT DOCUMENTS. The OWNER at any time, however, after fifty (50) percent of the WORK has been completed, if he finds that satisfactory progress is being made, shall reduce retainage to five (5%) percent on the current and remaining estimates. When the WORK is substantially complete (operational or beneficial occupancy), the retained amount may be further reduced below five (5) percent to only that amount necessary to assure completion.

On completion and acceptance of a part of the WORK on which the price is stated separately in the CONTRACT DOCUMENTS, payment may be made in full, including retained percentages, less authorized deductions.

19.2 The request for payment may also include an allowance for the cost of such major materials and equipment which are suitably stored either at or near the site.

19.3 Prior to SUBSTANTIAL COMPLETION, the OWNER, with the approval of the ENGINEER and with the concurrence of the CONTRACTOR, may use any completed or substantially completed portions of the WORK. Such use shall not constitute an acceptance of such portions of the WORK.

19.4 The OWNER shall have the right to enter the premises for the purpose of doing work not covered by the CONTRACT DOCUMENTS. This provision shall not be construed as relieving the CONTRACTOR of the sole responsibility for the care and protection of the WORK, or the restoration of any damaged WORK except such as may be caused by agents or employees of the OWNER.

19.5 Upon completion and acceptance of the WORK, the ENGINEER shall issue a certificate attached to the final payment request that the WORK has been accepted by him under the conditions of the CONTRACT DOCUMENTS. The entire balance found to be due the CONTRACTOR, including the retained percentages, but except such sums as may be lawfully retained by the OWNER, shall be paid to the CONTRACTOR within thirty (30) days of completion and acceptance of the WORK.

19.6 The CONTRACTOR will indemnify and save the OWNER or the OWNER'S agents harmless from all claims growing out of the lawful demands of SUBCONTRACTORS, laborers, workmen, mechanics, materialmen, and furnishers of machinery and parts thereof, equipment, tools, and all supplies, incurred in the furtherance of the performance of the WORK. The CONTRACTOR shall, at the OWNER'S request, furnish satisfactory evidence that all obligations of the nature designated above have been paid, discharged, or waived. If the CONTRACTOR fails to do so the OWNER may, after having notified the CONTRACTOR, either pay unpaid bills or withhold from the CONTRACTOR'S unpaid compensation a sum of money deemed reasonably sufficient to pay any and all such lawful claims until satisfactory evidence is furnished that all liabilities have been fully discharged where upon payment to the CONTRACTOR shall be resumed, in accordance with the terms of the CONTRACT DOCUMENTS, but in no event shall the provisions of this sentence be construed to impose any obligations upon the OWNER to either the CONTRACTOR, his Surety, or any third party. In paying any unpaid bills of the CONTRACTOR, any payment so made by the

OWNER shall be considered as a payment made under the CONTRACT DOCUMENTS by the OWNER to the CONTRACTOR and the OWNER shall not be liable to the CONTRACTOR for any such payments made in good faith.

19.7 If the OWNER fails to make payment thirty (30) days after approval by the ENGINEER, in addition to other remedies available to the CONTRACTOR, there shall be added to each such payment interest at the maximum legal rate commencing on the first day after said payment is due and continuing until the payment is received by the CONTRACTOR.

20. ACCEPTANCE OF FINAL PAYMENT AS RELEASE

20.1 The acceptance by the CONTRACTOR of final payment shall be and shall operate as a release to the OWNER of all claims and all liability to the CONTRACTOR other than claims in stated amounts as may be specifically excepted by the CONTRACTOR for all things done or furnished in connection with this WORK and for every act and neglect of the OWNER and others relating to or arising out of this WORK. Any payment, however, final or otherwise, shall not release the CONTRACTOR or his sureties from any obligations under the CONTRACT DOCUMENTS or the Performance BOND and Payment BONDS.

21. INSURANCE

21.1 The CONTRACTOR shall purchase and maintain such insurance as will protect him from claims set forth below which may arise out of or result from the CONTRACTOR'S execution of the WORK, whether such execution be by himself or by any SUBCONTRACTOR or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

21.1.1 Claims under workmen's compensation, disability benefit, and other similar employee benefit acts:

21.1.2 Claims for damages because of bodily injury, occupational sickness or disease, or death of his employees:

21.1.3 Claims for damages because of bodily injury, sickness or disease, or death of any person other than his employees:

21.1.4 Claims for damages insured by usual personal injury liability coverage which are sustained (1) by any person as a result of an offense directly or indirectly related to the employment of such person by the CONTRACTOR, or (2) by any other person; and

21.1.5 Claims for damages because of injury to or destruction of tangible property, including loss of use resulting therefrom.

21.2 Certificates of Insurance acceptable to the OWNER shall be filed with the OWNER prior to commencement of the WORK. These Certificates shall contain a provision that coverages afforded under the policies will not be canceled unless at least fifteen (15) days prior WRITTEN NOTICE has been given to the OWNER.

21.3 The CONTRACTOR shall procure and maintain, at his own expense, during the CONTRACT TIME, liability insurance as hereinafter specified:

21.3.1 CONTRACTOR'S General Public Liability and Property Damage Insurance including vehicle coverage issued to the CONTRACTOR and protecting him from all claims for personal injury, including death, and all claims for destruction of or damage to property, arising out of or in connection with any operations under the CONTRACT DOCUMENTS, whether such operations be by himself or by any SUBCONTRACTOR under him, or anyone directly or indirectly employed by the CONTRACTOR or by a SUBCONTRACTOR under him. Insurance shall be written with a limit of liability of not less than \$1,000,000 for all damages arising out of bodily injury, including death, at any time resulting therefrom, sustained by any one person in any one accident: and a limit of liability of not less than \$1,000,000 aggregate for any such damages sustained by two or more persons in any one accident. Insurance shall be written with a limit of liability of not less than \$500,000 for all property damage sustained by any one person in any one accident; and a limit of liability of not less than \$500,000 aggregate for any such damage sustained by two or more persons in any one accident.

21.3.2 The CONTRACTOR shall acquire and maintain, if applicable, Fire and Extended Coverage insurance upon the PROJECT to the full insurable value thereof for the benefit of the OWNER, the CONTRACTOR, and SUBCON-

TRACTORS as their interest may appear. This provision shall in no way release the CONTRACTOR or CONTRACTOR'S surety from obligations under the CONTRACT DOCUMENTS to fully complete the PROJECT.

21.4 The CONTRACTOR shall procure and maintain, at his own expense, during the CONTRACT TIME, in accordance with the provisions of the laws of the state in which the work is performed. Workmen's Compensation Insurance, including occupational disease provisions, for all of his employees at the site of the PROJECT and in case any work is sublet, the CONTRACTOR shall require such SUBCONTRACTOR similarly to provide Workmen's Compensation Insurance, including occupational disease provisions for all of the latter's employees unless such employees are covered by the protection afforded by the CONTRACTOR. In case any class of employees engaged in hazardous work under this contract at the site of the PROJECT is not protected under Workmen's Compensation statute, the CONTRACTOR shall provide, and shall cause each SUBCONTRACTOR to provide, adequate and suitable insurance for the protection of his employees not otherwise protected.

21.5 The CONTRACTOR shall secure, if applicable, "All Risk" type Builder's Risk Insurance for WORK to be performed. Unless specifically authorized by the OWNER, the amount of such insurance shall not be less than the CONTRACT PRICE totaled in the BID. The policy shall cover not less than the losses due to fire, explosion, hail, lightning, vandalism, malicious mischief, wind, collapse, riot, aircraft, and smoke during the CONTRACT TIME, and until the WORK is accepted by the OWNER. The policy shall name as the insured the CONTRACTOR, the ENGINEER, and the OWNER.

22. CONTRACT SECURITY

22.1 The CONTRACTOR shall within ten (10) days after the receipt of the NOTICE OF AWARD furnish the OWNER with a Performance Bond and a Payment Bond in penal sums equal to the amount of the CONTRACT PRICE, conditioned upon the performance by the CONTRACTOR of all undertakings, covenants, terms, conditions, and agreements of the CONTRACT DOCUMENTS, and upon the prompt payment by the CONTRACTOR to all persons supplying labor and materials in the prosecution of the WORK

provided by the CONTRACT DOCUMENTS. Such BONDS shall be executed by the CONTRACTOR and a corporate bonding company licensed to transact such business in the state in which the WORK is to be performed and named on the current "Department of the Treasury's Listing of Approved Sureties (Department Circular 570)." The expense of these BONDS shall be borne by the CONTRACTOR. If at any time a surety on any such BOND is declared a bankrupt or loses its right to do business in the state in which the WORK is to be performed or is removed from the listing of approved sureties, CONTRACTOR shall within ten (10) days after notice from the OWNER to do so, substitute an acceptable BOND (or BONDS) in such form and sum and signed by such other surety or sureties as may be satisfactory to the OWNER. The premiums on such BOND shall be paid by the CONTRACTOR. No further payments shall be deemed due nor shall be made until the new surety or sureties shall have furnished an acceptable BOND to the OWNER.

23. ASSIGNMENTS

23.1 Neither the CONTRACTOR nor the OWNER shall sell, transfer, assign, or otherwise dispose of the Contract or any portion thereof, or of his right, title, or interest therein, or his obligations thereunder, without written consent of the other party.

24. INDEMNIFICATION

24.1 The CONTRACTOR will indemnify and hold harmless the OWNER and the ENGINEER and their agents and employees from and against all claims, damages, losses, and expenses including attorney's fees arising out of or resulting from the performance of the WORK, provided that any such claims, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property including the loss of use resulting therefrom: and is caused in whole or in part by any negligent or willful act or omission of the CONTRACTOR, and SUBCONTRACTOR, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable.

24.2 In any and all claims against the OWNER or the ENGINEER, or any of their agents or employees, by any employee of the CONTRACTOR, any SUBCONTRACTOR,

anyone directly or indirectly employed by any of them, or anyone for whose acts any of them may be liable, the indemnification obligation shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for the CONTRACTOR or any SUBCONTRACTOR under workmen's compensation acts, disability benefit acts or other employee benefits acts.

24.3 The obligation of the CONTRACTOR under this paragraph shall not extend to the liability of the ENGINEER, his agents or employees arising out of the preparation or approval of maps, DRAWINGS, opinions, reports, surveys, CHANGE ORDERS, designs, or SPECIFICATIONS.

25. SEPARATE CONTRACTS

25.1 The OWNER reserves the right to let other contracts in connection with this PROJECT. The CONTRACTOR shall afford other CONTRACTORS reasonable opportunity for the introduction and storage of their materials and the execution of their WORK, and shall properly connect and coordinate his WORK with theirs. If the proper execution or results of any part of the CONTRACTOR'S WORK depends upon the WORK of any other CONTRACTOR, the CONTRACTOR shall inspect and promptly report to the ENGINEER any defects in such WORK that render it unsuitable for such proper execution and results.

25.2 The OWNER may perform additional WORK related to the PROJECT by himself, or he may let other contracts containing provisions similar to these. The CONTRACTOR will afford the other CONTRACTORS who are parties to such Contracts (or the OWNER, if he is performing the additional WORK himself), reasonable opportunity for the introduction and storage of materials and equipment and the execution of WORK, and shall properly connect and coordinate his WORK with theirs.

25.3 If the performance of additional WORK by other CONTRACTORS or the OWNER is not noted in the CONTRACT DOCUMENTS prior to the execution of the CONTRACT, written notice thereof shall be given to the CONTRACTOR prior to starting any such additional WORK. If the CONTRACTOR believes that the performance of such additional WORK by the OWNER or others involves him in additional expense or entitles him to an extension of the CONTRACT TIME, he may make a claim

therefor as provided in Sections 14 and 15.

26. SUBCONTRACTING

26.1 The CONTRACTOR may utilize the services of specialty SUBCONTRACTORS on those parts of the WORK which, under normal contracting practices, are performed by specialty SUBCONTRACTORS.

26.2 The CONTRACTOR shall not award WORK to SUBCONTRACTOR(S), in excess of fifty (50%) percent of the CONTRACT PRICE, without prior written approval of the OWNER.

26.3 The CONTRACTOR shall be fully responsible to the OWNER for the acts and omissions of his SUBCONTRACTORS, and of persons either directly or indirectly employed by them, as he is for the acts and omissions of persons directly employed by him.

26.4 The CONTRACTOR shall cause appropriate provisions to be inserted in all subcontracts relative to the WORK to bind SUBCONTRACTORS to the CONTRACTOR by the terms of the CONTRACT DOCUMENTS in so far as applicable to the WORK of SUBCONTRACTORS and to give the CONTRACTOR the same power as regards terminating any subcontract that the OWNER may exercise over the CONTRACTOR under any provision of the CONTRACT DOCUMENTS.

26.5 Nothing contained in this CONTRACT shall create any contractual relation between any SUBCONTRACTOR and the OWNER.

27. ENGINEER'S AUTHORITY

27.1 The ENGINEER shall act as the OWNER'S representative during the construction period. He shall decide questions which may arise as to quality and acceptability of materials furnished and WORK performed. He shall interpret the intent of the CONTRACT DOCUMENTS in a fair and unbiased manner. The ENGINEER will make visits to the site and determine if the WORK is proceeding in accordance with the CONTRACT DOCUMENTS.

27.2 The CONTRACTOR will be held strictly to the intent of the CONTRACT DOCUMENTS in regard to the quality of materials, workmanship, and execution of the WORK. Inspections may be made at the factory or fabrication plant of the source of material supply.

27.3 The ENGINEER will not be responsible for the construction means, controls, techniques, sequences, procedures, or construction safety.

27.4 The ENGINEER shall promptly make decisions relative to interpretation of the CONTRACT DOCUMENTS.

28. LAND AND RIGHTS-OF-WAY

28.1 Prior to issuance of NOTICE TO PROCEED, the OWNER shall obtain all land and rights-of-way necessary for carrying out and for the completion of the WORK to be performed pursuant to the CONTRACT DOCUMENTS, unless otherwise mutually agreed.

28.2 The OWNER shall provide to the CONTRACTOR information which delineates and describes the lands owned and rights-of-way acquired.

28.3 The CONTRACTOR shall provide at his own expense and without liability to the OWNER any additional land and access thereto that the CONTRACTOR may desire for temporary construction facilities, or for storage of materials.

29. GUARANTY

29.1 The CONTRACTOR shall guarantee all materials and equipment furnished and WORK performed for a period of one (1) year from the date of SUBSTANTIAL COMPLETION. The CONTRACTOR warrants and guarantees for a period of one (1) year from the date of SUBSTANTIAL COMPLETION of the system that the completed system is free from all defects due to faulty materials or workmanship and the CONTRACTOR shall promptly make such corrections as may be necessary by reason of such defects including the repairs of any damage to other parts of the system resulting from such defects. The OWNER will give notice of observed defects with reasonable promptness. In the event that the CONTRACTOR should fail to make such repairs, adjustments, or other WORK that may be made necessary by such defects, the OWNER may do so and charge the CONTRACTOR the cost thereby incurred. The Performance BOND shall remain in full force and effect through the guarantee period.

30. DISPUTES

30.1 If the parties are unable to resolve a dispute, claim, or controversy relating to this Contract by direct discussions or by voluntary nonbinding mediation, the OWNER and the CONTRACTOR may pursue their respective remedies at law or equity.

31. TAXES

31.1 The CONTRACTOR will pay all sales, consumer, use and other similar taxes required by the law of the place where the WORK is performed.

SUPPLEMENTAL GENERAL CONDITIONS

1. DEFINITIONS

1.1 The following shall be added to the definitions listed in the General Conditions:

- (a) APPROVED - shall mean as approved, directed, required or permitted by the Engineer, unless specified otherwise.
- (b) CITY, COUNTY, OR AUTHORITY - City of Fort Oglethorpe, Georgia.
- (c) CONTRACT DOCUMENTS - The Contract Documents shall also include Certificate of Owner's Attorney, General Conditions, Supplemental General Conditions, funding agency requirements, EEO and MBE/WBE requirements, wage rate decisions, and all other certificates, regulations and documents herein bound.
- (d) ENGINEER - CTI Engineers, Inc., or its lawfully designated successor.
- (e) OWNER - City of Fort Oglethorpe, Georgia.
- (f) OWNER'S ATTORNEY – Robert L. Stulz or his/her lawfully designated successor or assistant.
- (g) SUBSTANTIAL COMPLETION - The determination as to whether the project is sufficiently complete so it can be utilized for its intended purposes will be based upon a consideration of completion items and submittals specified in the Specifications.
- (h) SUPPLEMENTAL GENERAL CONDITIONS - Also such modifications to the General Conditions as the Owner or Engineer may deem necessary.
- (I) THE SITE is the location of the proposed WORK as shown on the Drawings.

2. ADDITIONAL INSTRUCTIONS AND DETAIL DRAWINGS

(RESERVED)

3. SCHEDULES, REPORTS, AND RECORDS

3.1 Each such schedule is to be subject to change from time to time in accordance with the progress of the work.

3.2 The Contractor shall also furnish on forms to be supplied by the Owner and/or his Engineer:

- (a) a detailed estimate giving a complete breakdown of a lump sum contract price and

- (b) periodic itemized estimates of work done for the purpose of making partial payments thereon.

The costs employed in making up any of these schedules will be used only for determining the basis of partial payments and will not be considered as fixing a basis for additions to or deductions from the Contract Price.

4. DRAWINGS AND SPECIFICATIONS

- 4.1 The Drawings, Specifications and Addenda shall form part of this Contract and the provisions thereof shall be as binding upon the parties hereto as if they were herein fully set forth. The table of contents, titles, headings, running headlines and marginal notes contained in the Contract Documents are solely to facilitate reference to various provisions of the Contract Documents and in no way affect, limit, or cast light on the interpretation of the provisions to which they refer.
- 4.2 Upon award of the Contract, the Contractor upon request will be supplied free of charge up to six complete sets of the Drawings and Specifications. If the Contractor requests additional prints or specifications, they will be furnished to him at cost at the Contractor's expense.
- 4.3 The Contractor shall keep on the job a copy of the Drawings and Specifications and shall at all times give the Owner and Engineer access thereto. Anything mentioned in the Specifications and not shown on the Drawings or shown on the Drawings and not mentioned in the Specifications shall be of like effect as if shown or mentioned in both.
- 4.4 The Contractor shall not take advantage of any errors or omission which may exist in the Drawings and Specifications, but shall immediately call them to the attention of the Engineer whose prompt interpretation or correction thereof shall be conclusive.

5. SHOP DRAWINGS

- 5.1 After checking and verifying all field measurements, the Contractor shall submit to the Engineer for review seven copies of all Shop Drawings, which shall have been checked by and stamped with the approval of Contractor and identified as the Engineer may require. The data shown on the Shop Drawings will be complete with respect to dimensions, design criteria, materials of construction and the like to enable the Engineer to review the information as required.
- 5.2 The Contractor shall also submit for the Engineer's review with such promptness as to cause no delay in work, all samples required by the Contract Documents. All samples will have been checked by and stamped with the approval of the Contractor, identified clearly as to material, manufacturer, any pertinent catalog numbers and the use for which intended.
- 5.3 At the time of each submission, the Contractor shall in writing call the Engineer's attention to any deviations that the Shop Drawing or sample may have from the requirements of the Contract Documents.

5.4 The Engineer will review with reasonable promptness those Shop Drawings and samples submitted in accordance with the Contractor's approved Submittal Schedule, but his review shall be only for general conformance with the information given in the Contract Documents. The Contractor shall make any corrections required by the Engineer and shall return the required number of corrected copies of Shop Drawings and resubmit new samples. The Contractor shall direct specific attention in writing or on resubmitted Shop Drawings to revisions other than the corrections called for by the Engineer on previous submissions. Contractor's stamp of approval on any Shop Drawing or sample shall constitute a representation to the Owner and the Engineer that the Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data, or he assumes full responsibility for doing so, and that he has reviewed or coordinated each Shop Drawing or sample with the requirements of the work and the Contract Documents.

5.5 Engineer's review of Shop Drawings or samples shall not relieve the Contractor from his responsibility for any deviations from the requirements of the Contract Documents unless the Contractor has in writing called the Engineer's attention to such deviation at the time of submission and the Engineer has concurred in writing with the specific deviation, nor shall any review by the Engineer relieve the Contractor from responsibility for errors or omissions in the Shop Drawings.

6. MATERIALS, SERVICES AND FACILITIES

6.1 Any work necessary to be performed after regular working hours, on Sundays or on legal holidays, shall be performed without additional expense to the Owner.

6.2 The Contractor warrants that he has good title to all materials, supplies, and equipment used by him in the work.

6.3 All materials required in the work may be stored on the site upon which the project is to be constructed, subject to approval by the Engineer, but all such materials, tools, and machinery shall be neatly and compactly stored in such a manner as to not interfere with traffic and to cause the least inconvenience to the property owners. All fire hydrants must at all times be kept free and unobstructed, and water and gas shut-off boxes, underground power and telephone line manholes must not be covered by such materials.

6.4 Materials, tools, and machinery shall not be piled or placed against trees unless the trees shall be amply protected against injury therefrom. All materials, tools, machinery, etc., stored upon public thoroughfares must be provided with warning lights at night to warn the traffic of such obstruction.

6.5 The Contractor shall make his own arrangements for delivery and handling of equipment and materials as he may require for the prosecution of the work. The location of all temporary lines, roadways and similar facilities shall be subject to the approval of the Engineer, and these shall be located and operated so as not to interfere with other work carried on by the Owner or by other contractors.

6.6 It is agreed that any temporary power lines, roadways or other facilities which the Contractor furnishes, installs, maintains, and removes at the completion of the work, may be used by the Owner or any of its contractors at such reasonable time or

times as may be directed by the Engineer. Likewise, it is provided that similar facilities of other contracts will become available to the Contractor under similar conditions.

- 6.7 Adequate sanitary facilities shall be provided by the Contractor. All such sanitary facilities shall conform to the requirements of the respective State and County Departments of Public Health.
- 6.8 Office space and furnishings for the Resident Project Representative, if required, will be as specified in the Specifications. If required, office space must be provided before the Contractor's first partial payment estimate will be approved. No separate payment shall be made for office space.
- 6.9 Contractor shall furnish six hard hats which shall be made available to authorized representatives and agents of the Owner and any interested governmental agency while visiting the job site.

7. INSPECTION AND TESTING

- 7.1 Where testing and inspection of materials or equipment are required by the Contract Documents, the cost of all inspection and testing shall be included in the contract price for supplying the applicable materials and equipment, as no separate payment will be made for these services. The laboratory or inspection agency shall be approved by the Owner.
- 7.2 Where mill tests of materials are required by the Engineer under the Contract Documents, Contractor shall furnish certified copies of such mill tests.
- 7.3 Where shop equipment performance tests are specified, the Engineer shall be permitted to witness such tests. In the absence of a witnessed test, certified copies of shop tests shall be submitted at the discretion of the Engineer. Cost of Engineer's services in this test will be borne by the Owner.
- 7.4 No payment will be made to the Contractor for samples taken for tests such as concrete cylinders, etc., where testing is required by the Contract Documents.

8. SUBSTITUTIONS

- 8.1 The Contract is based on the materials, equipment, and methods described in the Contract Documents.
- 8.2 The Owner, through the Engineer, will consider proposals for substitution of materials, equipment, and methods only when such proposals are accompanied by full and complete technical data and all other information required to evaluate the proposed substitution.
- 8.3 The Contractor shall not substitute materials, equipment, or methods unless such substitution has been specifically approved for this project by the Engineer.

9. PATENTS

- 9.1 License and/or royalty fees for the use of a process which is authorized by the Owner of the project must be reasonable and paid to the holder of the patent, or his authorized licensee, directly by the Owner and not by or through the Contractor.

10. SURVEYS, PERMITS, REGULATIONS

- 10.1 The baseline and benchmark, if applicable, are indicated on the Drawings. The Contractor shall be responsible for all surveying required for laying out and constructing the Work.
- 10.2 The Contractor shall procure all permits and licenses, pay all charges or fees, and give all notices necessary for the completion of the work.

11. PROTECTION OF WORK, PROPERTY AND PERSONS

- 11.1 In order to protect the lives and health of his employees under the Contract, the Contractor shall comply with all pertinent provisions of the "Manual of Accident Prevention in Construction" issued by the Associated General Contractors of America, Inc., and shall maintain an accurate record of all cases of death, occupational disease and injury requiring medical attention or causing loss of time from work, arising out of and in the course of employment on work under the Contract.
- 11.2 The Contractor alone shall be responsible for the safety, efficiency, and adequacy of his plant, appliances and methods, and for any damage which may result from their failure or their improper construction, maintenance, or operation.
- 11.3 The Contractor shall, at his own expense, shore up and protect any buildings, bridges, or other public or private structures which may be encountered or endangered in the prosecution of the work, and that may not be otherwise provided for, and he shall repair and make good any damages to such property by reason of his operations. All existing fences which were removed by the Contractor due to prosecution of the work shall be replaced by the Contractor. No extra payment will be made for said work or materials.
- 11.4 Contractor shall repair or replace at his own expense any existing water pipes, power and communication lines, or other public utilities, roads, drain pipes, sewers, drainage ditches and all plantings (including grass) that are damaged during construction. The site shall be left in its present condition after all cleanup work has been done. Any damage to drainage or water pipes, local sewers, or plantings (including grass, utilities, roads, parking space, or other structures) shall be repaired and replaced immediately in the condition found. Such repairs and replacement shall be at the expense of the Contractor.
- 11.5 Contractor shall preserve all governmental markers (e.g. U.S.G.S., T.V.A., etc.), and none such will be removed or disturbed without prior approval of the Engineer. Any removal and replacement of such markers shall be at the expense of the Contractor.

- 11.6 The Contractor shall employ watchmen on the work as necessary to protect the work from damage, vandalism, etc., and shall, when necessary, erect and maintain such strong and suitable barriers and such lights as will effectually prevent the happening of any accident to health, limb or property. Lights shall be maintained between the hours of one-half hour before sunset and one-half hour after sunrise.
- 11.7 Contractor will be required, at his own expense, to do everything necessary to support, protect and sustain all sewer, water or gas pipe; service pipes; electric lights; power, telephone, or telegraph poles; conduits; and other fixtures laid across or along the site of the work. The Engineer, as well as the company or the corporation owning said poles, pipes or conduits, must be notified by the Contractor before any such fixtures are removed or molested. In case any of the said sewer, gas, or water pipes; service pipes; electric lights; power, telephone or telegraph poles; conduits; or other fixtures are damaged, they shall be repaired by the authorities having control of the same, and the expense of said repairs shall be deducted from the monies due or to become due the Contractor under this Contract.
- 11.8 Should it become necessary to temporarily change the position or remove any poles, electric conduits, water pipes, gas pipes, or other pipes or wires, the Contractor shall notify the Engineer and company or the corporation owning said poles, pipes or conduits of the location and circumstances, and shall cease work if necessary until satisfactory arrangements have been made by the owners of the said poles, pipes, conduits, or wires to properly care for the same. No claims for damages will be allowed on account of any delay occasioned thereby. The entire cost of such temporary changes or removal must be included in the unit or lump sum prices bid for the various items of work under this Contract.
- 11.9 In the event of temporary suspension of work, or during inclement weather, or whenever the Engineer shall direct, the Contractor will, and will cause his subcontractors to protect carefully his and their work and materials against damage or injury from the weather. If, in the opinion of the Engineer, any work or materials shall have been damaged or injured by reason of failure on the part of the Contractor or any of his subcontractors to so protect the work, such materials shall be removed and replaced at the expense of the Contractor.
- 11.10 Before, during, and after installation, the Contractor shall furnish and maintain satisfactory protection to all equipment against injury by weather, flood or breakage, thereby permitting the work to be left in a perfect condition at the completion of the contract. No extra payment will be made for this work but the entire cost of the same shall be included in the price bid for the construction of the work done under this contract.
- 11.11 All chemicals used during project construction or furnished for project operation, whether herbicide, pesticide, disinfectant, polymer, reactant, or of other classification, must show approval of either EPA or USDA. Use of all such chemicals and disposal of residues shall strictly conform with the manufacturer's instructions.
- 11.12 Reasonable care shall be taken during construction to avoid damage to vegetation. Ornamental shrubbery and tree branches shall be temporarily tied back, where appropriate, to minimize damage. Trees which receive damage to branches shall be trimmed of those branches to improve the appearance of the tree. Tree trunks receiving damage from equipment shall be treated with a tree dressing.

12. SUPERVISION BY CONTRACTOR

12.1 It is understood that the Contractor's representative shall be one who can be continued in that capacity for the particular job involved unless he ceases to be on the Contractor's payroll.

13. CHANGES IN THE WORK

13.1 All Change Orders, including a change in technical design or an increase in cost, must be approved by the Owner, the Engineer and those governmental agencies whose approval is required.

13.2 Before executing any Change Order involving adjustment of the contract price, where necessary and desirable, the Contractor shall first obtain the consent of his surety.

13.3 No claim for extra work or cost shall be allowed unless the same was done in pursuance of a written order of the Engineer approved by the Owner. When the work is performed under the terms of the General Conditions, the Contractor shall furnish satisfactory bills, payrolls, and vouchers covering all items of cost and when requested by the Owner, give the Owner access to accounts relating thereto.

13.4 The location of utility lines, pavements, and other appurtenant construction shown on the Drawings may be raised or lowered, may be moved from one location to another, or may be lengthened or shortened by the Owner because of clearances needed, easement changes, design changes, or any other reason. In such case, the Contractor shall be entitled to payment for the work based on the unit prices shown in the Bid Schedule. No additional payment will be allowed because of such changes unless the Contractor notifies the Owner in writing prior to commencing that portion of the work and an appropriate change order is prepared.

13.5 If additional time is requested on account of a change in the work, the documentation of the basis for the requested time shall include a detailed justification and calculation relating the time extension to the project schedule and critical path. Any time extensions claimed for abnormal weather must be supported by historical weather records for the period in question. Generally, for changes that do not directly affect work elements on the critical path of the project, additional time will be granted only in proportion to the cost of the change over the original contract price.

13.6 Failure to submit the written notice or failure to document the basis for the change in contract price or time within the times specified shall bar the Contractor from all future claims for a change in contract price or an extension of time on account of the change.

13.7 Changes in contract price will not be granted in connection with so-called "Acts of God" or nature (i.e., floods, storms, earthquakes, etc.).

14. CHANGES IN CONTRACT PRICE

- 14.1 For any change in contract price, the Contractor shall submit a detailed price breakdown sufficient to permit analysis of all material, labor, equipment, subcontract, and overhead costs, as well as profit, regardless of whether the change is an increase or a decrease in price. Any amounts claimed by subcontractors must be supported by a similar price breakdown.
- 14.2 The change in contract price shall be deemed to cover all costs, overhead, and profit attributable to the change, including any delays or impacts related thereto. There will be no reservation of rights for future or further increases in contract price in connection with a particular change.

15. TIME FOR COMPLETION AND LIQUIDATED DAMAGES

- 15.1 The said amount is fixed and agreed upon by and between the Contractor and the Owner because of the impracticability and extreme difficulty of fixing and ascertaining the actual damages the Owner would in such event sustain, and said amount is agreed to be the amount of damages which the Owner would sustain, and said amount shall be retained from time to time by the Owner from current periodic estimates.
- 15.2 The Owner will suffer financial loss if the project is not "substantially completed" on the date set forth in the Contract Documents. The Contractor and his Surety shall be liable for and shall pay to the Owner the sums stipulated in the Bid or Contract as fixed, agreed, and liquidated damages for each calendar day of delay until the project is "substantially completed."

16. CORRECTION OF WORK

- 16.1 If, in the opinion of the Engineer, it is undesirable to replace any defective or damaged materials or to reconstruct or correct any portion of the work injured or not performed in accordance with the Contract Documents, the compensation to be paid to the Contractor hereunder shall be reduced by such amount as, in the judgment of the Engineer, shall be equitable.

17. SUBSURFACE CONDITIONS

- 17.1 Owner and Engineer make no representations or guarantee, either expressed or implied, about any subsurface conditions that may be encountered within the scope of the project. The Contractor should satisfy himself/herself by on-site inspections, core-drillings or other methods of the subsurface conditions that may be encountered. The risk of encountering and correcting such subsurface conditions shall be borne solely by the Contractor, and the Contract price shall include the cost of performing the work complete-in-place.
- 17.2 The Engineer may have made certain subsurface explorations in the vicinity of the work to be constructed under this Contract. These borings were made only for the Engineer's information in designing the project. Copies of these logs of borings and their locations will be provided to prospective Bidders upon request. These logs of

borings are furnished only as information to Bidders for whatever interpretation and use they desire to make of conditions found when the borings were made. The Owner and Engineer do not warrant that the same conditions exist between borings and the Bidder shall satisfy himself as to the nature of the subsurface conditions throughout the project. If the Bidder wishes to make borings at any location, he shall be afforded the opportunity to do so. Cost of such borings shall be at the Bidder's expense.

18. SUSPENSION OF WORK, TERMINATION, AND DELAY

- 18.1 In the event a portion of the work is delayed or interrupted, the Contractor shall continue to prosecute those portions of the work unaffected by the delay or interruption.
- 18.2 In the event of a delay or interruption in the work, the Contractor shall make reasonable and appropriate adjustments in his job site resources (manpower and equipment) to minimize the overall cost impact of the delay or interruption.
- 18.3 In the event of a delay or interruption in the work due to the failure of the Owner or Engineer to act within the time specified in the Contract Documents, or if no time is specified, within a reasonable time, the Contractor shall so notify the Engineer in writing immediately upon becoming aware of the delay. The Contractor shall submit a detailed justification for any claim for adjustment in contract price or extension in contract time on account of the delay or interruption as soon as the price or time impact can be quantified, but in no case later than 30 days following the end of the delay or interruption. Failure to submit the written notification or the justification within the time specified shall bar the Contractor from all future claims for adjustment in contract price or time on account of the delay.

19. PAYMENTS TO CONTRACTOR

- 19.1 No separate payment will be made for any items specified in the General Conditions or Supplemental General Conditions. Payments for such items shall be included in the unit price and lump sum prices bid by the Contractor for items listed in the Bid Schedule.

20. ACCEPTANCE OF FINAL PAYMENT AS RELEASE

(RESERVED)

21. INSURANCE

- 21.1 Each insurance policy shall be renewed at least 30 days before the expiration date thereof.
- 21.2 Insurance must be carried by a recognized insurance company licensed to do business in the state in which the project is constructed and approved by the Owner's Attorney.

21.3 The Contractor's and his Subcontractor's Public Liability and Property Damage Insurance shall provide protection in the amounts specified in Paragraph 21.3.1 of the General Conditions and as further specified in the Special Conditions (if included) against the following special hazards:

- Blasting damage
- Damage to existing structures
- Damage to private driveways, walks, shrubbery, plantings, etc.
- Damage to public utilities, electric, water, telephone, gas, sewerage, etc.
- Damage to U.S. Government markers.

21.4 The Contractor shall not commence work under this Contract until he has obtained all the insurance required and such insurance has been approved by the Owner, nor shall the Contractor allow any subcontractor to commence work on his subcontract until the insurance required of the subcontractor has been so obtained and approved.

21.5 In the event any insurance coverage should be canceled or allowed to lapse, Contractor will not be permitted to work until adequate and satisfactory insurance is in effect. Failure to keep insurance policies in effect WILL NOT be cause for any claims for extension of time under this Contract.

21.6 Limits of liability for general public liability and property damage insurance shall not be less than:

Bodily Injury	\$1,000,000	each person
	1,000,000	each occurrence
Property Damage	\$ 500,000	each occurrence
	500,000	aggregate

21.7 Limits of liability for comprehensive motor vehicle liability and property damage insurance.

Bodily Injury	\$1,000,000	each person
	1,000,000	each occurrence
Property Damage	\$ 250,000	each occurrence

21.8 The Contractor shall provide builder's risk insurance to protect the Contractor and the Owner against risks of damage to buildings, structures, materials, and equipment not otherwise covered under installation floater insurance, from the perils of fire and lightning, the perils included in the standard extended coverage endorsement, and the perils of vandalism and malicious mischief. The amount of such insurance shall be not less than the insurable value of the work at completion less the value of the materials and equipment insured under installation floater insurance. If the work does not include the construction of building structures, builder's risk insurance may be omitted providing the installation floater insurance fully covers the work.

21.9 The Contractor shall provide installation floater insurance to protect the Contractor and the Owner from all insurable risks of physical loss or damage to materials, products and equipment not otherwise covered under builder's risk insurance while

in warehouses or storage areas, during installation, during testing, and after the work is completed. Equipment such as pumps, motors, engine-generators, compressors, process equipment, switchgear, transformers, panel boards, control equipment, and other similar equipment shall be insured under installation floater insurance when the aggregate value of the equipment exceeds \$10,000.

- 21.10 If the work does not include the construction of building structures or installation of equipment, the builder's risk insurance and installation floater insurance may be omitted.

22. CONTRACT SECURITY

- 22.1 A Payment Bond in the amount of 100 percent of the contract price and a Performance Bond in the amount of 100 percent of the contract price shall be required in the form set forth in the Contract Documents.

23. ASSIGNMENTS

- 23.1 In case the Contractor assigns all or any part of any monies due or to become due under this Contract, the instrument of assignment shall contain a clause substantially to the effect that it is agreed that the right of the assignee in and to any monies due or to become due to the Contractor shall be subject to prior claims of all persons, firms and corporations for services rendered or materials supplied for the performance of the work called for in this contract.

24. INDEMNIFICATION

(RESERVED)

25. SEPARATE CONTRACTS

(RESERVED)

26. SUBCONTRACTING

- 26.1 The Contractor shall not award any work to any Subcontractor without prior written approval of the Owner, which approval will not be given until the Contractor submits to the Owner a written statement concerning the proposed award to the Subcontractor, which statement shall contain such information as the Owner may require.

27. ENGINEER'S AUTHORITY

- 27.1 The Engineer may appoint such resident project representatives as he may desire. Scope of the resident project representative's authority will extend to all parts of the work and to the preparation and manufacture of the materials to be used. A resident project representative is placed on the work to keep the Engineer and

Engineer. In the event of conflicts between funding agency documents, the more restrictive will apply.

- 32.2 In case of unresolved conflict between items of the Contract Documents, the following order of precedence shall govern, with the higher item taking precedence over a lower item:

- Contract (including Supplemental Agreements and Change Orders thereto)
- Addenda
- Bid Proposal
- Supplemental General Conditions
- General Conditions
- Specifications
- Governing Standard Specifications
- Schedules on Drawings
- Notes on Drawings
- Details on Drawings
- Large Scale Drawings
- Small Scale Drawings
- Dimensions Given in Figures
- Scaled Dimensions

- 32.3 In the event of any discrepancy between any drawing and the figure written thereon, the figures, unless obviously incorrect, shall be taken as correct.

33. REQUIRED PROVISIONS DEEMED INSERTED

- 33.1 Each and every provision of law and clause required by law to be inserted in this Contract shall be deemed to be inserted herein, and the Contract shall be read and enforced as though it were included herein, and if through mistake or otherwise any such provision is not inserted, or is not correctly inserted, then upon the application of either party the Contract shall forthwith be physically amended to make such insertion or correction.

34. PROHIBITED INTEREST

- 34.1 No member of or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this Contract or to any benefit that may arise therefrom, but this provision shall not be construed to extend to this Contract if made with a corporation for its general benefit.
- 34.2 No official of the Owner who is authorized in such capacity and on behalf of the Owner to negotiate, make, accept or approve, or to take part in negotiating, making, accepting or approving any architectural, engineering, inspection, construction or material supply contract or any subcontract in connection with the construction of the Project, shall become directly or indirectly interested personally in this Contract or in any part hereof. No officer, employee, architect, attorney, engineer or inspector of or for the Owner who is authorized in such capacity and on behalf of the Owner to exercise any legislative, executive, supervisory or other similar functions in connection with the construction of the Project, shall become directly or indirectly interested personally in this contract or in any part thereof, any material, supply

contract, subcontract, insurance contract, or any other contract pertaining to the Project.

35. USE OF PREMISES AND REMOVAL OF DEBRIS

35.1 The Contractor expressly undertakes at his own expense:

- (a) To take every precaution against injuries to persons or damage to property;
- (b) To store his apparatus, materials, supplies and equipment in such orderly fashion at the site of the work as will not unduly interfere with the progress of his work or the work of any other contractors;
- (c) To place upon the Work or any part thereof only such loads as are consistent with the safety of that portion of the Work;
- (d) To clean up frequently all refuse, rubbish, scrap materials and debris caused by these operations, to the end that at all times the site of the Work shall present a neat, orderly and workmanlike appearance;
- (e) Before final payment to remove all surplus material, false work, temporary structures, including foundations thereof, plant of any description and debris of every nature resulting from his operations, and to put the site in a neat, orderly condition;
- (f) To effect all cutting, fitting or patching of his work required to make the same to conform to the Drawings and Specifications and, except with the consent of the Engineer, not to cut or otherwise alter the work of any other contractor.

36. ESTIMATE OF QUANTITIES

36.1 Wherever the estimated quantities of work to be done and materials to be furnished under this Contract are shown in any of the Contract Documents including the proposal, they are given for use in comparing Bids, and the right is especially reserved except as herein otherwise specifically limited, to increase or diminish them as may be deemed reasonably necessary or desirable by the Owner to complete the Work contemplated by this Contract, and such increase or decrease shall in no way nullify this Contract, nor shall any such increase or decrease give cause for claims or liability for damages.

37. CONTRACTOR'S OBLIGATIONS

37.1 The Contractor shall in good workmanlike manner perform all work and furnish all supplies and materials, machinery, equipment, facilities and means, except as herein otherwise expressly specified, necessary or proper to perform and complete the Work required by this Contract, within the time herein specified, in accordance with the provisions of this Contract and said Specifications and in accordance with the Drawings covered by this Contract and all supplemental drawings, and in accordance with the directions of the Engineer as given from time to time during the progress of the Work. He shall furnish, erect, maintain and remove such construction plant and such temporary works as may be required. The Contractor

shall observe, comply with and be subject to all terms, conditions, requirements, and limitations of the Contract and Specifications and shall do, carry on, and complete the entire work to the satisfaction of the Engineer and the Owner.

37.2 The Contractor shall restore disturbed areas to original or better condition.

37.3 When work performed under this Contract is in areas where easements and working agreements have been obtained by the Owner on private properties, it shall be the responsibility of the Contractor to protect trees, shrubs, gardens, etc., insomuch as is possible and to restore said properties to the satisfaction of the property owners, said protection and restoration shall include but not be limited to the fencing off of trees and shrubs, transplanting of trees and shrubs, etc., replacing topsoil removed with topsoil of equal or better quality, regrassing, and replacing fences. All expenses for said protection and restoration shall be borne by the Contractor, and no separate payment shall be made for this work.

37.4 When work is done on private property in easements and working agreements obtained by the Owner, the Contractor shall furnish affidavits from the property owners attesting to the fact that their property has been satisfactorily restored before that portion of the work will be considered for final payment.

38. PAYMENTS BY CONTRACTOR

38.1 The Contractor shall pay (a) for all transportation and utility services not later than the 20th day of the calendar month following that in which services are rendered, (b) for all materials, tools, and other expendable equipment to the extent of 90 percent of the cost thereof, not later than the 20th day of the calendar month following that in which such materials, tools, and equipment are delivered at the site of the Project, and the balance of the cost thereof not later than the 30th day following the completion of that part of the Work in or on which such materials, tools, and equipment are incorporated or used, and (c) to each of his subcontractors, not later than the 5th day following each payment to the Contractor, the respective amounts allowed the Contractor on account of the work performed by his subcontractors to the extent of each subcontractor's interest therein.

39. INFORMATION TO BE FURNISHED

39.1 Contractor shall fill out all questionnaire forms completely in preparing his Bid and after award shall supply to the Engineer all pertinent information required.

40. WAIVER

40.1 It is expressly understood and agreed that any waiver granted by the Engineer or the Owner of any term, provision or covenant of this Contract shall not constitute a precedent nor breach of the same or any other terms, provisions or covenants of this Contract.

40.2 Neither the acceptance of the Work by the Owner nor the payment of all or any part of the sum due the Contractor hereunder shall constitute a waiver by the Owner of

any claim which the Owner may have against the Contractor or surety under this Contract or otherwise.

41. CONNECTING OF EXISTING WORK

41.1 Contractor shall remove such existing masonry and piping as is necessary in order to make the proper connections to these structures at the locations shown. Also, he shall make the necessary pipeline, roadway, and other connections at the several points in order that on completion of the Contract, all required flows may flow through the several pipelines and structures. No extra payment shall be made for this work, but the entire cost of the same shall be included in the price bid for the various items of the Work to be done under this Contract.

42. PROGRAM AND METHOD OF CONSTRUCTION

42.1 The order or sequence of execution of the Work and the general arrangements of the construction plant to be installed shall at all times be subject to the review of the Engineer. If at any time before the commencement or during the progress of the Work, or any part of it, such features, and appliances used or to be used appear to the Engineer as insufficient, or improper, he may order the Contractor to improve their character, and the Contractor shall conform to such orders, but the failure of the Engineer to demand any increase of safety, efficiency, adequacy, or any improvement shall not release the Contractor from his obligation to secure the safe conduct and quality of the Work specified.

43. BUILDINGS AND SHANTIES

43.1 No shanties, camps, or buildings for the housing of men employed on the Work shall be erected on land owned or leased by the Owner unless a permit, in writing, is secured from the Owner allowing their construction. Should permission be asked and granted, the Contractor must comply with all regulations regarding the construction and maintenance of such buildings.

44. "OR EQUAL" CLAUSE

44.1 Any reference to an item of equipment or material by a specific manufacturer's brand or trade name in these Contract Documents is intended merely as a standard. Products or materials of other manufacturers which, in the opinion of the Engineer, are the equal of that specified considering quality, workmanship, and economy of operation and are suitable for the purpose intended, will be accepted.

44.2 Where the phrase "or equal" occurs in the Contract Documents, the Contractor shall not assume that materials, equipment, or methods will be approved by the Engineer unless the item has been specifically approved for this project by the Engineer.

44.3 The decision of the Engineer shall be final.

44.4 The Contractor shall provide all data required by the Engineer to verify the equality of items which the Contractor may wish to substitute for the specified items.

- 44.5 The Contractor shall verify prior to bidding that all specified items will be available in time for installation during orderly and timely progress of the project.
- 44.6 In the event specified items will not be so available, the Contractor shall notify the Engineer prior to receipt of bids.
- 44.7 Costs of delays because of non-availability of specified items, when such delays could have been avoided by the Contractor, will be back charged as necessary and shall not be borne by the Owner.
- 44.8 In cases where experience clauses are used, an alternate bond or cash deposit may be accepted from manufacturers which do not meet the specified experience period. The bond or cash deposit provided by the manufacturer or supplier will guarantee replacement of the equipment or process in the event of failure or unsatisfactory service. The period of time for which the bond or cash deposit is required shall be the same as the experience period of the time specified.

45. CONSTRUCTION METHODS AND PROTECTION OF PROPERTIES

45.1 Cooperation with Utilities - The Contractor shall be cooperative at all times with all utilities, or their duly authorized agent or contractor, installing or connecting new services and shall coordinate all phases of the work with said utilities to avoid unnecessary delays or complications.

45.2 Damage to Property

- (a) The Contractor is warned to prevent excessive dust or air pollution that may disfigure or soil any public or private facilities. The use of water sprinklers or other approved devices to reduce dust will be necessary if such is the case. Additionally, in cases of heavy rains or storms, every effort shall be made to prevent mud or water which may result due to the construction from accumulating on or damaging any property or any private owner.
- (b) Contractor shall use special care in working in areas where the right-of-way crosses private property. Contractor shall also replace, at his/her own expense, any existing water pipes, power lines, communication lines, or other public utilities, roads, drain pipes, sewers, drainage ditches, and all plantings including grass and/or sod on private property. The site shall be left in its present condition after all cleanup work has been done. Any damage to drainage pipes, water pipes, local sewers, plantings (including grass and/or sod), utilities, roads, parking space, or other structures shall be repaired and replaced immediately in the condition found. Such repairs and replacement shall be at the expense of the Contractor.

45.3 Existing Sanitary, Combined and/or Storm Sewers

- (a) Whenever existing sewers are broken or damaged as a result of traffic or excavation by the Contractor, the maintenance, replacement, and/or repairs to the damaged existing sanitary, combined, and/or storm sewer shall be the Contractor's responsibility, except as otherwise provided for on the Drawings and in the Contract Documents, or as authorized by the Engineer, and the

expense of maintaining, repairing, replacing, or connecting to existing sewers shall be borne by the Contractor.

- (b) No separate payment will be made for handling sewage from existing sewers or interrupted connections, since it shall be the responsibility of the Contractor to maintain services until such time as the proposed or relocated sewers can be constructed. If the Contractor should damage any existing sewer, such that it affects the public interest, health, or general welfare, the Contractor shall replace or repair that sewer at his/her own expense as directed by the Engineer.
- (c) Contractor shall make all connections to existing sewerage facilities as shown on the Drawings.

46. SEWAGE, SURFACE, AND FLOOD FLOWS

- 46.1 The Contractor shall furnish all the necessary equipment, shall take all necessary precautions and shall assume the entire cost of handling any sewage, seepage, storm, surface, and flood flows which may be encountered at any time during the construction of the Work. The manner of providing for these flows shall meet the approval of the Engineer, and the entire cost of said work shall be included in prices bid for the various items of the Work to be done under this Contract.
- 46.2 The Contractor will minimize siltation and bank erosion during construction.
- 46.3 During the period of construction the Contractor shall cooperate with the Owner's employees in maintaining all existing collection, pumping, and treatment facilities in operation. The cost of any temporary conveyances or bypass pumping shall be included in the price bid for other items of work under this Contract, as no separate payment will be made.
- 46.4 The Contractor shall not discharge or allow discharge of pollutants, as defined in the Clean Water Act, including fill and sediment, into waters of the State or United States, including wetlands, unless authorized by an appropriate State or Federal permit. This prohibition specifically applies to silt and sediment in storm water runoff and in water pumped from trenches and excavations.
- 46.5 In the event that pollutants are discharged or otherwise released to the environment as the result of the Contractor's negligence or unlawful conduct, it is understood and agreed that the Contractor shall bear all risks associated with such release(s), shall indemnify the Owner and the Engineer from any liabilities resulting from the release(s), and shall not make any claim for additional compensation for delays or damage resulting from such release(s).

47. OBSTRUCTIONS ENCOUNTERED

- 47.1 In addition to showing the structures to be built under this Contract, the Drawings show certain information obtained by the Owner regarding the pipelines and other structures which exist along the site of the Work, both at and below the surface of the ground. The Owner expressly disclaims any responsibility for the accuracy or completeness of the information given on the Drawings with regard to existing

structures and pipelines, and the Contractor will not be entitled to any extra compensation on account of inaccuracy or incompleteness of such information, said structures and pipelines being shown only for the convenience of the Contractor who must verify the information to his own satisfaction. The giving of this information upon the Drawings will not relieve the Contractor of his obligations to support and protect all pipelines and other structures which may be encountered during the construction of the work and to make good all damages done to such pipelines and structures as provided in these Supplemental General Conditions.

48. USE OF STREETS

- 48.1 During the progress of the Work, the Contractor shall make ample provision for both vehicular and foot traffic on any public road, and shall indemnify and save harmless the Owner from any expense whatsoever due to his operations over said roadways. The Contractor shall also provide free access to all fire hydrants, water and gas valves located along the line of his work. Gutters and waterways must be kept open or other provisions made for the removal of storm water. Street intersections may be blocked only one-half at a time, and the Contractor shall lay and maintain temporary driveways, bridges and crossings such as in the opinion of the Engineer are necessary to reasonably accommodate the public and to provide access to needed private driveways. In the event of the Contractor's failure to comply with these provisions, the Owner may cause the same to be done and will deduct the cost of such work from any monies due or to become due the Contractor under this Contract, but the performance of such work by the Owner or at its insistence shall serve in no way to release the Contractor from his general or particular liability for the safety of the public or the Work.
- 48.2 Required line crossings of all streets and roads shall be done in accordance with the applicable state Department of Transportation procedures.
- 48.3 Contractor will be permitted to close a street when necessary for the proper prosecution of the work. The Contractor shall keep the Police and Fire Department continuously informed as to his intentions to close streets and give the Police Department sufficient notice in order that "No Parking" signs may be placed at the proper time to clear the street for construction.
- 48.4 The Contractor shall maintain property barricades and flagmen to detour traffic.
- 48.5 At all times the Contractor is responsible for damage to city and county streets as a result of their use in this project. The streets must be kept clear of all dirt, stone, or other debris. All debris, dirt, etc., whether caused by rains, storms, spillage from trucks or otherwise, shall be kept out of sewers. The Contractor is responsible for and may not plead ignorance of city and county ordinances and amendments thereto that may affect this use of streets or sewers.

49. CONSULTING AND RESIDENT OBSERVATION SERVICES DURING CONSTRUCTION

- 49.1 In providing the Owner with consulting services and resident project representation during construction, the Engineers and their employees do not assume any duty to supervise construction means or methods and safety procedures followed by any

contractor, subcontractor and/or their respective employees or to any other person; nor for any public liability or for property damage caused through acts of the Contractor, subcontractor and/or their respective employees or any other person.

50. SAFETY AND HEALTH REGULATIONS

50.1 The Contractor shall comply with the Department of Labor Safety and Health Regulations for construction promulgated under the Occupational Safety and Health Act of 1970 (PL 91-596) and under Section 107 of the Contract Work Hours and Safety Standards Act (PL 91-54).

50.2 Contractor shall allow free access to any Department of Labor Representative for inspection purposes.

51. ACCESS BY REPRESENTATIVES OF GOVERNMENTAL AGENCIES

51.1 The authorized representatives and agents of all governmental agencies involved in this project shall have access to the work at all times and shall be permitted to inspect all work, materials, payrolls, records of personnel, invoices of materials, and other relevant data and records. Contractor shall provide proper facilities for the access and inspection of the work by such persons.

52. LOCAL AND STATE LAWS

52.1 The Contractor shall abide by all local and State laws or ordinances to the extent that such requirements do not conflict with Federal laws or regulations.

53. NEW JOB OPPORTUNITIES (WHERE REQUIRED BY FUNDING AGENCY ONLY)

53.1 The Contractor shall:

(a) To the maximum extent practicable, follow hiring and employment practices which will assure that performance of the Work results in new job opportunities for the unemployed and the underemployed; and

(b) Insert or cause to be inserted the same or similar provisions in each construction subcontract.

54. CONSTRUCTION RESTRICTIONS

54.1 Heavy construction machinery shall not be used within 500 feet of residential areas between the hours of 10:00 p.m. and 7:30 a.m.

54.2 No blasting or drilling shall be performed within 500 feet of residential areas between the hours of 10:00 p.m. and 7:30 a.m.

55. LEAD BASE PAINT AND JOINT SEALERS

55.1 No lead-based paints, protective coatings or joint sealers may be used on this project.

56. SUSPENSION AND RESUMPTION OF CONTRACT

56.1 Pursuant to the conditions as set out in the Specifications for hot asphaltic concrete binder and surface courses with particular reference to the limitations or temperature and weather conditions, the Owner may at its option and upon written notice, suspend the Contract over the winter and bad weather months. The Contract may then be resumed when weather conditions will permit the application of the above pavement, at the discretion of the Engineer. The notice to resume said contract shall be in writing. The suspended period will in no way be counted against the Contractor's allotted time to do the entire work.

56.2 This provision does not relieve the Contractor of the responsibility to maintain existing work already completed or any other responsibilities of the Contract; nor shall the Contractor, upon the basis of this fair notice herein; be eligible to make claim for or receive any damages for loss of overhead, plant expense, or anticipated profits, nor any other expenses incurred due to delay.

57. ABANDONMENT OR TERMINATION OF CONTRACT

57.1 For contracts over \$10,000, the Owner reserves the right to abandon the Contract if it will be in the Owner's best interest. The Contractor will be paid a fair payment, as negotiated with the Owner, for the work completed to date.

58. EVIDENCE OF PAYMENT

58.1 Contractor may be asked to present acceptable evidence from time to time that all bills have been paid for labor, materials, and equipment for which payment on account has been made in monthly estimates. Before final payment is made, Contractor shall, if required by the Owner, present sworn affidavit that all labor, materials, equipment, and service engaged for the work have been paid in full and that there are no outstanding debts or liens on any portions of the work.

59. ACCESSIBILITY OF RECORDS (PROJECTS WITH FEDERAL FUNDS ONLY)

59.1 The Owner, representatives of applicable federal agencies, the Comptroller General of the United States, or any of their duly authorized representatives, for a period of three years beyond completion of the Contract, shall have access to any books, documents, papers, and records of the Contractor which are directly pertinent to this Project for the purpose of making audit, examination, excerpts, and transcriptions of contracts in excess of \$10,000.

60. WORK WEEK, OVERTIME PAY, SHOW-UP PAY, AND ON-CALL PAY

- 60.1 All work performed under this Contract shall be performed on a 40-hour work week basis and shall include not only the prime Contractor but any and all subcontractors. The 40-hour work week shall be established by the Contractor at the Preconstruction Conference. Any deviation from the established work week will be approved in advance in writing by the Owner. Any additional cost incurred by the Owner due to deviations from the established work week will be borne by the Contractor. The Contractor shall provide written acknowledgment that he will pay any overtime cost incurred by the Owner at the time of requesting an increase in the 40-hour work week.
- 60.2 The Contractor will be assessed for each hour of overtime incurred by the Engineer's field representative(s) as a result of extended work hours (i.e., a total of more than 40 hours per calendar week) by the Contractor or his subcontractors.
- 60.3 If the Contractor advises the Engineer's field representative(s) that he will work on a particular day and subsequently decides not to work and does not so advise the representative(s) before he departs for the job site, the Contractor will be assessed an amount equal to 2 hours of the representative's time for "show-up" pay plus round-trip travel time and mileage. Show-up pay will not be assessed in the event of inability to work due to unanticipated inclement weather.
- 60.4 If the Contractor requests that the Engineer's field representative(s) be available to work on a weekend or a holiday but does not actually commit to work, the Contractor will be assessed an amount equal to 2 hours of the representative's time for "on-call" pay for each day that the Contractor so requests.
- 60.5 The above assessments for field representative's overtime pay, show-up pay, and on-call pay will be deducted as a separate line item on the Contractor's next progress payment request. Unless otherwise stated, the Engineer's field representative's time will be assessed at \$60.00 per hour for regular time and \$90.00 per hour for overtime.

END OF SECTION

SUPPLEMENTAL GENERAL CONDITIONS FOR GEORGIA

1. Local and State Laws

The provisions of Chapter 9 of Title 25 of the Official Code of Georgia Annotated (O.C.G.A.) known as the Georgia Utility Facility Protection Act (and all amendments thereto), enacted by the General Assembly of the State of Georgia, is in its entirety to be considered a part of these documents.

2. Water Quality

The Georgia Department of Natural Resources Environmental Protection Division NPDES Permit No. GAR 100000 for Storm Water Discharges from Construction Activities requirements, in their entirety, shall be considered a part of these documents.

3. Land Disturbance Activity Permit

The provisions of Chapter 7 of Title 12 of the O.C.G.A., Section 12-7, known as the Georgia Erosion and Sediment Act of 1975 (and all amendments thereto), enacted by the General Assembly of the State of Georgia, is in its entirety to be considered a part of these documents.

4. Contractor Licensing

The provisions of the O.C.G.A. Section 43-14 (and all amendments thereto), enacted by the General Assembly of the State of Georgia, is in its entirety to be considered a part of these Specifications.

5. Escrow Account of Contractor Retainage

If applicable, the Owner will set up separate escrow account for deposit of retainage due Contractor in accordance with the provisions of the O.C.G.A., Sections 13-10-80, 13-10-81, 13-10-82, and 13-10-83 (and all amendments thereto), are in their entirety to be considered a part of these Specifications.

6. Conflicts Between Documents

In the event of conflicts between funding agency documents, the more restrictive shall apply.

DIVISION 01

GENERAL REQUIREMENTS

SECTION 01 11 00

SUMMARY OF WORK

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The work described in these Contract Documents consists of furnishing, delivering, and installing all materials, equipment, and products for the construction of Municipal Maintenance Facility Improvements as shown on the Drawings.
- B. Furnish all materials, power, equipment, tools, labor, transportation, and other items necessary or convenient to the Contractor for the installation of the equipment, materials, and products specified or described in these Contract Documents and for the completion of all work to be performed by the Contractor as specified herein.

1.2 PROJECT COORDINATION

- A. The Contractor shall be responsible for project coordination, which includes but is not limited to the following:
 - 1. Work of employees and subcontractors under contract to him. Conduct work to ensure compliance with schedules.
 - 2. Submission of all invoices, progress schedules, progress reports, progress estimates, and other data needed in support of requests for payment.
 - 3. Product and equipment deliveries adequate to maintain the schedule of construction. Report noncompliance to Owner with a recommendation for remedy.
 - 4. Obtaining and use of all temporary structures, offices, storage sheds, and utilities.
 - 5. Obtaining any required building permits, special permits, and approvals from all authorities having jurisdiction.
 - 6. Testing laboratory activities associated with Contractor's scope of work.
 - 7. Check-out of systems and equipment and start-up operations.
 - 8. Work and operations between the Contractor and all trades in such a manner that no union labor dispute of jurisdiction arises regarding unloading, handling, installations, and connections to utilities and otherwise of the various items in the various trades.

1.3 SUBSTANTIAL COMPLETION

- A. The work will not be considered to be fully functional and usable by the Owner for its intended purposes and will not be considered substantially complete until the following items are submitted.

1. Copies of final Operation and Maintenance Manuals in conformance with Section 01 78 23, Operating and Maintenance Data.
 2. Copies of Equipment Start-up Report and Certification Report forms signed by authorized factory representatives on items of process, mechanical, and control equipment in conformance with Section 01 32 00, Schedules and Reports.
 3. Delivery of specified spare parts and copies of signed Spare Parts Inventory Report forms in accordance with Section 01 32 00, Schedules and Reports.
 4. Training of Owner's operators and maintenance personnel as specified in the appropriate specification sections.
 5. Delivery of specified keys for all permanent locks.
 6. Copies of specified inspection and test reports and certifications on materials.
 7. Copies of written warranties on equipment and products in accordance with Section 01 78 36, Warranties and Bonds.
- B. In addition to the above submissions, the work will not be considered to be fully functional and useful by the Owner for its intended purposes and will not be accepted as substantially complete until all of the following components and/or items have been completed:
1. Foundations and structures, including roofing, fenestration, gutters, stairways, railings, ladders, and gratings.
 2. Process and mechanical equipment and tankage.
 3. Process and mechanical piping, valving, and manholes, including pressure and leak testing.
 4. Alarm, communication, and control systems, telemetry, and instrumentation.
 5. Electrical panels and equipment.
 6. Electrical and control wiring and conduits.
 7. Check-out and start-up of equipment and controls, including telemetry, communication, and alarm systems, if provided.
 8. Lighting.
 9. Plumbing.
 10. Heating, ventilation, and air conditioning systems.
 11. Ceilings, floorings, and finishes, except for minor blemishes or spots damaged during construction.
 12. Thermal and moisture protection.

13. Windows, doors, and hardware.
14. Fencing.
15. Roadways, parking areas, and stone surfaces.
16. Drainage.
17. Slope protection and riprap.
18. Signage and identification.
19. The following items, unless waived in writing by the Owner due to inclement weather:
 - a. Finish grading.
 - b. Seeding and mulching.
 - c. Pavements and surface treatment.
 - d. Sidewalks.
 - e. Landscaping.

1.4 FINAL COMPLETION

- A. The work under these Contract Documents will not be considered for final acceptance as complete until all of the following items have been completed or submitted:
 1. Any items not completed at the time of substantial completion, including all remaining punch list items.
 2. Final cleanup.
 3. Restoration of all disturbed or damaged properties.
 4. Executed project close-out documents included with the Contract Documents.
 5. Record drawings.
 6. As-built surveys, if required by the Specifications.

1.5 ACCEPTANCE AND START-UP OF OPERABLE COMPONENTS

- A. Because of the need to maintain operation during construction, it may be necessary to accept as substantially complete and start-up operable components of the project at various times prior to the completion and acceptance of the entire project.
- B. An "operable component" of the project, as used herein, shall mean a complete process subsystem capable of independent operation and shall include all associated structures, equipment, piping, controls, etc.
- C. Acceptance and start-up of operable components shall not relieve the Contractor of his obligation to substantially complete the project within the Contract Time.

END OF SECTION

SECTION 01 22 00

MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplemental Conditions and other Division 1 specification sections, apply to this section.

1.2 LUMP SUM PRICES

- A. Lump sum prices shall include all items of work shown on the Drawings, specified, or otherwise required or necessary for complete, working systems including work, services, fees, equipment or material not specifically listed, overhead, profit, and applicable taxes.

1.3 SCHEDULE OF VALUES

- A. A "Schedule of Values" is required to facilitate payment for partial completion of lump sum items as the project progresses.

PART 2 - PARTIAL PAYMENT

- A. Partial payment may be made for stored material on site, providing:

1. The material meets the specifications outlined elsewhere in these documents.
2. The material is stored according to the recommendations of the Engineer and/or manufacturer.
3. The Contractor submits copies of all shipping invoices for the stored materials delivered to the site.

PART 3 - MEASUREMENT AND PAYMENT

3.1 MEASUREMENT AND PAYMENT

- A. Measurement and payment for all items of work shown on the Drawings, specified, or otherwise required or necessary for complete, working systems shall be made at the lump sum prices listed in the Bid Schedule. No separate payment shall be made for items of work, services, fees, or equipment not specifically listed, but payment for those items shall be included in the payment for items listed.

END OF SECTION

SECTION 01 29 76

APPLICATIONS FOR PAYMENT

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

- A. Submit Applications for Payment to the Engineer.

1.2 RELATED DOCUMENTS

- A. Contract between Owner and Contractor.
- B. General Conditions: Progress Payments, Retainages and Final Payment.
- C. Section 01 78 00, Project Closeout.

1.3 FORMAT AND INFORMATION REQUIRED

- A. Review preliminary application with resident project representative.
- B. Submit applications typed on forms acceptable to the Owner.
- C. Provide itemized data on application:
 - 1. Format, schedules, line items, unit prices, units completed by month and project-to-date, and values.
 - 2. Project photographs illustrating progress of work during the period.
 - 3. Documentation of employee wages, as requested.

1.4 PREPARATION OF APPLICATION FOR EACH PROGRESS PAYMENT

A. Application Form

- 1. Fill in required information, including that for Change Orders executed prior to date of submittal of application.
- 2. Fill in summary of dollar values to agree with respective totals indicated.
- 3. Execute certification with signature of a responsible officer.

B. Continuation Sheets

- 1. Fill in total list of all scheduled component items of work, with item number and scheduled dollar value for each item.

2. Fill in dollar value in each column for each scheduled line item when work has been performed or products stored. Round off values to nearest dollar, or as specified for the Bid Schedule.
3. List each Change Order executed prior to date of submission. List by Change Order number and description, as for an original component item of work.
4. To receive approval for payment on component material stored on site, submit copies of the original paid invoices with the application for payment along with the material location report (see Section 01 32 00, Schedules and Reports).

1.5 SUBSTANTIATING DATA FOR PROGRESS PAYMENTS

- A. Substantiating Data. When the Owner or the Engineer requires substantiating data, submit suitable information, with a cover letter identifying:

1. Project.
2. Application number and date.
3. Detailed list of enclosures.
4. For stored products:
 - a. Item number and identification as shown on application.
 - b. Description of specific material.

- B. Submit one copy of data and cover letter for each copy of application.

1.6 PREPARATION OF APPLICATION FOR FINAL PAYMENT

- A. Fill in application form as specified for progress payments.

1.7 SUBMITTAL PROCEDURE

- A. Submit Applications for Payment to the Engineer at the times stipulated in the Contract.
- B. Number: Six copies of each application.

1.8 PROCESSING OF PERIODIC APPLICATIONS FOR PAYMENT

- A. No applications for payment for work under this Contract will be processed until the Contractor's Preliminary Construction Schedule, Submittal Tabulation, and Schedule of Values are submitted in accordance with the requirements of Section 01 32 00, Schedules and Reports.
- B. No further applications for payment will be processed after the due date of the Contractor's Construction Schedule and Submittal Schedule until both schedules are submitted in conformance with the requirements of Section 01 32 00, Schedules and Reports.

- C. No applications will be processed for stored materials unless the application is accompanied with copies of original paid invoices and the Material Location Report specified in Section 01 32 00, Schedules and Reports.
- D. No further applications for payment will be processed after the expiration of the Contract Time, including approved extensions thereof, until the date of Substantial Completion as described in these Contract Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 31 19

PROJECT MEETINGS

PART 1 - GENERAL

1.1 SCOPE

- A. This section specifies administrative and procedural requirements for project meetings including but not limited to:
 - 1. Pre-Construction Conference.
 - 2. Pre-Installation Conferences.
 - 3. Coordination Meetings.
 - 4. Progress Meetings.
- B. Construction schedules are specified in another Division 1 section.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplemental Conditions and other Division 1 specification sections, apply to this section.

1.3 PRE-CONSTRUCTION CONFERENCE

- A. Attend and participate in a pre-construction conference and organizational meeting at the project site or other convenient location no later than 15 days after execution of the Agreement and prior to commencement of construction activities. Conduct the meeting to review responsibilities and personnel assignments.
- B. Attendees. The Owner, Engineer and their consultants, the contractor and its superintendent, major subcontractors, manufacturers, suppliers and other concerned parties shall each be represented at the conference by persons familiar with and authorized to conclude matters relating to the work.
- C. Agenda. Discuss items of significance that could affect progress including such topics as:
 - 1. Tentative construction schedule.
 - 2. Critical work sequencing.
 - 3. Designation of responsible personnel.
 - 4. Procedures for processing field decisions and Change Orders.
 - 5. Procedures for processing Applications for Payment.
 - 6. Distribution of Contract Documents.
 - 7. Submittal of shop drawings, product data and samples.
 - 8. Preparation of record documents.
 - 9. Use of the premises.
 - 10. Office, work and storage areas.
 - 11. Equipment deliveries and priorities.
 - 12. Safety procedures.
 - 13. First aid.

14. Security.
15. Housekeeping.
16. Working hours.

1.4 PRE-INSTALLATION CONFERENCES

- A. Conduct a pre-installation conference at the site before each construction activity that requires coordination with other construction. The installer and representatives of manufacturers and fabricators involved in or affected by the installation, and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise the Engineer of scheduled meeting dates.
 1. Review the progress of other construction activities and preparations for the particular activity under consideration at each pre-installation conference, including requirements for:
 - a. Contract documents.
 - b. Options.
 - c. Related change orders.
 - d. Purchases.
 - e. Deliveries.
 - f. Shop drawings, product data and quality control samples.
 - g. Possible conflicts.
 - h. Compatibility problems.
 - i. Time schedules.
 - j. Weather limitations.
 - k. Manufacturer's recommendations.
 - l. Compatibility of materials.
 - m. Acceptability of substrates.
 - n. Temporary facilities.
 - o. Space and access limitations.
 - p. Governing regulations.
 - q. Safety.
 - r. Inspection and testing requirements.
 - s. Required performance results.
 - t. Recording requirements.
 - u. Protection.
 2. Record significant discussions and agreements and disagreements of each conference, along with the approved schedule. Distribute the record of the meeting to everyone concerned, promptly, including the Owner and Engineer.
 3. Do not proceed if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of work and reconvene the conference at the earliest feasible date.

1.5 COORDINATION MEETINGS

- A. Conduct project coordination meetings at regularly scheduled times convenient for all parties involved. Project coordination meetings are in addition to specific meetings held for other purposes, such as regular progress meetings and special pre-installation meetings.

- B. Request representation at each meeting by every party currently involved in coordination or planning for the construction activities involved.
- C. Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.6 PROGRESS MEETINGS

- A. Conduct progress meetings at the project site at regularly scheduled intervals but not less than monthly. Notify the Owner and Engineer of scheduled meeting dates. Coordinate dates of meetings with preparation of the payment request.
- B. Attendees. In addition to representatives of the Owner and Engineer, each subcontractor, supplier or other entity concerned with current progress or involved in planning, coordination or performance of future activities shall be represented at these meetings by persons familiar with the Project and authorized to conclude matters relating to progress.
- C. Agenda. Review and correct or approve minutes of the previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to the current status of the project.
 - 1. Contractor's Construction Schedule: Review progress since the last meeting. Determine where each activity is in relation to the Contractor's Construction Schedule, whether on time or ahead or behind schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the contract time.
 - 2. Contractor's Submittal Schedule: Review progress since the last meeting. Determine where each activity is in relation to the Contractor's Submittal Schedule, whether on time or ahead or behind schedule. Determine how submittals behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the contract time.
 - 3. Review the present and future needs of each entity present, including such items as:
 - a. Interface requirements.
 - b. Time.
 - c. Sequences.
 - d. Deliveries.
 - e. Off-site fabrication problems.
 - f. Access.
 - g. Site utilization.
 - h. Temporary facilities and services.
 - i. Hours of work.
 - j. Hazards and risks.
 - k. Housekeeping.
 - l. Quality and work standards.
 - m. Change Orders.
 - n. Documentation of information for payment requests.

D. Reporting. No later than 3 days after each progress meeting date, distribute copies of minutes of the meeting to each party present and to other parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report.

1. Schedule Updating: Revise the construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue the revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 01 32 00

SCHEDULES AND REPORTS

PART 1 - GENERAL

1.1 SUMMARY

- A. General. This section specifies administrative and procedural requirements for schedules and reports required for proper performance of the work.
- B. Coordination. Each prime Contractor shall closely coordinate scheduling and reporting with the scheduling and reporting of other prime Contractors.
- C. Schedules required include:
 - 1. Preliminary Construction Schedule, including Submittals Tabulation.
 - 2. Contractor's Construction Schedule.
 - 3. Submittal Schedule.
 - 4. Schedule of Values.
- D. Reports required include:
 - 1. Daily Construction Reports.
 - 2. Material Location Reports.
 - 3. Field Correction Reports.
 - 4. Spare Parts Inventory Reports.
 - 5. Equipment Start-up Report and Certifications.
- E. Project meeting minutes are included in Section 01 31 19, Project Meetings.
- F. Inspection and test reports are included in Section 01 40 00, Quality Control Services.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplemental Conditions and other Division 1 specification sections, apply to this section.

1.3 PRELIMINARY CONSTRUCTION SCHEDULE

- A. Bar Chart Schedule. Submit a preliminary horizontal bar chart type construction schedule within seven days of the date established for commencement of the work.
- B. Bar Chart Schedule. The Contractor for General Construction shall submit a preliminary horizontal bar chart type construction schedule, with a copy to each prime Contractor, within seven days of the date established for commencement of the work. Within five working days of this submittal, each other prime Contractor shall submit a matching preliminary horizontal bar chart schedule showing their construction operations sequenced and coordinated with general construction.

1. Provide a separate time bar for each significant construction activity. Coordinate each element on the schedule with other construction activities. Schedule each construction activity in proper sequence. Provide a continuous vertical line to identify the first working day of each week.
 2. Indicate completion of the work in advance of the date established for substantial completion.
 3. If adjustments are necessary for sequencing and coordination of the work, the Contractor for general construction shall arrange a meeting with the other prime Contractors at the earliest possible date. At this meeting each prime Contractor shall negotiate reasonable adjustments to their schedules.
- C. Submittal Tabulation. With the submittal of the preliminary construction schedule, include a tabulation by date of submittals required during the first 90 days of construction. List those submittals required to maintain orderly progress of the work, and those required early because of long lead time for manufacture or fabrication.
1. At the Contractor's option, submittal dates may be shown on the schedule, in lieu of being tabulated separately.

1.4 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Bar Chart Schedule. Prepare a comprehensive, fully developed, horizontal bar chart type Contractor's construction schedule based on the preliminary construction schedule and on whatever updating and feedback was received since the start of the project.
- B. Bar Chart Schedule. The Contractor for general construction shall secure time commitments for performing critical construction activities from each of the other prime Contractors and shall prepare a combined construction schedule for the entire project. The Schedule shall be a comprehensive, multi-sheet, integrated, fully developed horizontal bar chart type schedule based on the preliminary construction schedules and reflecting updating and feedback received since the start of the project.
1. Submit the schedule within 30 calendar days of the date established for commencement of the work, unless a longer time has been requested and approved.
 2. Provide a separate time bar for each significant construction activity. Provide a continuous vertical line to identify the first working day of each week.
 - a. If practical, use the same breakdown of units of the work as indicated in the "Schedule of Values."
 3. For significant construction activities that require 3 months or longer to complete, indicate an estimated completion percentage in 10 percent increments within the time bar. As work progresses, place a contrasting mark in each bar to indicate actual completion percentage.

4. Prepare the schedule on a sheet, or series of sheets, of stable transparency, or other reproducible media, of sufficient width to show data clearly for the entire construction period.
 - a. Show the activities of each prime contract on a separate sheet.
 - b. Prepare a simplified summary sheet indicating the combined construction activities of the prime contracts.
 5. Secure time commitments for performing critical elements of the work from parties involved. Coordinate each element on the schedule with other portions of the work; include minor elements involved in the overall sequence of the work. Show each construction activity in proper sequence. Indicate graphically sequences necessary for completion of related portions of the work. Show critical path activities or elements.
 6. Coordinate the Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests and other required schedules and reports.
 7. Indicate completion of the work in advance of the date established for substantial completion. Indicate substantial completion on the schedule to allow ample time for the Engineer's administrative procedures necessary for certification of substantial completion.
- C. Work Stages. Use crosshatched bars to indicate important stages of construction for each major portion of the work.
- D. Such stages include, but are not necessarily limited to:
1. Subcontract awards.
 2. Purchases.
 3. Mockups.
 4. Fabrication.
 5. Sample testing.
 6. Deliveries.
 7. Installation.
 8. Testing.
 9. Adjusting.
 10. Curing.
 11. Start-up and placement into final use and operation.
- E. Distribution. Following the Engineer's response to initial submittal of the Contractor's construction schedule, print and distribute copies to the Engineer, Owner, separate contractors, subcontractors, suppliers, fabricators, and other parties required to comply with scheduled dates.
1. Post copies of the schedule in the project meeting room and temporary field office.
 2. When revisions are made, distribute the updated schedule to the same parties and post in the same locations. Delete parties from distribution when they have

completed their assigned portion of the work and are no longer involved in performance of construction activities.

- F. Schedule Updating. Revise the schedule immediately after each meeting or other activity, where revisions have been recognized or made. Issue the updated schedule concurrently with report of each meeting.

1.5 SUBMITTAL SCHEDULE

- A. Prepare a complete submittal schedule concurrent with the development of the Contractor's construction schedule. Submit the schedule within 30 calendar days of the date established for commencement of the work, unless a longer period has been requested and approved.
 - 1. Coordinate submittal schedule with the list of subcontracts, Schedule of Values, and the list of products specified in Section 01 60 00, Materials and Equipment, as well as the Contractor's construction schedule.
 - 2. Prepare the schedule in chronological order; include submittals listed on the tabulation of submittals required during the first 90 days of construction. Provide the following information on the schedule:
 - a. Schedule date for the first submittal.
 - b. Related section number.
 - c. Submittal category.
 - d. Name of subcontractor.
 - e. Description of the part of the work covered.
 - f. Scheduled date of the Engineer's final release or approval.
 - 3. Scheduled submittal dates shall be staggered.
 - 4. Items of a critical nature shall be prioritized and so noted.
 - 5. Scheduled final release or approval dates shall be coordinated with construction schedule.
- B. Distribution. Following the Engineer's response to initial submittal, print and distribute the schedule to the Engineer, Owner, separate Contractors, subcontractors, suppliers, fabricators, and other parties required to comply with submittal dates indicated.
 - 1. Post copies in the project meeting room and temporary field office.
 - 2. When revisions are made, distribute the updated schedule to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned part of the work and are no longer involved in the performance of construction activities.
- C. Schedule Updating. Revise the schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue the updated schedule concurrently with report of each meeting.

1.6 SCHEDULE OF VALUES

- A. Prepare and submit a schedule of values established in the Agreement within 15 days of the date established for commencement of the work.
 - 1. A listing of categories of work for unit prices must be submitted to the Engineer for approval prior to submitting a Schedule of Values.
 - 2. Refer to individual specification sections for portions of the work where the establishment of unit prices is required. Methods of measurement and pricing are specified in these sections.
- B. Prepare the schedule in tabular form, including the following items:
 - 1. Name of the part of the work.
 - 2. Related specification section.
 - 3. Name of subcontractor assigned.
 - 4. Unit of measurement.
 - 5. Price per unit.
- C. Distribution. Distribute to the Owner, Engineer, and each party involved in performance of the portion of the work, where established unit prices could come into force and effect.
- D. Following review by the Owner and Engineer, revise the schedule of values to correct any elements which the Owner and Engineer find unacceptable. After revision, the schedule of values shall be submitted for further review.

1.7 REPORTS

- A. Daily Construction Reports. Prepare a daily construction report, recording the following information concerning events at the site; and submit duplicate copies to the Engineer at weekly intervals:
 - 1. List of subcontractors at the site.
 - 2. List of separate contractors at the site.
 - 3. Approximate count of personnel at the site.
 - 4. High and low temperature, general weather conditions.
 - 5. Accidents (refer to accident reports).
 - 6. Meetings and significant decisions.
 - 7. Unusual events (refer to special reports).
 - 8. Stoppages, delays, shortages, losses.
 - 9. Meter readings and similar recordings.
 - 10. Emergency procedures.
 - 11. Orders and requests of governing authorities.
 - 12. Change Orders received, implemented.
 - 13. Substantial completions authorized.
- B. Material Location Reports. At monthly intervals prepare a comprehensive list of materials delivered to and stored at the site. The list shall be cumulative, showing materials previously reported plus items recently delivered. Include with the list a statement of progress on and delivery dates for all materials or items of equipment

being fabricated or stored away from the building site. Submit copies of the list to the Engineer at monthly intervals.

- C. Field Correction Report. When the need to take corrective action that requires a departure from the Contract Documents arises, prepare a detailed report including a statement describing the problem and recommended changes. Indicate reasons the Contract Documents cannot be followed. Submit a copy to the Engineer immediately.

1.8 LOGS

- A. RFI Log. Maintain a tabular log of all Requests for Information (RFI). Number RFIs in a sequential manner. Note date of request and date of response for each. Update the RFI log monthly and distribute at the monthly progress meeting.
- B. Shop Drawing and Product Data Submittal Log. Maintain a tabular log of all shop drawing and product data submittals. Number submittals in a sequential manner. Note dates of initial submittal, first return, resubmittal, second or final return along with Engineer's action noted for each submittal. Update the shop drawing submittal log monthly and distribute at the monthly progress meeting.
- C. Change Order Request/Proposal Log. Maintain a tabular log of all change order requests/proposals. Number change order requests/proposals in a sequential manner. Note date of submittal, brief description of covered work, proposed price, requested number of days (if applicable), and status (denied/approved/pending). For those that are approved, indicate in which change order they are included. Update the log monthly and distribute at the monthly progress meeting.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 PAYMENT

- A. No requests for payment for work under this Contract will be processed until the Contractor's Preliminary Construction Schedule, Submittals Tabulation, and Schedule of Values are submitted and found acceptable by the Owner and Engineer in conformance with the requirements of this section.
- B. No further requests for payment will be processed after the due date of the Contractor's Construction Schedule and Submittal Schedule until both schedules are submitted in conformance with the requirements of this section.
- C. If payment is being requested for stored materials, the material location report must be included with the request for payment.

END OF SECTION

SECTION 01 33 23

SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

PART 1 - GENERAL

1.1 SUMMARY

- A. This section specifies administrative and procedural requirements for submittal of shop drawings, product data, and samples to verify that products, materials, and systems proposed for use comply with provisions of the Contract Documents.
- B. Shop drawings are required for all materials, products, and equipment furnished on this project, unless otherwise specified.
- C. Standard information prepared without specific reference to the project is not considered to be shop drawings.
- D. Coordination drawings are a special type of shop drawing that show the relationship and integration of different construction elements that require close and careful coordination during fabrication or during installation to fit in the restricted space provided or to function as intended.
- E. Product data include, but are not limited to, the following:
 - 1. Manufacturer's product specifications.
 - 2. Manufacturer's installation instructions.
 - 3. Standard color charts.
 - 4. Catalog cuts.
 - 5. Roughing-in diagrams and templates.
 - 6. Standard wiring diagrams.
 - 7. Printed performance curves.
 - 8. Operational range diagrams.
 - 9. Mill reports.
 - 10. Standard product operating and maintenance manuals.
- F. Samples include, but are not limited to, the following:
 - 1. Partial sections of manufactured or fabricated components.
 - 2. Small cuts or containers of materials.
 - 3. Complete units of repetitively used materials.
 - 4. Swatches showing color, texture, and pattern.
 - 5. Color range sets.
 - 6. Components used for independent inspection and testing.
- G. Administrative Submittals. Refer to other Division 1 sections and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to:
 - 1. Permits.
 - 2. Applications for payment.

3. Performance and payment bonds.
4. Insurance certificates.
5. Listing of subcontractors.

H. Inspection and Test Reports. Submittal of inspection and test reports is included under Section 01 40 00, Quality Control Services.

1.2 CONTRACTOR'S RESPONSIBILITY

A. It is the duty of the Contractor to check all drawings, data, and samples prepared by or for him before submitting them to the Engineer for review. Each and every copy of the Drawings and data shall bear Contractor's stamp showing that they have been so checked. Shop drawings submitted to the Engineer without the Contractor's stamp will be returned to the Contractor for conformance with this requirement. Shop drawings shall indicate any deviations in the submittal from requirements of the Contract Documents.

B. The Contractor shall determine and verify:

1. Field measurements.
2. Field construction criteria.
3. Catalog numbers and similar data.
4. Conformance with Specifications.

C. Do not begin any of the work covered by a drawing, data, or a sample returned for correction until a revision or correction thereof has been reviewed and accepted by the Engineer.

D. Submit to the Engineer all drawings and schedules sufficiently in advance of construction requirements to provide no less than 21 calendar days for checking and appropriate action from the time the Engineer receives them.

E. Stagger shop drawing submittals and indicate priority for critical delivery items on the shop drawing submittal schedule.

F. Submit four copies for the Engineer plus the number of copies the Contractor requires of descriptive or product data submittals to complement shop drawings (up to a maximum of eight copies). The Engineer will retain four sets. All blueprint shop drawings shall be submitted with one set of reproducibles and only four sets of prints. The Engineer will review the blueprints and return to the Contractor the set of marked-up prints with appropriate review comments.

G. Contractor shall be responsible for and bear all cost of damages which may result from the ordering of any material or from proceeding with any part of the work prior to the review by Engineer of the necessary shop drawings.

1.3 ENGINEER'S REVIEW OF SHOP DRAWINGS

A. The Engineer's review of drawings, data, and samples submitted by the Contractor is for general conformance with the design concept of the project and for general compliance with the information given in the Contract Documents. The Engineer's

review and exception, if any, will not constitute an approval of dimensions, quantities, and details of the material, equipment, device, or item shown.

- B. The review of drawings and schedules shall not be construed:
 - 1. As permitting any departure from the Contract requirements;
 - 2. As relieving the Contractor of responsibility for any errors, including details, dimensions, and materials;
 - 3. As approving departures from details furnished by the Engineer, except as otherwise provided herein.
- C. If the drawings or schedules as submitted describe variations and show a departure from the Contract requirements which the Engineer finds to be in the interest of the Owner and to be so minor as not to involve a change in contract price or time for performance, the Engineer may return the reviewed drawings without noting an exception.
- D. When reviewed by the Engineer, each of the shop drawings will be identified as having received such review, being so stamped and dated. Shop drawings stamped "REVISE AND RESUBMIT" and with required corrections shown will be returned to the Contractor for correction and resubmittal.
- E. Resubmittals will be handled in the same manner as first submittals. On resubmittals the Contractor shall direct specific attention, in writing or on resubmitted shop drawings, to revisions other than the corrections requested by the Engineer on previous submissions. Make any corrections required by the Engineer.
- F. If the Contractor considers any correction indicated on the Drawings to constitute a change to the Contract Drawings or Specifications, the Contractor shall give written notice thereof to the Engineer.
- G. The Engineer will review a submittal/resubmittal a maximum of 3 times, after which the cost of review will be borne by the Contractor. The cost of engineering will be equal to the Engineer's charges to the Owner under the terms of the Engineer's agreement with the Owner.
- H. When the shop drawings have been completed to the satisfaction of the Engineer, the Contractor shall carry out the construction in accordance therewith and shall make no further changes therein except upon written instructions from the Engineer.
- I. No partial submittals will be reviewed. Submittals not complete will be returned to the Contractor, and will be considered "Rejected" until resubmitted.

1.4 SUBMITTAL PROCEDURES

- A. Coordination. Coordinate preparation and processing of submittals with performance of the work. Transmit each submittal to the Engineer sufficiently in advance of scheduled performance of related construction activities to avoid delay.

1. Coordinate each submittal with other submittals and related activities that require sequential activity including:
 - a. Testing.
 - b. Purchasing.
 - c. Fabrication.
 - d. Delivery.

 2. Coordinate transmittal of different types of submittals for the same element of the work and different elements of related parts of the work so that processing will not be delayed by the Engineer's need to review submittals concurrently for coordination.
 - a. The Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are forthcoming.
 - b. No extension of time will be authorized because of the Contractor's failure to transmit submittals to the Engineer sufficiently in advance of the work to permit processing.
- B. Submittal Preparation. Prepare and submit shop drawings in accordance with the following:
1. Attach a submittal cover sheet to each copy of a shop drawing. The submittal cover sheet shall contain the following information:
 - a. Project name and Owner's name.
 - b. Contractor's name and address.
 - c. Engineer's name and address.
 - d. Specification section and title.
 - e. Drawing reference number.
 - f. Submittal number.
 - g. Space to indicate the results of the Contractor's review.
 - h. Space to indicate any deviations from the Contract Documents or comments by the Contractor.
 - i. Space approximately 8 inches wide and 4 inches high for the Engineer to indicate the results of his review and any comments.

 2. Each shop drawing submittal shall be assigned a sequential number, beginning with the number 1. Resubmittals shall be identified by a letter suffix (i.e., 1A, 1B, etc.).
- C. Submittal Transmittal. Package each submittal appropriately for transmittal and handling. Transmit each submittal from Contractor to Engineer, and to other destinations, as indicated, by use of a transmittal form. Submittals received from sources other than the Contractor will be returned to the sender without action. A separate transmittal shall be used for each shop drawing submittal.

1.5 SHOP DRAWINGS

- A. The term "shop drawings," when used in the Contract Documents, shall be considered to mean Contractor's plans for material and equipment which become an integral part

of the Project. These drawings shall be complete and detailed. Shop drawings shall consist of fabrication, erection and setting drawings and schedule drawings, manufacturer's scale drawings, and wiring and control diagrams. Cuts, catalogs, pamphlets, descriptive literature, and performance and test data, shall be considered only as support to required shop drawings as defined above.

- B. Drawings and schedules shall be checked and coordinated with the work of all trades involved before they are submitted for review by the Engineer. Contractor shall indicate whether the shop drawing complies with or deviates from the requirement of the Contract Documents.
- C. If drawings show deviations from Contract requirements because of standard shop practice or for other reasons, the Contractor shall clearly mark and describe such deviation in his letter of transmittal. If the Contractor fails to describe such variations, he shall not be relieved of the responsibility for executing the Work in accordance with the Contract, even though such drawings have been reviewed.
- D. Data on materials and equipment include, without limitation, materials and equipment lists, catalog data sheets, cuts, performance curves, diagrams, materials of construction and similar descriptive material. Materials and equipment lists shall give, for each item thereon, the name and location of the supplier or manufacturer, trade name, catalog reference, size, finish and all other pertinent data.
- E. Installation List. When requested by the Engineer, manufacturers or equipment suppliers who propose to furnish equipment or products shall submit an installation list to the Engineer along with the required shop drawings. The installation list shall include at least five installations where identical equipment has been installed and has been in operation for a period of at least 1 year.
- F. Color. Only the Engineer will utilize the color "red" in marking shop drawing submittals.
- G. Before final payment is made, the Contractor shall furnish to Engineer five sets of record drawings, all clearly revised, complete and up-to-date showing the permanent construction as actually made for all reinforcing and structural steel, miscellaneous metals, process and mechanical equipment, yard piping, electrical system and instrument system.

1.6 SAMPLES

- A. Furnish, for the approval of the Engineer, samples required by the Contract Documents or requested by the Engineer. Samples shall be delivered to the Engineer as specified or directed. The Contractor shall prepay all shipping charges on samples. Materials or equipment for which samples are required shall not be used in work until approved by the Engineer.

1.7 SPECIFIC SUBMITTAL REQUIREMENTS

- A. Submit coordination drawings where required for integration of different construction elements. Show construction sequences and relationships of separate components where necessary to avoid conflicts in utilization of the space available.

- B. Highlight, encircle, or otherwise indicate deviations from the Contract Documents on the shop drawings.
- C. Do not permit shop drawing copies without an appropriate final stamp or other marking indicating the action taken by the Engineer to be used in connection with construction.
- D. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit shop drawings on sheets at least 8½ by 11 inches but no larger than 30 by 40 inches.

1.8 PRODUCT DATA

- A. Collect product data into a single submittal for each element of construction or system. Mark each copy to show which choices and options are applicable to the Project.
- B. Where product data have been printed to include information on several similar products, some of which are not required for use on the project, or are not included in this submittal, mark copies to clearly indicate which information is applicable.
- C. Where product data must be specially prepared for required products, materials, or systems, because standard printed data are not suitable for use, submit as "shop drawings," not "product data."
- D. Include the following information in product data:
 - 1. Manufacturer's printed recommendations.
 - 2. Compliance with recognized trade association standards.
 - 3. Compliance with recognized testing agency standards.
 - 4. Application of testing agency labels and seals.
 - 5. Notation of dimensions verified by field measurement.
 - 6. Notation of coordination requirements.
- E. Submittals. Submit two copies of each required product data submittal; submit two additional copies where copies are required for maintenance manuals. The Engineer will retain one copy, and will return the other marked with the action taken and corrections or modifications required.
- F. Distribution. Furnish copies of final product data submittal to manufacturers, subcontractors, suppliers, fabricators, installers, governing authorities and others as required for performance of the construction activities. Show distribution on transmittal forms.
 - 1. Do not proceed with installation of materials, products and systems until a copy of product data applicable to the installation is in the installer's possession.
 - 2. Do not permit use of unmarked copies of project data in connection with construction.

1.9 ENGINEER'S ACTION

- A. Action Stamp: The Engineer will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be appropriately marked, as follows, to indicate the action taken:

1. Final Unrestricted Release: Where submittals are marked "NO EXCEPTIONS," that part of the work covered by the submittal may proceed, provided it complies with requirements of the Contract Documents; final acceptance will depend upon that compliance.
2. Final-But-Restricted Release: When submittals are marked "EXCEPTIONS AS NOTED," that part of the work covered by the submittal may proceed, provided it complies with both the Engineer's notations or corrections on the submittal and requirements of the Contract Documents; final acceptance will depend on that compliance.
3. Returned for Resubmittal: When submittal is marked "REVISE AND RESUBMIT," do not proceed with that part of the work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal in accordance with the Engineer's notations; resubmit without delay. Repeat if necessary to obtain a different action mark.
 - a. Do not permit submittals marked "REVISE AND RESUBMIT" to be used at the project site, or elsewhere where construction is in progress.
4. Rejected: When submittal is marked "REJECTED," the materials, equipment, and/or methods identified in the submittal do not comply with the Contract requirements and shall not be incorporated into the work. No resubmittal of the same materials, equipment, and/or methods shall be made.
5. Other Action: Where a submittal is primarily for information or record purposes, for special processing or other Contractor activity, the submittal will be returned, marked "Action Not Required."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 01 40 00

QUALITY CONTROL SERVICES

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. This section specifies administrative and procedural requirements for quality control services.
- B. Quality control services include inspections and tests and related actions including reports, performed by independent agencies, governing authorities, and the Contractor. They do not include contract enforcement activities performed by the Engineer.
- C. Inspection and testing services are required to verify compliance with requirements specified or indicated. These services do not relieve the Contractor of responsibility for compliance with Contract Document requirements.
 - 1. Specific quality control requirements for individual construction activities are specified in the sections that specify those activities. Those requirements, including inspections and tests, cover production of standard products as well as customized fabrication and installation procedures.
 - 2. Inspections, tests, and related actions specified are not intended to limit the Contractor's quality control procedures that facilitate compliance with Contract Document requirements.
 - 3. Requirements for the Contractor to provide quality control services required by the authorities having jurisdiction are not limited by provisions of this section.

1.2 RESPONSIBILITIES

- A. Contractor Responsibilities. Provide inspections, tests, and similar quality control services, specified in individual specification sections and required by governing authorities, except where they are specifically indicated to be the Owner's responsibility, or are provided by another identified entity; these services include those specified to be performed by an independent agency and not by the Contractor. Costs for these services shall be included in the contract sum.
 - 1. Employ and pay an independent agency to perform specified quality control services.
 - 2. The Owner will engage and pay for the services of an independent agency to perform inspections and tests specified as the Owner's responsibility.
 - 3. Retesting: The Contractor is responsible for retesting where results of required inspections, tests, or similar services prove unsatisfactory and do not indicate compliance with Contract Document requirements, regardless of whether the original test was the Contractor's responsibility.
 - a. Cost of retesting construction revised or replaced by the Contractor is the Contractor's responsibility, where required tests were performed on original construction.

4. Associated Services: Cooperate with agencies performing required inspections, tests, and similar services and provide reasonable auxiliary services as requested. Notify the agency sufficiently in advance of operations to permit assignment of personnel. Auxiliary services required include but are not limited to:
 - a. Providing access to the Work and furnishing incidental labor and facilities necessary to facilitate inspections and tests.
 - b. Taking adequate quantities of representative samples of materials that require testing or assisting the agency in taking samples.
 - c. Providing facilities for storage and curing of test samples, and delivery of samples to testing laboratories.
 - d. Providing the agency with a preliminary design mix proposed for use for materials mixes that require control by the testing agency.
 - e. Security and protection of samples and test equipment at the project site.
 - B. Owner Responsibilities. The Owner will employ and pay for the services of an independent agency, testing laboratory, or other qualified firm to perform services which are the Owner's responsibility.
 - C. Duties of the Testing Agency. The independent testing agency engaged to perform inspections, sampling, and testing of materials and construction specified in individual specification sections shall cooperate with the Engineer and Contractor in performance of its duties, and shall provide qualified personnel to perform required inspections and tests.
 1. The agency shall notify the Engineer and Contractor promptly of irregularities or deficiencies observed in the work during performance of its services.
 2. The agency is not authorized to release, revoke, alter, or enlarge requirements of the Contract Documents, or approve or accept any portion of the work.
 3. The agency shall not perform any duties of the Contractor.
 - D. Coordination. The Contractor and each agency engaged to perform inspections, tests, and similar services shall coordinate the sequence of activities to accommodate required services with a minimum of delay. In addition, the Contractor and each agency shall coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests.
 1. The Contractor is responsible for scheduling times for inspections, tests, taking samples, and similar activities.
- 1.3 SUBMITTALS
- A. The independent testing agency shall submit to the Engineer, in duplicate, a certified written report of each inspection, test, or similar service.
 1. Submit additional copies of each written report directly to the governing authority, when the authority so directs.

2. Report Data: Written reports of each inspection, test, or similar service shall include, but not be limited to:
 - a. Date of issue.
 - b. Project title and number.
 - c. Name, address, and telephone number of testing agency.
 - d. Dates and locations of samples and tests or inspections.
 - e. Names of individuals making the inspection or test.
 - f. Designation of the work and test method.
 - g. Identification of product and specification section.
 - h. Complete inspection or test data.
 - i. Test results and an interpretation of test results.
 - j. Ambient conditions at the time of sample-taking and testing.
 - k. Comments or professional opinion as to whether inspected or tested work complies with Contract Document requirements.
 - l. Name and signature of laboratory inspector.
 - m. Recommendations on retesting.

1.4 QUALITY ASSURANCE

- A. Qualification for Service Agencies. Engage inspection and testing service agencies, including independent testing laboratories, which are prequalified as complying with "Recommended Requirements for Independent Laboratory Qualification" by the American Council of Independent Laboratories, and which specialize in the types of inspections and tests to be performed.
 1. Each independent inspection and testing agency engaged on the Project shall be authorized by authorities having jurisdiction to operate in the state in which the project is located.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

- A. General. Upon completion of inspection, testing, sample-taking, and similar services, repair damaged construction and restore substrates and finishes to eliminate deficiencies, including deficiencies in visual qualities of exposed finishes.
- B. Protect construction exposed by or for quality control service activities, and protect repaired construction.
- C. Repair and protection is the Contractor's responsibility, regardless of the assignment of responsibility for inspection, testing, or similar services.

END OF SECTION

SECTION 01 42 13

ABBREVIATIONS

PART 1 - GENERAL

1.1 GENERAL

- A. Wherever in these Specifications and Contract Documents the abbreviations, or pronouns in place of them are used, the intent and meaning shall be interpreted as specified herein.

1.2 ABBREVIATIONS

AA	Aluminum Association
AAMA	Architectural Aluminum Manufacturer's Association
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
AEIC	Association of Edison Illuminating Companies
AFBMA	Anti-Friction Bearing Manufacturers Association
AF&PA	American Forest & Paper Association
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AIA	American Institute of Architects
AIEE	American Institute of Electrical Engineers
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
ALSC	American Lumber Standard Committee
ANSI	American National Standards Institute
AMCA	Air Moving and Conditioning Association
APA	American Plywood Association
APHA	American Public Health Association
API	American Petroleum Institute
APWA	American Public Works Association
ARC	Appalachian Regional Commission
AREA	American Railroad Engineering Association
ASA	American Standards Association
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWPA	American Wood Preservers' Association
AWS	American Welding Society
AWWA	American Water Works Association
BIA	Brick Institute of America
CFR	Code of Federal Regulations
CRSI	Concrete Reinforcing Steel Institute
CTI	Cooling Tower Institute

DIPRA	Ductile Iron Pipe Research Association
EIA	Electronic Industries Association
EPA	Environmental Protection Agency
EPD	Georgia Environmental Protection Division
FM	Factory Mutual
FmHA	Farmers Home Administration
FS	Federal Specifications
HEI	Heat Exchange Institute
IBC	International Building Code
IEEE	Institute of Electronic and Electrical Engineers
IES	Illuminating Engineering Society
IPCEA	Insulated Power Cable Engineers Association
IPC	Institute of Printed Circuits
ISA	Instrument Society of America
MBMA	Metal Building Manufacturers Association
MSS	Manufacturers Standardization Society of the Valve and Fitting Industry
MUTCD	Manual on Uniform Traffic Control Devices
NAAMM	National Association of Architectural Metal Manufacturers
NACE	National Association of Corrosion Engineers
NAPF	National Association of Piping Fabricators
NBFU	National Board of Fire Underwriters
NBS	National Bureau of Standards
NCMA	National Concrete Masonry Association
NCPI	National Clay Pipe Institute
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NRMA	National Ready-Mix Association
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute
SBC	Southern Building Code Congress International, Inc.
SJI	Steel Joist Institute
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SSCRB	Standard Specification Construction of Roads and Bridges, Department of Transportation, State of Georgia
SSPC	SSPC: The Society for Protective Coatings
SSRBC	Standard Specifications for Road and Bridge Construction, Tennessee Department of Transportation
SSRS	Standard Specifications for Roads and Structures, latest edition, North Carolina Department of Transportation, Division of Highways
TCA	Tile Council of America
TDEC	Tennessee Department of Environment and Conservation
TEMA	Tubular Exchangers Manufacturers Association
UBC	Uniform Building Code
UL	Underwriters Laboratories
USDC	United States Department of Commerce
WEF	Water Environment Federation (Formerly WPCF)
WPCF	Water Pollution Control Federation

END OF SECTION

SECTION 01 42 19

APPLICABLE CODES AND STANDARDS

PART 1 - GENERAL

1.1 GENERAL

- A. All materials, equipment, fabrication, and installation practices shall comply with the following applicable codes and standards, unless the Contractor's quality standards establish more stringent quality requirements, as determined by the Engineer.

1. Pressure Piping and Tubing

ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
AWWA	American Water Works Association
NAPF	National Association of Piping Fabricators
NSF	NSF International

2. Materials

AASHTO	American Association of State Highway and Transportation Officials
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials

3. Painting and Surface Preparation

NACE	National Association of Corrosion Engineers
SSPC	SSPC: The Society for Protective Coatings

4. Gear Reducers and Bearings

AFBMA	Anti-friction Bearing Manufacturers Association
AGMA	American Gear Manufacturers Association

5. Ventilating Fans

AMCA	Air Moving and Conditioning Association
PFMA	Power Fan Manufacturers Association

6. Electrical and Instrumentation

EIA	Electronic Industries Association
IEEE	Institute of Electrical and Electronic Engineers
IPC	Institute of Printed Circuits
IPCEA	Insulated Power Cable Engineers Association
ISA	Instrument Society of America
NEMA	National Electrical Manufacturers Association

NFPA National Fire Protection Association
UL Underwriter's Laboratories

7. Aluminum Structures

AA Aluminum Association
AAMA Architectural Aluminum Manufacturers Association

8. Steel Structures

AISC American Institute of Steel Construction
API American Petroleum Institute
AWWA American Water Works Association
SJI Steel Joist Institute

9. Concrete Structures

ACI American Concrete Institute

10. Welding

ASME American Society of Mechanical Engineers
AWS American Welding Society

11. Safety

OSHA Occupational Safety and Health Act

12. General Building Construction

FM Factory Mutual Fire Insurance Corporation
IBC International Building Code by the International Code Council
NFPA National Fire Protection Association

13. Subgrades and Pavement

SSCRB Standard Specification Construction of Roads and Bridges,
Department of Transportation, State of Georgia, 1993 Edition, and
Supplemental Specifications
SSRBC Standard Specifications for Road and Bridge Construction,
Tennessee Department of Transportation
SSRS Standard Specifications for Roads and Structures, latest edition,
North Carolina Department of Transportation, Division of Highways.

14. Ductwork and Sheet Metal Work

SMACNA Sheet Metal and Air Conditioning Contractors National
Association

15. Plumbing

AGA	American Gas Association
NSF	NSF International
PDI	Plumbing Drainage Institute
SPC	SBC Standard Plumbing Code

16. Refrigeration, Heating, and Air Conditioning

ARI	American Refrigeration Institute
ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers

17. Pressure Vessels

ASME	American Society of Mechanical Engineers
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18. Wood

AF&PA	American Forest & Paper Association
AWPA	American Wood Preservers' Association

In addition, all work shall comply with the applicable requirements of local codes, utilities, and other authorities having jurisdiction.

- B. All material and equipment, for which a UL Standard, an AGA approval, or an ASME requirement is established, shall be so approved and labeled or stamped. Label or stamp shall be conspicuous and not covered, painted, or otherwise obscured from visual inspection.

END OF SECTION

SECTION 01 60 00

MATERIALS AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This section specifies administrative and procedural requirements governing the Contractor's selection of products for use in the project.
 - 1. Multiple Prime Contracts: Provisions of this section apply to the construction activities of each prime Contractor.
- B. Standards. Refer to Section 01 42 19, Applicable Codes and Standards, for applicability of industry standards to products specified.

1.2 DEFINITIONS

- A. Definitions used in this Article are not intended to change the meaning of other terms used in the Contract Documents, such as "specialties," "system," "structure," "finishes," "accessories," and similar terms. Such terms are self-explanatory and have well recognized meanings in the construction industry.
 - 1. "Products" are items purchased for incorporation in the work, whether purchased for the project or taken from previously purchased stock. In all cases, products shall be new and unused. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - a. "Named products" are items identified by manufacturer's product name, including make or model designation, indicated in the manufacturer's published product literature, that is current as of the date of the Contract Documents.
 - 2. "Materials" are products that are substantially shaped, cut, worked, mixed, finished, refined, or otherwise fabricated, processed, or installed to form a part of the work.
 - 3. "Equipment" is a product with operational parts, whether motorized or manually operated, that requires service connections such as wiring or piping.

1.3 QUALITY ASSURANCE

- A. Source Limitations. To the fullest extent possible, provide products of the same kind, from a single source.
- B. Compatibility of Options. When the Contractor is given the option of selecting between two or more products for use on the project, the product selected shall be compatible with products previously selected, even if previously selected products were also options.

1. Each prime Contractor is responsible for providing products and construction methods that are compatible with products and construction methods of other prime or separate Contractors.
2. Equipment Nameplates: Provide a permanent nameplate of each item of service-connected or power-operated equipment. Locate on an easily accessible surface. The nameplate shall contain the following information and other essential operating data:
 - a. Name of product and manufacturer.
 - b. Model and serial number.
 - c. Capacity.
 - d. Speed.
 - e. Ratings.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products in accordance with the manufacturer's recommendations, using means and methods that will prevent damage, deterioration, and loss, including theft.
 1. Schedule delivery to minimize long-term storage at the site and to prevent overcrowding of construction spaces.
 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 3. Deliver products to the site in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 4. Inspect products upon delivery to ensure compliance with the Contract Documents, and to ensure that products are undamaged and properly protected.
 5. Store products at the site in a manner that will facilitate inspection and measurement of quantity or counting of units.
 6. Store heavy materials away from the project structure in a manner that will not endanger the supporting construction.
 7. Store products subject to damage by the elements above ground, under cover in a weathertight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION

- A. General Product Requirements. Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, unused at the time of installation.
1. Provide products complete with all accessories, trim, finish, safety guards, and other devices and details needed for a complete installation and for the intended use and effect.
 2. Standard Products: Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.
- B. Product Selection Procedures. Product selection is governed by the Contract Documents and governing regulations. Procedures governing product selection include the following:
1. Proprietary Specification Requirements: Where only a single product or manufacturer is named, provide the product indicated. No substitutions will be permitted.
 2. Semiproprietary Specification Requirements: Where two or more products or manufacturers are named, provide one of the products indicated. No substitutions will be permitted.
 - a. Where products or manufacturers are specified by name, accompanied by the term "or equal" or "or approved equal," comply with the Contract Document provisions concerning "substitutions" to obtain approval for use of an unnamed product.
 3. Non-Proprietary Specifications: When the Specifications list products or manufacturers that are available and may be incorporated in the Work, but do not restrict the Contractor to use of these products only, the Contractor may propose any available product that complies with Contract requirements. Comply with Contract Document provisions concerning "substitutions" to obtain approval for use of an unnamed product.
 4. Descriptive Specification Requirements: Where Specifications describe a product or assembly, listing exact characteristics required, with or without use of a brand or trade name, provide a product or assembly that provides the characteristics and otherwise complies with Contract requirements.
 5. Performance Specification Requirements: Where Specifications require compliance with performance requirements, provide products that comply with these requirements, and are recommended by the manufacturer for the application indicated. General overall performance of a product is implied where the product is specified for a specific application.
 - a. Manufacturer's recommendations may be contained in published product literature, or by the manufacturer's certification of performance.

6. Compliance with Standards, Codes, and Regulations: Where the Specifications only require compliance with an imposed code, standard, or regulation, select a product that complies with the standards, codes, or regulations specified.
7. Visual Selection: Where specified product requirements include the phrase "...as selected from manufacturer's standard colors, patterns, textures..." or a similar phrase, select a product and manufacturer to comply with other specified requirements. The Engineer will select the color, pattern, and texture from the product line selected.

2.2 SHOP PRIMING AND PAINTING

- A. Shop prime and/or shop finish all shop fabricated equipment prior to shipping.
- B. Surface preparation, primers, finishes, number of coats, and film thicknesses shall comply with applicable provisions of Section 09 91 00, Painting (if included), unless alternative procedures and materials are accepted by the Engineer during shop drawing and product data review.
- C. Prepare and finish electrical and mechanical equipment prior to final assembly. Do not sandblast or paint assembled equipment or machined interior surfaces of equipment.
- D. Coat interior, inaccessible surfaces of equipment with an epoxy system suitable for the lifetime of the equipment at anticipated operating conditions and temperatures, unless otherwise specified or accepted.
- E. Coat exterior and accessible interior surfaces with an appropriate epoxy system, unless otherwise specified or accepted.

PART 3 - EXECUTION

3.1 INSTALLATION OF PRODUCTS

- A. Comply with manufacturer's instructions and recommendations for installation of products in the applications indicated. Anchor each product securely in place, accurately located and aligned with other work.
 1. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

END OF SECTION

SECTION 01 65 00

TRANSPORTATION AND HANDLING

PART 1 - GENERAL

1.1 SCOPE

- A. Provide transportation of all equipment, materials, and products furnished under these Contract Documents to the site of the work. In addition, provide preparation for shipment and storage, unloading, handling and rehandling, short-term storage, extended storage, storage facilities, maintenance and protection during storage, preparation for installation, and all other work and incidental items necessary or convenient to the Contractor for the satisfactory prosecution and completion of the work.

1.2 TRANSPORTATION

- A. Suitably box, crate, or otherwise protect all equipment during transportation.
- B. Ship and deliver all equipment in the largest assembled sections practical or permitted by carrier regulations to minimize the number of field connections.
- C. Ensure that the equipment is assembled and transported in such a manner so as to clear buildings, power lines, bridges, and similar structures encountered during shipment or delivery to the site of the work.
- D. Ensure that the weights of the assembled sections do not exceed the capacity of the cranes or hoisting equipment where equipment will be installed using existing cranes or hoisting equipment.
- E. Small items and appurtenances such as gauges, valves, switches, instruments, and probes which could be damaged during shipment shall be removed from the equipment prior to shipment and packaged and shipped separately. All openings shall be plugged or sealed to prevent the entrance of water or dirt.
- F. Paint temporary shipping braces and supports orange or yellow for easy identification.

1.3 HANDLING

- A. Carefully handle all equipment, materials, and products to prevent damage or excessive deflections during unloading or transportation. All equipment, materials, and products damaged during transportation or handling shall be repaired or replaced by the Contractor at no additional cost to the Owner prior to being incorporated into the work.
- B. Strictly follow lifting and handling drawings and instructions furnished by the manufacturer or supplier. Eyebolts or lifting lugs furnished on the equipment shall be used in handling the equipment. Shafts and operating mechanisms shall not be used as lifting points. Spreader bars or lifting beams shall be used when the distance

between lifting points exceeds that permitted by standard industry practice. Slings and chains shall be padded as required to prevent damage to protective coatings and finishes.

- C. Under no circumstances shall equipment or products such as pipe, structural steel, casting, reinforcement, lumber, piles, poles, etc., be thrown or rolled off of trucks onto the ground.
- D. Handle items such as nonmetallic pipe, nonmetallic conduit, flagpoles, and lighting poles using nonmetallic slings or straps.

END OF SECTION

SECTION 01 66 00

STORAGE AND PROTECTION

PART 1 - GENERAL

1.1 SCOPE

- A. Equipment shall be received, inspected, unloaded, handled, stored, maintained, and protected by the Contractor in a suitable location on or off site, if necessary, until such time as installation is required.
- B. Storage and protection of Contractor-furnished equipment shall be in strict conformance with the requirements of the applicable provisions of the General Conditions and Supplemental General Conditions of these Specifications.

1.2 STORAGE

- A. Provide satisfactory storage facilities which are acceptable to the Engineer. In the event that satisfactory facilities cannot be provided on site, satisfactory warehouse, acceptable to the Engineer, will be provided by the Contractor for such time until the equipment, materials, and products can be accommodated at the site.
- B. Equipment, materials, and products which are stored in a satisfactory warehouse acceptable to the Engineer will be eligible for progress payments as though they had been delivered to the job site.
- C. Maintain and protect all equipment, materials, and products placed in storage and bear all costs of storage, preparation for transportation, transportation, rehandling, and preparation for installation.
- D. Equipment and products stored outdoors shall be supported above the ground on suitable wooden blocks or braces arranged to prevent excessive deflection or bending between supports. Items such as pipe, structural steel, and sheet construction products shall be stored with one end elevated to facilitate drainage.
- E. Building products and materials such as cement, grout, plaster, gypsum-board, particleboard, resilient flooring, acoustical tile, paneling, finish lumber, insulation, wiring, etc., shall be stored indoors in a dry location, unless otherwise permitted in writing by the Engineer. Building products such as rough lumber, plywood, concrete block, and structural tile may be stored outdoors under a properly secured waterproof covering.
- F. Tarps and other coverings shall be supported above the stored equipment or materials on wooden strips to provide ventilation under the cover and minimize condensation. Tarps and covers shall be arranged to prevent ponding of water.

1.3 EXTENDED STORAGE

- A. In the event that certain items of major equipment such as air compressors, pumps, and mechanical aerators have to be stored for an extended period of time, the

Contractor shall provide satisfactory long-term storage facilities which are acceptable to the Engineer. The Contractor shall provide all special packaging, protective coverings, protective coatings, power, nitrogen purge, desiccants, lubricants, and exercising necessary or recommended by the manufacturer to properly maintain and protect the equipment during the period of extended storage.

END OF SECTION

SECTION 01 78 00

PROJECT CLOSEOUT

PART 1 - GENERAL

1.1 SUMMARY

- A. This section specifies administrative and procedural requirements for project closeout, including but not limited to:
 - 1. Inspection procedures.
 - 2. Project record document submittal.
 - 3. Submittal of warranties.
 - 4. Final cleaning.
- B. Closeout requirements for specific construction activities are included in the appropriate sections in Divisions 2 through 48.

1.2 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures. Before requesting inspection for certification of substantial completion, complete the following. List exceptions in the request.
 - 1. Advise Owner of pending insurance change-over requirements.
 - 2. Complete start-up testing of systems, and instruction of the Owner's operating and maintenance personnel. Discontinue or change over and remove temporary facilities from the site, along with construction tools, mock-ups, and similar elements.
 - 3. Complete final clean up requirements, including touch-up painting. Touch-up and otherwise repair and restore marred exposed finishes.
- B. Inspection Procedures. On receipt of a request for inspection, the Engineer will either proceed with inspection or advise the Contractor of unfulfilled requirements. The Engineer will prepare the Certificate of Substantial Completion following inspection, or advise the Contractor of construction that must be completed or corrected before the certificate will be issued.
 - 1. The Engineer will repeat inspection when requested and assured that the work has been substantially completed.
 - 2. Results of the completed inspection will form the basis of requirements for substantial completion.
- C. Reinspection Procedure. The Engineer will reinspect the work upon receipt of notice that the work, including inspection list items from earlier inspections, has been completed, except items whose completion has been delayed because of circumstances acceptable to the Engineer.

1. Upon completion of reinspection, the Engineer will prepare a certificate of final acceptance or advise the Contractor of work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.
2. If necessary, reinspection will be repeated.

1.3 FINAL ACCEPTANCE

- A. Preliminary Procedures. Before requesting final inspection for certification of final acceptance and final payment, complete the following. List exceptions in the request.
1. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
 2. Submit an updated final statement, accounting for final additional changes to the contract sum.
 3. Submit a certified copy of the Engineer's final inspection list of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, and the list has been endorsed and dated by the Engineer.
 4. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications, and similar documents.
 5. Obtain and submit releases enabling the Owner unrestricted use of the work and access to services and utilities; include occupancy permits, operating certificates, and similar releases.
 6. Submit record drawings, final project photographs, damage or settlement survey, property survey, and similar final record information.
 7. Deliver any specified tools, spare parts, extra stock, and similar items.
 8. Make final change-over of permanent locks and transmit keys to the Owner. Advise the Owner's personnel of change-over in security provisions.
 9. Submit all project close out forms completed and executed.
 10. Submit project record drawings (mark-up of plans showing revisions during construction).
 11. Submit a final liquidated damages settlement statement, if required.
 12. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 CLOSEOUT PROCEDURES

- A. Operating and Maintenance Instructions. Arrange for each installer of equipment that requires regular maintenance to meet with the Owner's personnel to provide instruction in proper operation and maintenance. If installers are not experienced in procedures, provide instruction by manufacturer's representatives. Include a detailed review of the following items:
1. Maintenance manuals.
 2. Record documents.
 3. Spare parts and materials.
 4. Tools.
 5. Lubricants.
 6. Fuels.
 7. Identification systems.
 8. Control sequences.
 9. Hazards.
 10. Cleaning.
 11. Warranties and bonds.
 12. Maintenance agreements and similar continuing commitments.
- B. A list of available instruction dates shall be submitted to the Owner through the Engineer at least two weeks in advance of the earliest proposed date for each instruction program. The Engineer will, within three business days, notify the Contractor of the Owner's preferred date. To the maximum extent possible, instruction of related equipment systems will be conducted concurrently. The final coordination of the instruction is the sole responsibility of the Contractor.
- C. Demonstrate the following procedures as part of instruction for operating equipment.
1. Start-up.
 2. Shutdown.
 3. Emergency operations.
 4. Noise and vibration adjustments.
 5. Safety procedures.
 6. Economy and efficiency adjustments.
 7. Effective energy utilization.

3.2 FINAL CLEANING

- A. General. General cleaning during construction is required by the General Conditions.
- B. Cleaning. Employ experienced workers or professional cleaners for final cleaning. Clean all work areas to original condition or to satisfaction of Owner and Engineer.
1. Complete the following cleaning operations before requesting inspection for Certification of Substantial Completion.
 2. Clean the site, including landscape development areas, of rubbish, litter, and other foreign substances. Sweep paved areas broom clean; remove stains, spills,

and other foreign deposits. Rake grounds that are neither paved nor planted, to a smooth even-textured surface.

- C. Removal of Protection. Remove temporary protection and facilities installed for protection of the work during construction.
- D. Compliance. Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from the site and dispose of in a lawful manner.
 - 1. Where extra materials of value remaining after completion of associated work have become the Owner's property, arrange for disposition of these materials as directed.

END OF SECTION

SECTION 01 78 23

OPERATING AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

- A. This section specifies administrative and procedural requirements for operating and maintenance manuals including the following:
 - 1. Preparation and submittal of operating and maintenance manuals for building operating systems or equipment.
 - 2. Preparation and submittal of instruction manuals covering the care, preservation, and maintenance of architectural products and finishes.
 - 3. Instruction of the Owner's operating personnel in operation and maintenance of building systems and equipment.
- B. Special operating and maintenance data requirements for specific pieces of equipment or building operating systems are included in the appropriate sections of Divisions 2 through 49.
- C. Preparation of shop drawings and product data are included in Section 01 33 23, Shop Drawings, Product Data and Samples.
- D. General closeout requirements are included in Section 01 78 00, Project Closeout.
- E. General requirements for submittal of project record documents are included in Section 01 7839, Project Record Documents.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplemental Conditions and other Division 1 specification sections, apply to this section.

1.3 QUALITY ASSURANCE

- A. Operation and Maintenance Manual Preparation. In preparation of operation and maintenance manuals, use personnel thoroughly trained and experienced in operation and maintenance of the equipment or system involved.
 - 1. Where written instructions are required, use personnel skilled in technical writing to the extent necessary for communication of essential data.
 - 2. Where Drawings or diagrams are required, use drafters capable of preparing Drawings clearly in an understandable format.
- B. Instructions for the Owner's Personnel. For instruction of the Owner's operating and maintenance personnel, use experienced instructors thoroughly trained and

experienced in the operation and maintenance of the building equipment or system involved.

1.4 SUBMITTALS

A. Submittal Schedule. Comply with the following schedule for submittal of operating and maintenance manuals.

1. Prior to the 80 percent completion point on the work, submit two draft copies of each manual to the Engineer for review. Include a complete index or table of contents of each manual.
2. Prior to substantial completion, make corrections or modifications to comply with the Engineer's comments and submit the specified number of copies of each approved manual to the Engineer.
3. Number: Four final copies of each manual.

B. Form of Submittal. Prepare operating and maintenance manuals in the form of an instructional manual for use by the Owner's operating personnel. Organize into suitable sets of manageable size. Where possible, assemble instructions for similar equipment into a single binder.

1. Binders: For each manual, provide heavy-duty, commercial quality, 3-ring, vinyl-covered loose-leaf binders, in thickness necessary to accommodate contents, sized to receive 8½- by 11-inch paper. Provide a clear plastic sleeve on the spine to hold labels describing the contents. Provide pockets in the covers to receive folded sheets.
 - a. Where two or more binders are necessary to accommodate data, correlate data in each binder into related groupings in accordance with the project manual Table of Contents. Cross-reference other binders where necessary to provide essential information for proper operation or maintenance of the piece of equipment or system.
 - b. Identify each binder on the front and spine, with the typed or printed title "OPERATION AND MAINTENANCE MANUAL," project title or name, and subject matter covered. Indicate the volume number for multiple-volume sets of manuals.
2. Dividers: Provide heavy paper dividers with celluloid covered tabs for each separate section. Mark each tab to indicate contents. Provide a typed description of the product and major parts of equipment included in the section on each divider.
3. Protective Plastic Jackets: Provide protective transparent plastic jackets designed to enclose diagnostic software for computerized electronic equipment.
4. Text Material: Where written material is required as part of the manual, use the manufacturer's standard printed material, or if it is not available, specially prepared data, neatly typewritten, on 8½- by 11-inch, 20-pound white bond paper.

5. Drawings: Where drawings or diagrams are required as part of the manual, provide reinforced, punched binder tabs on the drawings and bind in with the text.
 - a. Where oversized drawings are necessary, fold the drawings to the same size as the text pages and use as a fold-out.
 - b. If drawings are too large to be used practically as a fold-out, place the drawing, neatly folded, in the front or rear pocket of the binder. Insert a typewritten page indicating the drawing title, description of contents, and drawing location at the appropriate location in the manual.

1.5 MANUAL CONTENT

- A. In each manual include information specified in the individual specification section, and the following information for each major component of building equipment and its controls:
 1. General system or equipment description.
 2. Design factors and assumptions.
 3. Copies of applicable shop drawings and product data.
 4. System or equipment identification, including:
 - a. Name of manufacturer.
 - b. Model number.
 - c. Serial number of each component.
 5. Operating instructions.
 6. Emergency instructions.
 7. Wiring diagrams.
 8. Inspection and test procedures.
 9. Maintenance procedures and schedules.
 10. Precautions against improper use and maintenance.
 11. Copies of warranties.
 12. Repair instructions including spare parts listing.
 13. Sources of required maintenance materials and related services.
 14. Manual index.
- B. Organize each manual into separate sections for each piece of related equipment. As a minimum, each manual shall contain a title page, a table of contents, copies of product data supplemented by drawings and written text, and copies of each warranty, bond, and service contract issued.
 1. Title Page: Provide a title page in a transparent plastic envelope as the first sheet of each manual. Provide the following information:
 - a. Subject matter covered by the manual.
 - b. Name and address of the project.
 - c. Date of submittal.
 - d. Name, address, and telephone number of the Contractor.
 - e. Name and address of the Engineer.
 - f. Cross reference to related systems in other operating and maintenance manuals.
 2. Table of Contents: After the Title Page, include a typewritten table of contents for each volume, arranged systematically according to the project manual format.

Include a list of each product included, identified by product name or other appropriate identifying symbol and indexed to the content of the volume.

- a. Where more than one volume is required to accommodate data for a particular system, provide a comprehensive table of contents for all volumes in each volume of the set.
3. General Information: Provide a general information section immediately following the Table of Contents, listing each product included in the manual, identified by product name. Under each product, list the name, address, and telephone number of the subcontractor or installer, and the maintenance contractor. Clearly delineate the extent of responsibility of each of these entities. In addition, list a local source for replacement parts and equipment.
4. Product Data: Where manufacturer's standard printed data is included in the manuals, include only sheets that are pertinent to the part or product installed. Mark each sheet to identify each part or product included in the installation. Where more than one item in a tabular format is included, identify each item, using appropriate references from the Contract Documents. Identify data applicable to the installation and delete references to information that is not applicable.
5. Written Text: Where manufacturer's standard printed data is not available, and information is necessary for proper operation and maintenance of equipment or systems, or it is necessary to provide additional information to supplement data included in the manual, prepare written text to provide necessary information. Organize the text in a consistent format under separate headings for different procedures. Where necessary, provide a logical sequence of instruction for each operating or maintenance procedure.
6. Drawings: Provide specially prepared drawings where necessary to supplement manufacturer's printed data to illustrate the relationship of component parts of equipment or systems, or to provide control or flow diagrams. Coordinate these drawings with information contained in project record drawings to ensure correct illustration of the completed installation.
7. Do not use original record documents as part of the operating and Maintenance Manuals.
8. Warranties, Bonds, and Service Contracts: Provide a copy of each warranty, bond, or service contract in the appropriate manual for the information of the Owner's operating personnel. Provide written data outlining procedures to be followed in the event of product failure. List circumstances and conditions that would affect validity of the warranty or bond.

1.6 MATERIAL AND FINISHES MAINTENANCE MANUAL

- A. Unless otherwise specified, submit three copies of each manual on material and finishes, in final form, to the Engineer for distribution. Provide one section for architectural products, including applied materials and finishes, and a second for products designed for moisture-protection and products exposed to the weather.

1. Refer to individual specification sections for additional requirements on care and maintenance of materials and finishes.
- B. Architectural Products: Provide manufacturer's data and instructions on care and maintenance of architectural products, including applied materials and finishes.
1. Manufacturer's Data: Provide complete information on architectural products, including the following, as applicable:
 - a. Manufacturer's catalog number.
 - b. Size.
 - c. Material composition.
 - d. Color.
 - e. Texture.
 - f. Reordering information for specially manufactured products.
 2. Care and Maintenance Instructions: Provide information on care and maintenance, including manufacturer's recommendations for types of cleaning agents to be used and methods of cleaning. Provide information regarding cleaning agents and methods that could prove detrimental to the product. Include manufacturer's recommended schedule for cleaning and maintenance.
- C. Moisture-Protection and Weather-Exposed Products: Provide complete manufacturer's data with instructions on inspection, maintenance, and repair of products exposed to the weather or designed for moisture-protection purposes.
1. Manufacturer's Data: Provide manufacturer's data giving detailed information, including the following, as applicable:
 - a. Applicable standards.
 - b. Chemical composition.
 - c. Installation details.
 - d. Inspection procedures.
 - e. Maintenance information.
 - f. Repair procedures.

1.7 EQUIPMENT AND SYSTEMS OPERATION AND MAINTENANCE MANUAL

- A. Unless otherwise noted, submit six copies of each completed manual on equipment and systems, in final form, to the Engineer for distribution. Provide separate manuals for each unit of equipment, each operating system, and each electric and electronic system.
1. Refer to specification sections for additional requirements on operating and maintenance of the various pieces of equipment and operating systems.
- B. Equipment and Systems. Provide the following information for each piece of equipment, each building operating system, and each electric or electronic system.
1. Description: Provide a complete description of each unit and related component parts, including the following:
 - a. Equipment or system function.

- b. Operating characteristics.
 - c. Limiting conditions.
 - d. Performance curves.
 - e. Engineering data and tests.
 - f. Complete nomenclature and number of replacement parts.
2. Manufacturer's Information: For each manufacturer of a component part or piece of equipment, provide the following:
 - a. Printed operating and maintenance instructions.
 - b. Assembly drawings and diagrams required for maintenance.
 - c. List of items recommended to be stocked as spare parts.
3. Maintenance Procedures: Provide information detailing essential maintenance procedures, including the following:
 - a. Routine operations.
 - b. Trouble-shooting guide.
 - c. Disassembly, repair, and reassembly
 - d. Alignment, adjusting, and checking.
4. Operating Procedures: Provide information on equipment and system operating procedures, including the following:
 - a. Start-up procedures.
 - b. Equipment or system break-in.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Instructions on stopping.
 - f. Shut-down and emergency instructions.
 - g. Summer and winter operating instructions.
 - h. Required sequences for electric or electronic systems.
 - i. Special operating instructions.
5. Servicing Schedule: Provide a schedule of routine servicing and lubrication requirements, including a list of required lubricants for equipment with moving parts.
6. Controls: Provide a description of the sequence of operation and as-installed control diagrams by the control manufacturer for systems requiring controls.
7. Coordination Drawings: Provide each contractor's coordination drawings.
 - a. Provide as-installed, color-coded piping diagrams, where required for identification.
8. Valve Tags: Provide charts of valve tag numbers, with the location and function of each valve.
9. Circuit Directories: For electric and electronic systems, provide complete circuit directories of panelboards, including the following:
 - a. Electric service.

- b. Controls.
- c. Communication.

1.8 INSTRUCTION OF THE OWNER'S PERSONNEL

- A. Prior to substantial completion, instruct the Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Provide instruction at mutually agreed upon times.
 - 1. For equipment that requires seasonal operation, provide similar instruction during other seasons.
 - 2. Use operation and maintenance manuals as the basis of instruction for each piece of equipment or system. Review contents in detail to explain all aspects of operation and maintenance.
- B. Training shall be conducted by an experienced, authorized service representative of the manufacturer (not a sales representative).

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 01 78 36

WARRANTIES AND BONDS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section specifies general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturer's standard warranties on products and special warranties.
 - 1. General closeout requirements are included in Section 01 78 00, Project Closeout.
 - 2. Specific requirements for warranties for the work and products and installations that are specified to be warranted, are included in the individual sections of Divisions 2 through 49.
- B. Disclaimers and Limitations. Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.
- C. Separate Prime Contracts: Each Prime Contractor is responsible for warranties related to its own contract.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplemental Conditions and other Division 1 specification sections, apply to this section.

1.3 DEFINITIONS

- A. Standard product warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.
- B. Special warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

1.4 WARRANTY REQUIREMENTS

- A. Standard Warranty: Warrant all equipment, materials, products, and workmanship provided under these Contract Documents for a period of 24 months after the date of substantial completion established by the Engineer.
- B. Related Damages and Losses: When correcting warranted work that has failed, remove and replace other work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted work.

- C. Reinstatement of Warranty: When work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty.
- D. Replacement Cost: Upon determination that work covered by a warranty has failed, replace or rebuild the work to an acceptable condition complying with requirements of Contract Documents. Complete warranty work as soon as possible after receipt of notice from the Owner for a warranty claim. The Contractor is responsible for the cost of replacing or rebuilding defective work regardless of whether the Owner has benefitted from use of the work through a portion of its anticipated useful service life.
- E. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights, and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.
 - 1. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.
 - 2. If the required repairs or replacements have not been completed or if positive and good faith efforts have not been made to complete the repairs or replacements within 30 consecutive calendar days after receipt of notice from the Owner of the warranty claim, the Owner shall be authorized to proceed with the repairs or replacements and the cost thereof shall be assessed against the Contractor's Performance Bond. Evidence of positive and good faith efforts shall include, as a minimum, joint visits by the Contractor and affected equipment vendors and manufacturers, and certified copies of purchase orders or invoices.
- F. The Owner reserves the right to refuse to accept work for the project where a special warranty, certification, or similar commitment is required on such work or part of the work, until evidence is presented that entities required to countersign such commitments are willing to do so.
- G. Multiple Equipment Failures. In the event of multiple equipment failures of major consequence prior to the expiration of the one-year warranty described above, disassemble, inspect, and modify or replace the affected equipment as necessary to prevent further occurrences. As used herein, "multiple equipment failures" shall be interpreted to mean two or more successive failures of the same kind in the same item of equipment or failures of the same kind in two or more items of similar equipment. Major equipment failures may include, but are not limited to, cracked or broken housings, piping, or vessels, excessive deflections, bent or broken shafts or structural members, broken or chipped gear teeth, overheating, premature bearing failure, excessive wear, or excessive leakage around seals. Should multiple equipment failures occur in a given item or type of equipment, disassemble, inspect, modify or replace, as necessary, all equipment of the same size and type, and rewarrant for 12 months.

1.5 SUBMITTALS

- A. Submit written warranties to the Engineer prior to the date certified for substantial completion. If the Engineer's Certificate of Substantial Completion designates a commencement date for warranties other than the date of substantial completion for

the work, or a designated portion of the work, submit written warranties upon request of the Engineer.

1. When a designated portion of the work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Engineer within fifteen days of completion of that designated portion of the work.
- B. When a special warranty is required to be executed by the Contractor, or the Contractor and a subcontractor, supplier, or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Owner through the Engineer for approval prior to final execution.
1. Refer to individual sections of Divisions 2 through 49 for specific content requirements, and particular requirements for submittal of special warranties.
- C. Form of Submittal. At final completion, compile two copies of each required warranty and bond properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Contract Documents.
1. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

PART 2 - PRODUCTS (Not Applicable).

PART 3 - EXECUTION (Not Applicable).

END OF SECTION

SECTION 01 78 39

PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section specifies administrative and procedural requirements for project record documents.
- B. Project record documents required include:
 - 1. Marked-up copies of Contract Drawings.
 - 2. Marked-up copies of approved shop drawings.
 - 3. Newly prepared drawings.
 - 4. Marked-up copies of Specifications, Addenda, and Change Orders.
 - 5. Marked-up product data submittals.
 - 6. Construction photographs.
 - 7. Field records for variable and concealed conditions.
- C. Specific record copy requirements that expand requirements of this section are included in the individual sections of Division 2 through 49.
- D. General project closeout requirements are included in Section 01 78 00, Project Closeout.
- E. Maintenance of Documents and Samples. Store record documents and samples in the field office apart from Contract Documents used for construction. Do not permit project record documents to be used for construction purposes. Maintain record documents in good order, and in a clean, dry, legible condition. Make documents and samples available at all times for inspection by the Engineer.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplemental Conditions and other Division 1 specification sections, apply to this section.

1.3 RECORD DRAWINGS

- A. Mark-up Procedure. During the construction period, maintain a set of blue- or black-line prints of Contract Drawings and shop drawings for project record document purposes.
 - 1. Mark these Drawings to indicate the actual installation where the installation varies appreciably from the installation shown originally. Give particular attention to information on concealed elements which would be difficult to identify or measure and record later. Items required to be marked include but are not limited to:
 - a. Dimensional changes to the Drawings.
 - b. Revisions to details shown on the Drawings.
 - c. Depth of rock.
 - d. Locations and depths of underground utilities.

- e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Locations of concealed internal utilities.
 - i. Changes made by Change Order.
 - j. Details not on original Contract Drawings.
2. Mark completely and accurately record prints of Contract Drawings or shop drawings, whichever is most capable of showing actual physical conditions. Where shop drawings are marked, show cross-reference on Contract Drawings location.
 3. Mark record sets with red erasable colored pencil; use other colors to distinguish between changes for different categories of the work at the same location.
 4. Mark important additional information which was either shown schematically or omitted from original Drawings.
 5. Note construction change directive numbers, alternate numbers, Change Order numbers, and similar identification.
 6. Responsibility for Markup: Where feasible, the individual or entity who obtained record data, whether the individual or entity is the installer, subcontractor, or similar entity, is required to prepare the mark-up on record drawings.
 - a. Accurately record information in an understandable drawing technique.
 - b. Record data as soon as possible after it has been obtained. In the case of concealed installations, record and check the mark-up prior to concealment.
 7. At time of final acceptance, submit record drawings to Engineer for Owner's records. Organize into sets, bind, and label sets for Owner's continued use.

1.4 RECORD SPECIFICATIONS

- A. Maintain one copy of the project Specifications, including addenda and modifications issued, for project record document purposes during the construction period.
 1. Mark the Specifications to indicate the actual installation where the installation varies substantially from that indicated in Specifications and modifications issued. Note related project record drawings information, where applicable. Give particular attention to substitutions, selection of product options, and information on concealed installations that would be difficult to identify or measure and record later.

1.5 RECORD PRODUCT DATA

- A. Maintain one copy of each product data submittal for project record document purposes during the construction period.
 1. Mark project data to indicate the actual product installation where the installation varies substantially from that indicated in product data submitted. Include

significant changes in the product delivered to the site, and changes in manufacturer's instructions and recommendations for installation.

2. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
3. Note related Change Orders and mark-up of record drawings, where applicable.
4. Upon completion of mark-up, submit a complete set of record product data to the Engineer for the Owner's records.
5. Where record product data are required as part of maintenance manuals, submit marked-up product data as an insert in the manual, instead of submittal as record product data.

1.6 MISCELLANEOUS RECORD SUBMITTALS

- A. Refer to other specification sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Immediately prior to final acceptance, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for use and reference. Submit to the Engineer for the Owner's records.
 1. Categories of requirements resulting in miscellaneous records include, but are not limited to the following:
 - a. Field records on excavations and foundations.
 - b. Field records on underground construction and similar work.
 - c. Survey showing locations and elevations of underground lines.
 - d. Invert elevations of drainage piping.
 - e. Surveys establishing building lines and levels.
 - f. Authorized measurements utilizing unit prices or allowances.
 - g. Inspections and certifications by governing authorities.
 - h. Leakage and pressure test.
 - i. Disinfection test results.
 - j. Final inspection and correction procedures.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 RECORDING

- A. Post changes and modifications to the documents as they occur. Do not wait until the end of the project. The Engineer will periodically review record documents to ensure compliance with this requirement.

END OF SECTION

DIVISION 03

CONCRETE

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SCOPE

- A. This section specifies cast-in-place concrete, including formwork, reinforcing, mix design, placement procedures, and finishes.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplemental Conditions or General Provisions and Division 1 specification sections, apply to this section.

1.3 SUBMITTALS

- A. General. Submit the following in accordance with conditions of contract and Division 1 specification sections.
- B. Product data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, waterstops, joint systems, curing compounds, and others as requested by Engineer.
- C. Shop drawings for detailing, fabricating, bending, and placing concrete reinforcement. Comply with ACI 315R "Guide to Presenting Reinforcing Steel Design Details" showing bar schedules, bent bar diagrams, arrangement, and support of concrete reinforcement. Include special reinforcing required for openings through concrete structures. Splices, clearances, and tolerances shall comply with ACI 318 and 350 requirements.
- D. Shop drawings for formwork, prepared by a registered professional engineer, for fabrication and erection of forms for suspended slabs, beams, and other elevated concrete elements.
 - 1. Engineer's review is for general design compliance only. Design of formwork for structural stability and efficiency is Contractor's responsibility.
- E. Laboratory test reports for concrete materials and mix design test.
- F. Materials certificates for the items listed below. Materials certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with or exceeds specified requirements. Provide certification for admixture manufacturers that chloride content complies with specification requirements.
 - 1. Aggregates.
 - 2. Cement.
 - 3. Admixtures.
 - 4. Reinforcement (including welds).
 - 5. Curing compounds.
 - 6. Waterstops.
 - 7. Bonding compounds.

1.4 QUALITY ASSURANCE

- A. Codes and Standards. Comply with provisions of following codes, specifications, and standards, except where more stringent requirements are shown or specified:
 - 1. ACI 318, "Building Code Requirements for Reinforced Concrete."
 - 2. Tanks and process structures containing water, wastewater, or similar liquids shall comply with ACI 350, "Code Requirements for Environmental Engineering Concrete Structures."
 - 3. Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice."
- B. Concrete Testing. The Owner will engage an independent testing laboratory to conduct testing of materials and concrete to ensure compliance with this Specification.
- C. Materials and installed work may require testing and retesting at any time during progress of work. Tests, including retesting, of rejected materials or installed work which fails its initial testing, shall be done at Contractor's expense.

1.5 CONCRETE PRE-CONSTRUCTION MEETING

- A. A mandatory pre-construction meeting is required after the mix design has been accepted by the Engineer but prior to any concrete placement.
- B. Attendees must include, but are not limited to, representatives from the following:
 - 1. General Contractor.
 - 2. Ready Mix Plant .
 - 3. Concrete Sub-contractor.
 - 4. Testing Agency
 - 5. Project Manager or Design Engineer.
 - 6. Resident Project Representative (RPR).
- C. The meeting will be conducted by the project manager or the RPR

PART 2 - PRODUCTS

2.1 FORM MATERIALS

- A. Forms for Exposed Finish Concrete. Plywood, metal, metal-framed plywood-faced, or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on Drawings.
 - 1. Use overlaid plywood complying with U.S. Product Standard PS-1 "A-C or B-B High Density Overlaid Concrete Form," Class 1.
 - 2. Plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood," Class 1, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.

- B. Forms for Unexposed Finish Concrete. Plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns and Supports. Metal, fiberglass-reinforced plastic, or paper or fiber tubes. Provide paper or fiber tubes of laminated plies with water-resistant adhesive and wax-impregnated exterior for weather and moisture protection. Provide units with sufficient wall thickness to resist wet concrete loads without deformation.
- D. Form Coatings. Provide commercial formulation form-coating compounds with a maximum VOC of 350 g/l that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
- E. Form Ties. Factory-fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent form deflection and to prevent spalling concrete upon removal. Provide units that will leave no metal closer than 1½ inches to exposed surface. Provide ties that, when removed, will leave holes not larger than 1-inch diameter in concrete surface. Tie holes shall be filled with non-shrink grout.

2.2 REINFORCING MATERIALS

- A. Reinforcing Bars. ASTM A 615, Grade 60, deformed.
- B. Epoxy-Coated Reinforcing Bars. ASTM A 775.
- C. Steel Wire. ASTM A 82, plain, cold-drawn steel.
- D. Welded Wire Fabric. ASTM A 185, welded steel wire fabric.
- E. Welded Deformed Steel Wire Fabric. ASTM A 497.
- F. Supports for Reinforcement. Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire-bar-type supports complying with CRSI specifications.
 - 1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
 - 2. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs that are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).

2.3 CONCRETE MATERIALS

- A. Portland Cement. ASTM C 150, Type I. Use one brand of cement throughout project unless otherwise acceptable to Engineer.
- B. Fly Ash. ASTM C 618, Type C or Type F.
- C. Coarse Aggregate. ASTM C 33, Class Designation 3S, Grading Size No. 67, and as herein specified. Provide coarse aggregate from a single source for all exposed concrete.
- D. Fine Aggregate. Natural siliceous river sand, consisting of hard, clean, sharp, strong, durable, and uncoated particles, conforming to the requirements of ASTM C 33.

1. Fine aggregate shall have a fineness modulus of 2.40 minimum and 3.00 maximum and the material passing the No. 200 sieve shall not exceed 3.0 percent by weight of the total sample. Coal and lignite shall not exceed 0.5 percent by weight of the total sample for all concrete. The fineness modulus of fine aggregate incorporated in the work shall not vary more than 0.10 plus or minus from the fineness modulus of the fine aggregate in the appropriate preliminary mix design approved by the Engineer.

E. Water: Drinkable.

F. Admixtures, General. Provide admixtures for concrete that contain not more than 0.1 percent chloride ions.

1. Available Manufacturers: Provide admixtures from single source manufacturer for air entrainment and water reducing admixtures. Manufacturers of admixtures shall include but not be limited to the following provided single source availability requirements are met:
 - a. Master Builders, Inc.
 - b. W. R. Grace and Company.
 - c. Euclid Chemical Company.
2. Air-Entraining Admixture. ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
3. Water-Reducing Admixture: ASTM C 494, Type A.
4. High-Range Water-Reducing Admixture (Super Plasticizer). ASTM C 494, Type F or Type G.
5. Water-Reducing, Accelerating Admixture. ASTM C 494, Type E. Accelerating admixtures must be nonchloride type and are for use only when specifically authorized by the Engineer. Submittal of separate mix design using accelerating admixture will be required.
6. Water-Reducing, Retarding Admixture. ASTM C 494, Type D. Retarding admixtures must be nonchloride type and are for use only when specifically authorized by the Engineer. Submittal of separate mix design using retarding admixture will be required.

2.4 RELATED MATERIALS

A. Waterstops. Provide waterstops at construction joints and other joints as indicated on the Drawings.

1. Polyvinyl Chloride Waterstops. Corps of Engineers CRD-C 572.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:
 - 1) The Burke Company.
 - 2) Greenstreak Plastic Products Company.
 - 3) W. R. Meadows, Inc.
 - 4) Progress Unlimited.
 - 5) Schlegel Corp.
 - 6) Vinylex Corp.

2. Bentonite Clay Waterstops. Specially formulated joint sealant, manufactured in coils with a rectangular cross section, which swells upon contact with water. Adhesive supplied by the water stop manufacturer shall be used to secure the waterstop to existing concrete prior to placing adjoining concrete.
- B. Granular Base. Evenly graded and compacted washed coarse aggregate conforming to ASTM C33, Class Designation 3S, Grading Size No. 57.
 - C. Sand Cushion. Clean, manufactured, or natural sand.
 - D. Vapor Retarder. Provide polyethylene sheet vapor retarder cover not less than 8 mils thick over prepared base material where indicated below slabs on grade. Use only materials that are resistant to deterioration when tested in accordance with ASTM E 154.
 - E. Liquid Membrane-Forming Curing Compound. Liquid-type membrane-forming curing compound with fugitive dye complying with ASTM C 309, Type I-D, Class A. Moisture loss not more than 0.055 gr./sq. cm. when applied at 200 sq. ft./gal.
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers whose products may be incorporated in the work include, but are not limited to, the following:
 - a. Dayton Superior Corp.
 - b. Euclid Chemical.
 - c. Sonneborn Rexnord.
 - F. Epoxy Bonding Agent. ASTM C 881, two-component material suitable for use on dry or damp surfaces. Provide material "Type," "Grade," and "Class" to suit project requirements.
 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:
 - a. "Burke Epoxy M.V.," The Burke Company.
 - b. "Euco Epoxy System #452 or #620," Euclid Chemical Co.
 - c. "Sikadur 32 Hi-Mod," Sika Corporation.
 - G. Chemical Hardener. U.S. Army Corps of Engineers Specification 204, liquid hardener composed of magnesium and zinc fluorosilicates combined with an anionic surfactant to improve wetting penetration. Hardener to be colorless, nontoxic, nonflammable, and compatible with and providing good adhesion for subsequent topping and/or coatings. Install hardener in accordance with manufacturer's recommendations on interior concrete floors of shops, garages, vehicle service areas, and elsewhere as indicated on the Drawings.
 - H. Joint Filler. At joints in slabs and elsewhere as indicated on the Drawings, use preformed strips of asphalt saturated fiberboard (1/2-inch nominal thickness) complying with ASTM D 1751.
 1. All joints to be placed using an expansion board cap or "zip" cap to allow joint to be properly sealed, unless shown otherwise on drawings.
 2. See Section 07 90 00, Joint Sealants, for proper sealant material.

2.5 PROPORTIONING AND DESIGN OF MIXES

- A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method used, use an independent testing facility acceptable to Engineer for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing.
1. Fly ash may be substituted for cement in amounts not to exceed 20 percent of the specified cement content by weight providing that the mix conforms with all other requirements.
- B. Submit written reports to Engineer of each proposed mix for each class of concrete at least 15 days prior to start of concrete placement. Do not begin concrete production until proposed mix designs have been reviewed by Engineer.
- C. Design mixes to provide normal weight concrete with the following properties:

Property	Concrete Class	
	A	B
28-day Compressive Strength: Average of Three Consecutive Specimens	4,000 psi	2,500 psi
Minimum Any One Specimen	3,200 psi	2,000 psi
Minimum Cement Content (sacks/cubic yard)	6.5	5.0
Maximum Water-to-Cement Ratio: By Weight (pound/pound)	0.49	0.54
By Sack (gallon/sack)	5.5	6.0
Air Content** (percent by volume): Minimum	4.0	4.0
Maximum	6.0	6.0
Ratio of Coarse to Fine Aggregate (by weight): Minimum	1.0	1.0
Maximum	2.0	2.5
Class "A" concrete shall be used for all concrete work unless Class "B" is specifically called for on the Drawings **Air Entrainment may be omitted for interior slabs		

- D. Adjustment to Concrete Mixes. Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as accepted by Engineer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Engineer before using in work.

2.6 ADMIXTURES

- A. Use water-reducing admixture or high-range water-reducing admixture (Superplasticizer) in all concrete.
- B. Use nonchloride accelerating admixture in concrete placed at ambient temperatures below 50°F (10°C) when authorized by the Engineer.

- C. Use high-range water reducing admixture (HRWR) in pumped concrete.
- D. Admixtures. Use admixtures for water reduction and set control in strict compliance with manufacturer's directions.

2.7 SLUMP LIMITS.

- A. Proportion and design mixes to result in concrete slump at point of placement as follows:
 - 1. Ramps, slabs, and sloping surfaces: Not more than 3 inches.
 - 2. Walls: 2½ to 4 inches.
 - 3. Floors and slabs: 2 to 3 inches.
 - 4. Beams: 2 to 3 inches.
 - 5. Blocks and Footings: 2 to 4 inches.
- B. Concrete having a slump greater than 1 inch over the specified maximum shall be rejected.
- C. Pumped Concrete: the maximum slump of the concrete at the suction of the pump may be increased above the maximum specified slump by the amount of slump loss in the pumping system up to a maximum of 1 inch.
- D. Congested Placement. When specifically requested in writing by the Contractor and approved by the Engineer, increases in discharge slumps may be considered in placements that include congested areas of reinforcement or areas otherwise deemed to be difficult to place concrete and achieve necessary consolidation. The increases in slump, if approved, shall be achieved by the addition of high range water reducing agent at the site in accordance with the manufacturer's instructions. The request shall include the proposed amount of slump increase and the amount of high range water reducer to be added. The Engineer will evaluate each request independently.

2.8 CONCRETE MIXING

- A. Job-Site Mixing. Only allowed when specifically authorized by the Engineer.
- B. Ready-Mix Concrete. Comply with requirements of ASTM C 94, and as specified.
 - 1. When air temperature is between 85°F (30°C) and 90°F (32°C), reduce mixing and delivery time from 1½ hours to 75 minutes, and when air temperature is above 90°F (32°C), reduce mixing and delivery time to 60 minutes.

2.9 EPOXY ANCHORS AND DOWELS

- A. Anchors. Unless shown otherwise, dowels or anchors placed in existing or hardened concrete shall be stainless steel Type 316 ASTM F 593 and ASTM F 594, threaded rod with hex nuts.
- B. Epoxy adhesive shall be as follows:
 - 1. Two component, 100% solid (containing no solvents), non-sag paste, insensitive to moisture.

2. Conform to NSF Standard 61 for use in conjunction with drinking water systems.
3. Adhesive shall have been tested and qualified in accordance with ACI 355.4 and ICC-ES Acceptance Criteria 308 for cracked concrete and seismic applications. Design bond strength has been based on cracked concrete, ACI 355.4 Temperature Range B, and installations into dry holes drilled into concrete that has cured for at least 21 days using a carbide drill bit qualified by the manufacturer. Adhesive shall be installed by a certified adhesive anchor installer when required per ACI 318. Installations requiring certified installers shall be inspected per ACI 318.
4. Epoxy adhesive shall be:
 - a. Red Head C-6+-, manufactured by ITW Construction Products.
 - b. Simpson Strong-Tie SET-3G.
 - c. Hilti HIT-RE 500 V3.
 - d. Or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

- A. Coordinate the installation of joint materials and vapor retarders with placement of forms and reinforcing steel.
- B. All slabs on grade to have a minimum 6-inch granular base unless noted otherwise on Drawings. Granular base to be saturated with water just prior to placement of concrete.

3.2 FORMS

- A. General. Design, erect, support, brace, and maintain formwork to support vertical and lateral, static and dynamic loads that might be applied until concrete structure can support such loads. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances complying with ACI 347.
- B. Construct forms to sizes, shapes, lines, and dimensions shown and to obtain accurate alignment, location, grades, level, and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent leakage of cement paste.
- C. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.
- D. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete.

Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

- E. Chamfer exposed corners and edges at $\frac{3}{4}$ inch unless indicated otherwise on the Drawings, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.
- F. Provisions for Other Trades. Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.
- G. Cleaning and Tightening. Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before concrete is placed. Retighten forms and bracing before concrete placement as required to prevent mortar leaks and maintain proper alignment.

3.3 VAPOR RETARDER/BARRIER INSTALLATION

- A. General. Following leveling and tamping of granular base for slabs on grade, place vapor retarder/barrier sheeting with longest dimension parallel with direction of pour.
- B. Lap joints 6 inches and seal vapor barrier joints with manufacturers' recommended mastic and pressure-sensitive tape.
- C. After placement of vapor retarder/barrier, cover with sand cushion and compact to depth as shown on Drawings.

3.4 PLACING REINFORCEMENT

- A. General. Comply with ACI 318 and the CRSI's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports and as herein specified.
 - 1. Avoiding cutting or puncturing vapor retarder during reinforcement placement and concreting operations.
 - 2. Field bending of reinforcement using heat and/or welding of reinforcement is NOT permitted.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as approved by Engineer.
- D. Place reinforcement to obtain at least minimum coverage for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.5 JOINTS

- A. Construction and Control Joints. Locate and install construction and control joints as indicated or, if not indicated, locate so as not to impair strength and appearance of the structure, as acceptable to Engineer, and to comply with applicable code requirements (see Paragraph 1.4, herein).
1. Provide keyways at least 1½ inches deep with a width of approximately one-half the thickness of the thinnest section being joined at construction and control joints in walls, slabs, between walls and slabs, and between walls and footings unless otherwise indicated. Acceptable bulkheads designed for this purpose may be used for slabs.
 2. Place construction and control joints perpendicular to main reinforcement. Continue reinforcement across construction joints except as otherwise indicated. Do not continue reinforcement through sides of strip placements or at control joints.
 3. Use bonding agent on existing concrete surfaces that will be joined with fresh concrete at construction joints.
- B. Waterstops. Provide waterstops in construction and control joints as indicated. Install waterstops to form continuous diaphragm in each joint. Make provisions to support and protect exposed waterstops during progress of work. Field-fabricate joints in waterstops in accordance with manufacturer's printed instructions.
- C. Isolation Joints in Slabs-on-Ground for Floors of Buildings, Sidewalks, and Driveways. Construct isolation joints in slabs-on-ground at points of contact between slabs-on-ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated. Construct isolation joints using preformed joint filler board.
- D. Contraction Joints in Slabs-on-Ground for Floors of Buildings, Sidewalks, and Driveways. Construct contraction joints in slabs-on-ground to form panels of patterns as shown. Use saw cuts ⅛ inch wide by ¼ of slab depth or inserts ¼ inch wide by ¼ of slab depth, unless otherwise indicated.
1. Form contraction joints by inserting premolded plastic, hardboard, or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. Tool slab edges round on each side of insert. After concrete has cured, remove inserts and clean groove of loose debris.
 2. Begin saw cutting of contraction joints in floor slabs as soon as possible after slab finishing as may be safely done without dislodging aggregate. Saw cutting must be completed within 8 hours following slab placement.
 3. If joint pattern is not shown, provide joints not exceeding 15 feet in either direction and locate to conform to bay spacing wherever possible (at column centerlines, half bays, third bays).

3.6 INSTALLATION OF EMBEDDED ITEMS

- A. General. Set and build into work anchorage devices and other embedded items required for other work that is attached to or supported by cast-in-place concrete. Use

setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached thereto.

- B. Forms for Slabs. Set edge forms, bulkheads, and intermediate screed strips for slabs to obtain required elevations and contours in finished surfaces. Provide and secure units to support screed strips using strike-off templates or compacting-type screeds.
- C. Conduits, Pipes, and Sleeves
 - 1. Must be located within the middle third of the overall thickness of slab, wall, or beam.
 - 2. Shall not be spaced closer than three diameters or widths on center.
 - 3. Do not tie or support on concrete reinforcement. Provide chairs or stands as required.

3.7 PREPARATION OF FORM SURFACES

- A. General. Coat contact surfaces of forms with an approved, nonresidual, low-VOC, form-coating compound before reinforcement is placed.
- B. Do not allow excess form-coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.
- C. Coat steel forms with a nonstaining, rust-preventative material. Rust-stained steel formwork is not acceptable.

3.8 CONCRETE PLACEMENT

- A. Inspection. Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work.
- B. General. Comply with ACI 304, "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete," and as herein specified.
- C. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete that has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete to avoid segregation at its final location.
- D. Placing Concrete in Forms. Deposit concrete in forms in horizontal layers not deeper than 24 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
 - 1. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309.
 - 2. One operable, back-up, mechanical vibrator shall be on site prior to beginning concrete placement.

3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.
- E. Placing Concrete Slabs. Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.
1. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Bring slab surfaces to correct level with straightedge and strike off. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
 3. Maintain reinforcing in proper position during concrete placement.
- F. Cold-Weather Placing. If permitted by the Engineer, comply with provisions of ACI 306 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When air temperature has fallen or is expected to fall below 40°F (4°C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50°F (10°C) and not more than 80°F (27°C) at point of placement.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, and other materials containing antifreeze agents or chemical accelerators unless authorized by the Engineer.
 4. Provide adequate means for maintaining the temperature of the air surrounding the concrete at 70°F for three days, or 50°F for five days, or for as long as is necessary to ensure proper curing of the concrete. Rapid cooling of the concrete shall be prevented. Housing, covering, or other protection used in connection with heating shall remain in place and intact at least 24 hours after the artificial heat is discontinued.
- G. Hot-Weather Placing. When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.
1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 85°F. Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water. Use of liquid nitrogen to cool concrete is Contractor's option.

2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
3. Fog spray forms, reinforcing steel, and subgrade just before concrete is placed.
4. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, when acceptable to Engineer.

3.9 FINISH OF FORMED SURFACES

- A. Coordinate finish requirements with surface preparation requirements for concrete to be coated in accordance with Section 09 91 00, Painting, if applicable.
- B. Provide rough form finish for formed concrete surfaces not exposed to view in the finish work or concealed by other construction. This is the concrete surface having texture imparted by form-facing material, with tie holes and defective areas repaired and patched and fins and other projections exceeding ¼-inch in height rubbed down or chipped off.
- C. Provide smooth form finish for formed concrete surfaces exposed to view or to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, painting, or other similar system. This is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective areas with fins and other projections completely removed and smoothed.
- D. Grout-Cleaned Finish. Provide grout-cleaned finish as follows to concrete surfaces that have received smooth form finish treatment not to be coated with paint, waterproofing, dampproofing, or other similar system.
 1. Combine one part portland cement to 1½ parts fine sand by volume, and a 50:50 mixture of acrylic-based bonding admixture and water to consistency of thick paint. Blend standard portland cement and white portland cement, amounts determined by trial patches, so that final color of dry grout will match adjacent surfaces.
 2. Thoroughly wet concrete surfaces, apply grout to coat surfaces, and fill small holes. Remove excess grout by scraping and rubbing with clean burlap. Keep damp by fog spray for at least 36 hours after rubbing.
 3. A polymer-modified, Portland-cement based waterproofing coating may be substituted for the cement sand grout finish specified above. A two-coat application is required. Surface preparation, product mixing, product application, and product curing shall be in strict accordance with the manufacturer's written recommendations.
- E. Related Unformed Surfaces. At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.10 MONOLITHIC SLAB FINISHES

- A. Coordinate finish requirements with surface preparation requirements for concrete to be coated in accordance with Section 09 91 00, Painting, if applicable.
- B. Float Finish. Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified; slab surfaces to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo; and as otherwise indicated.
 - 1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using float blades or float shoes only, when surface water has disappeared, when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units. Check and level surface plane to a tolerance of plus or minus ¼-inch as measured from a 10-foot straight edge. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
- C. Trowel Finish. Apply trowel finish to monolithic slab surfaces to be exposed to view and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or other thin film finish coating system.
- D. Trowel and Fine Broom Finish. Where ceramic or quarry tile is to be installed with thin-set mortar, apply trowel finish as specified, then immediately follow with slightly scarifying surface by fine brooming.
- E. Nonslip Broom Finish. Apply nonslip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
 - 1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.

3.11 CONCRETE CURING AND PROTECTION

- A. General. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. In hot, dry, and windy weather, protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply in accordance with manufacturer's instructions after screeding and bull floating, but before power floating and troweling.
- B. Initial Curing. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing.
- C. Curing Methods. Perform curing of concrete by curing and sealing compound, by moist curing, by moisture-retaining cover curing, and by combinations thereof, as herein specified. Select curing method appropriate for subsequent coating and finishing requirements. Coordinate curing methods with Section 09 91 00, Painting, for concrete to be painted.
 - 1. Provide moisture curing by either of the following methods or combination thereof, maintaining concrete surface moisture for seven days:
 - a. Keep concrete surface continuously wet by covering with water.

- b. Use continuous water-fog spray.
 - c. Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4-inch lap over adjacent absorptive covers.
2. Moisture-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape. Maintain concrete surface moisture for seven days.
 3. Curing and sealing compound, when utilized, shall be applied as follows:
 - a. Flatwork: Apply curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within two hours and after surface water sheen has disappeared). Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's directions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - b. Use membrane curing compounds that will not affect surfaces to be covered with finish materials applied directly to concrete.
 - c. Formed Surfaces: Apply curing and sealing compound upon removal of form work.
 4. Curing Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces, by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.
 5. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces, by application of appropriate curing method.
 - a. Cure concrete surfaces to receive liquid floor hardener or other finish by use of moisture-retaining cover, unless otherwise directed.

3.12 REMOVAL OF FORMS

- A. General. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50°F (10°C) for 72 hours after placing concrete, provided curing and protection operations are maintained.
- B. Formwork supporting weight of concrete, such as beams, soffits, joists, slabs, and other structural elements, may not be removed in less than 14 days and until concrete has attained at least 75 percent of design minimum compressive strength at 28 days. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members.
- C. Form-facing material may be removed 4 days after placement only if shores and other vertical supports have been arranged to permit removal of form-facing material without loosening or disturbing shores and supports.

3.13 REUSE OF FORMS

- A. Clean and repair surfaces of forms to be reused in work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-coating compound as specified for new formwork.
- B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces except as acceptable to Engineer.

3.14 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In. Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.
- B. Curbs. Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations. Provide machine and equipment bases and foundations, as shown on Drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.
- D. Reinforced Masonry. Provide concrete grout for reinforced masonry lintels and bond beams where indicated on Drawings and as scheduled. Maintain accurate location of reinforcing steel during concrete placement.
- E. Concrete Embedment and Encasement of Pipe. Install concrete for embedment and encasement where indicated on the Drawings and at such locations where installation conditions require such pipe support as determined by the Engineer. Embedment and encasement of pipe shall be preceded by the following preliminary steps:
 - 1. Remove all loose material from the trench prior to placing concrete. All concrete shall have a continuous contact with undisturbed soil on sides and bottom of trench.
 - 2. Accurately place a base course of concrete to such grade and elevation that the pipe will be at specified grade when pipe bells are supported on, and in contact with, the top surface of the base course.
 - 3. Restrain each length of pipe to maintain alignment and prevent floatation in a manner acceptable to the Engineer.

3.15 CONCRETE SURFACE REPAIRS

- A. Patching Defective Areas. Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to Engineer.
 - 1. Cut out honeycomb, rock pockets, voids over ¼-inch in any dimension, and holes left by tie rods and bolts, down to solid concrete but in no case to a depth of less than 1-inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched

- with specified bonding agent. Place patching mortar before bonding compound has dried.
2. For exposed-to-view surfaces, blend white portland cement and standard portland cement so that, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.
- B. Repair of Formed Surfaces. Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Engineer. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on surface, and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with dry-pack mortar, or precast cement cone plugs secured in place with bonding agent.
1. Repair concealed formed surfaces, where possible, that contain defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.
- C. Repair of Unformed Surfaces. Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope and smoothness by using a template having required slope.
1. Repair finished unformed surfaces that contain defects that affect durability of concrete. Surface defects, as such, include crazing and cracks in excess of 0.01-inch wide or that penetrate to reinforcement or completely through nonreinforced sections regardless of width, spalling, popouts, honeycomb, rock pockets, and other objectionable conditions.
 2. Correct high areas in unformed surfaces by grinding after concrete has cured at least 14 days.
 3. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting out low areas and replacing with patching compound. Finish repaired areas to blend into adjacent concrete.
 4. Repair defective areas, except random cracks and single holes not exceeding 1-inch-diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least $\frac{3}{4}$ -inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
- D. Repair isolated random cracks and single holes not over 1-inch-diameter by dry-pack method. Groove top of cracks and cut out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Mix dry-pack, consisting of one part portland cement to $2\frac{1}{2}$ parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Place dry-pack before bonding compound has dried. Compact

3. Test cylinders will normally be laboratory-cured. However, the Engineer may require tests on field-cured specimens to check the adequacy of curing operations.
 4. A slump test and an air content test will be performed on each sample of concrete tested for compressive strength.
 5. Cement and aggregate will be subject to inspection, sampling, and field testing at the batching plant. Concrete will be subject to inspection, sampling, and field testing at the place of concrete placement.
 6. All field sampling, field testing, making and curing of field test cylinders, and laboratory testing performed during concreting operations for the purpose of determining if the requirements of this specification section are being satisfied shall be conducted by an independent testing laboratory selected by the Owner and paid for directly by the Owner and not as a part of this Contract.
 7. Furnish the testing laboratory representative satisfactory samples of cement, aggregate, and concrete for inspection and testing purposes. The Contractor shall furnish any barrows, shovels, mixing boards, shaded area for preparing test cylinders, and similar equipment required by the testing laboratory representative for securing samples, making test cylinders, and conducting field tests.
- C. Test results will be reported in writing to Engineer, Ready-Mix Producer, and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-day tests and 28-day tests.
- D. Nondestructive Testing. Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.
- E. Additional Tests. The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Engineer. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed. Contractor shall pay for any and all such tests.
- 3.17 LOADS APPLIED TO NEW CONCRETE
- A. Loads including, but not limited to, earth loads, loads exerted from bracing or shoring, wind loads, hydrostatic or hydraulic loads, equipment or vehicle loads, or loads exerted by stacked materials, shall not be applied to fresh concrete until the concrete has reached its specified 28-day strength.
 - B. Concrete which has cracked due to overloading, loading before required strength has developed, or otherwise damaged shall be repaired or replaced as determined by the Engineer.

3.18 INSTALLATION OF EPOXY ANCHORS AND DOWELS

- A. Verify number, size, depth, and location of anchors or dowels to be installed.
- B. Drill holes in concrete to the depth specified on the Drawings using methods as instructed by the epoxy manufacturer. The diameter of holes shall be as instructed by the epoxy manufacturer for the anchor or dowel being installed. Clean holes as instructed by the epoxy manufacturer.
- C. Install epoxy in strict accordance with the manufacturer's instructions using guns with self-mixing nozzles provided by the manufacturer. Verify epoxy is mixed prior to placement into the hole using methods per manufacturer's instructions. Insert dowel or anchor into the hole and hold steady as instructed by the manufacturer.

END OF SECTION

SECTION 03 48 00

MONOLITHIC OR SECTIONAL PRECAST CONCRETE STRUCTURES

PART 1 - GENERAL

1.1 SCOPE

- A. Furnish all labor, materials, equipment, and incidentals required to install rectangular, monolithic, or sectional precast water and wastewater structures, pipe connectors, and accessories as specified herein.

1.2 RELATED SECTIONS

- A. Section 31 2000 - Earthwork

1.3 REFERENCES

- A. Prestressed Concrete Institute. Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.
- B. National Precast Concrete Association. Quality Control Manual for Precast Concrete Plants.
- C. American Society for Testing and Materials (ASTM)
 - 1. ASTM C 478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.
 - 2. ASTM C 890 - Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures.
 - 3. ASTM C 891 - Standard Practice for Installation of Underground Precast Concrete Utility Structures.
 - 4. ASTM C 923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipe and Laterals.
 - 5. ASTM C 913 - Standard Specifications for Precast Concrete Water and Wastewater Structures.
- D. American Association of State Highway and Transportation Officials Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets (AASHTO M198).
- E. American Concrete Institute Building Code Requirements for Reinforced Concrete (ACI 318).
- F. Occupational Safety and Health Administration Standard 1926.704 - Requirements for Precast Concrete.

1.4 SUBMITTALS SHALL BE AS FOLLOWS

- A. Copy of certificate or report showing that the precast concrete manufacturer conforms to Article 1.5 - Qualifications.
- B. Schedule of precast concrete structure sections to be provided on the project, charting the following items, when applicable:
 - 1. Sheet number where the precast structure plan and profile is shown on the plans.
 - 2. Line number (when there is more than one line on the project).
 - 3. Precast structure station number.
 - 4. Invert elevation of the influent and effluent line as indicated on the plans.
 - 5. Top elevation of the precast structure frame as indicated on the plans.
 - 6. Top elevation of precast structure base slab as calculated.
 - 7. Total height of precast structure required from top of base slab to top of frame.
 - 8. Total height of assembled base, risers, and cone or top provided from top of base to top of top.
 - 9. Manufacturer's part number or catalog number and number required of each base, riser, and top provided for the precast structure.
 - 10. Each pipe size and type and its connector's part number, distance from top of base slab, and horizontal distances from inner wall corners of precast structure.
- C. Detail of each precast concrete structure section to be provided showing or charting the following:
 - 1. Manufacturer's part number or catalog number.
 - 2. Inside dimensions.
 - 3. Lay length excluding base slab.
 - 4. Wall thickness and base or top thickness where applicable.
 - 5. Handling weight.
 - 6. Wire size, spacing, and area provided per vertical foot.
 - 7. Reinforcing bar size and spacing.
 - 8. Design loads.
 - 9. Concrete mix number and design strength.
 - 10. Height, width, slope, and annular space of the tongue and groove.
- D. Pipe connector details and material specifications.
- E. Joint material detail, material specifications and calculations showing that the joint material cross section is greater than the joint's annular space times its height.
- F. Lifting device and hole detail.

G. Submit the following at the request of the Engineer or Owner:

1. Structural analysis and design calculations for precast components, performed in accordance with applicable codes and standards, showing that allowable stresses will not be exceeded. All calculations must be sealed by a registered professional engineer.
2. Calculations or test results verifying that the lifting device components and holes are designed in accordance with OSHA Standard 1926.704.
3. Concrete 28-day compression strength results for every day production of precast components for the project was performed showing the required strength according to the guidelines established in ACI 318.
4. Reinforcing and cement mill reports for materials used in the manufacture of precast components for this project.
5. The above test reports for similar precast components recently produced, submitted prior to production of precast components for this project.

1.5 QUALIFICATIONS

A. The precast manufacturer shall comply with one of the following requirements:

1. Manufacture precast components for the project in a plant certified in the Prestressed Concrete Institute's (PCI) Plant Certification Program.
2. Manufacture precast components for the project in a plant certified in the National Precast Concrete Association's (NPCA) Plant Certification Program.
3. Retain an independent testing or consulting engineering firm approved by the Engineer for precast plant inspection. The basis for plant inspection shall be the National Precast Concrete Association Quality Control Manual or the Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products. The above firm shall inspect the precast plant 2 weeks prior to and at 1 week intervals during production of materials for this project and issue a report, certified by a registered engineer that materials, methods, products, and quality control meet the requirements of the above quality control manuals.

B. The precast manufacturer shall have a recognized quality improvement process installed at the manufacturing facility.

C. The precast manufacturer shall provide engineering certification as to the structural adequacy of any precast component, if requested.

D. All concrete compressive strength testing shall be performed in a laboratory inspected by the CCRL of the National Bureau of Standards.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Maintain materials and surrounding air temperature to minimum 50°F prior to, during, and 48 hours after completion of masonry, grouting or concreting work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Concrete shall conform to ASTM C 478 and as follows:
1. Compressive Strength: 5,000 psi minimum at 28 days.
 2. Air Content: 4 percent minimum.
 3. Alkalinity: Adequate to provide a life factor, $A_z = \text{Calcium carbonate equivalent times cover over reinforcement}$, no less than 0.35 for bases, risers and tops.
 4. Cementitious Materials: Minimum of 564 pounds per cubic yard.
 5. Coarse Aggregates: ASTM C 33. Sound, crushed, angular stone only. Smooth or rounded stone shall not be used.
 6. Fine Aggregates: ASTM C 33. Free from organic impurities.
 7. Chemical Admixtures: ASTM C 494. Calcium chloride or admixtures containing calcium chloride shall not be used.
 8. Air Entraining Admixtures: ASTM C 260.
- B. Reinforcing steel shall be ASTM A 615 Grade 60 deformed bar, ASTM A82 wire or ASTM A 185 welded wire fabric.
- C. Lifting loops shall be ASTM A 416 steel strand. Lifting loops made from deformed bars shall not be allowed.
- D. Butyl rubber sealant shall conform to Federal Specification SS-S-210A, AASHTO M-198, Type B - Butyl Rubber and as follows: maximum of 1% volatile matter and suitable for application temperatures between 10 and 100°F.
- E. Butyl rubber with bentonite sealant shall conform to Federal Specification SS-S-210A, ASTM D 297, and containing no asphaltics as follows: maintaining 99% solids with a maximum of 1% volatile matter and suitable for application temperatures between 5 and 125°F.
- F. Epoxy gels used for interior patching of wall penetrations shall be a 2-component, solvent-free, moisture-insensitive, high modulus, high-strength, structural epoxy paste adhesive meeting ASTM C 881, Type I and II, Grade 3, Class B and C, Epoxy Resin Adhesive.

2.2 COMPONENTS

- A. Precast component fabrication and manufacture shall be as described in this paragraph and as described in the paragraphs for the specific components.

1. Precast structures shall be manufactured in conformance with ASTM C 913. Wall and inside slab finishes resulting from casting against forms standard for the industry shall be acceptable, except form ties through the wall of the product are not allowed. Exterior slab surfaces shall have a float finish. Small surface holes, normal color variations, normal form joint marks, minor depressions, chips and spalls will be tolerated. Dimensional tolerances shall be those set forth in the appropriate references and specified below.
 2. Joint surfaces for joints between precast structure components shall be keyways or tongue and grooves manufactured to the joint surface design and tolerance requirements of ASTM C 913.
 3. Lift holes and inserts used for handling precast structures shall be sized for a precision fit with the lift devices, shall not penetrate through the precast structure wall, and shall comply with OSHA Standard 1926.704.
- B. Precast base sections shall have the base slab cast monolithically with the walls, or have an approved galvanized or PVC waterstop cast in the cold joint between the base slab and the walls.
- C. Precast riser sections. The minimum lay length of precast riser sections shall be 36 inches.
- D. Precast cone sections shall have an inside diameter at the top of 24 inches. The width of the top ledge shall be no less than the wall thickness required for the cone section. Concentric cones shall be used only for shallow manholes.
- E. Precast top sections. Flat slab top sections shall be designed for HS-20 traffic loadings as defined in ASTM C 890. Transition top sections shall provide for transition to other diameter risers, cones, and flat slab top sections with a joint equal to that of a riser section. Venting of top sections shall be as shown on the details.
- F. Pipe to manhole connectors shall conform to ASTM C 923. On large diameter flexible pipes, provisions for control of the pipe outside diameter to within the tolerances of the connector shall be made.
- G. Joints shall be sealed internally between the tongue and the groove and additionally around the external perimeter of the joint as follows:
1. External seals shall consist of a polyethylene backed flat butyl rubber sheet no less than 1/16-inch thick and 6 inches wide applied to the outside perimeter of the joint.
 2. Joints with a perimeter greater than or equal to 18 feet shall be internally sealed with butyl rubber/bentonite sealant.
 3. Joints with a perimeter less than 18 feet shall be internally sealed with butyl rubber sealant.
- H. Manhole rings, covers, hatches and doors, frames and grate to be provided as equal to those shown on the precast structure details. Materials shall be cast iron, steel, or

aluminum as conforming to details per application. For dimensions of castings see precast top details.

- I. Lifting devices complying with OSHA Standard 1926.704 for handling the precast components shall be provided by the precast manufacturer. The design of lifting devices shall comply with ASTM C 913, Paragraph 5.8 standards.
- J. The interior/exterior of the precast structure wall shall be coated with 21 mils of coal tar epoxy, Koppers 300M or equal, where shown on the plans. The coating shall be spray applied according to the manufacturer's recommendations by an applicator with a minimum of 5 years experience. The joints between precast sections shall not be coated. Use joint sealant as specified above to seal the interior horizontal joint surface.

2.3 CONFIGURATION

- A. Precast concrete structures are to be constructed as specified and as shown on the detail drawings.
- B. The number of joints shall be minimized. Use no more than two sections up to 8 feet of depth and no more than one additional section for each 4 feet of depth.
- C. Provide inverts conforming to the details shown on the Drawings when rectangular sewer manholes are required.
- D. Round transition assemblies shall conform to ASTM C 478.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Inspect precast components prior to unloading from the delivery truck.

3.2 DELIVERY, STORAGE, AND HANDLING

- A. Coordinate delivery with the manufacturer. Handle and store the precast components in accordance with ASTM C 891 and the manufacturer's recommendations using methods that will prevent damage to the components and their joint surfaces.

3.3 PLACING PRECAST CONCRETE SECTIONS

- A. Excavate the required depth and remove materials that are unstable or unsuitable for a good foundation. Prepare a level, compacted foundation extending 6 inches beyond the precast base and follow ASTM C 891 excavation standards.
- B. Set base plumb and level, aligning pipe opening with pipe invert.
- C. Thoroughly clean bells and spigots to remove dirt and other foreign materials that may prevent sealing. Unroll the butyl sealant rope directly against base of spigot. Leave protective wrapper attached until sealant is entirely unrolled against spigot. Do not stretch. Overlap from side to side -- not top to bottom.

- D. Set risers and tops, aligning internal wall surfaces, so that proper alignment is achieved taking particular care to clean, prepare, and seal joints.
- E. Fill the void between horizontal joint surfaces with a sand cement grout around the outside perimeter, when recommended by the manufacturer.
- F. After joining manhole sections, apply the butyl sealant sheet around the outside perimeter of the joint.
- G. Lift holes leaving less than 2 inches of wall thickness shall be plugged from the outside using a sand cement mortar. Lift holes penetrating the wall shall be additionally sealed with an interior application of an epoxy gel 1/8 inch thick extending 2 inches beyond the penetration.
- H. Vacuum test the assembled precast structure after completing pipe connections and sealing but before backfilling or placing frame and cover as follows:
 - 1. Plug pipes with suitably sized and rated pneumatic or mechanical pipeline plugs. Place plugs a minimum of 6 inches beyond the precast wall and brace to prevent displacement of the plugs or pipes during testing.
 - 2. Position the vacuum tester head assembly to seal against the interior surface of the top of the top section and inflate according to the manufacturer's recommendations.
 - 3. Draw a vacuum of 10 inches of mercury, close the valve on the vacuum line, and shut off the vacuum pump.
 - 4. Measure the time for the vacuum to drop to 9 inches of mercury. The precast structure shall pass when the time to drop to 9 inches of mercury meets or exceeds the following:

Structure Area in Plain View (square feet)	10	20	30	40	50	80
Seconds	60	75	90	105	120	150
 - 5. If the precast structure fails the test, remove the head assembly and coat the interior with a soap and water solution and repeat the vacuum test for approximately 30 seconds. Leaking areas will have soapy bubbles. After the necessary repairs are made, repeat the test until the precast structure passes.
- I. Perform the final finishing to the manhole interior by filling all chips or fractures greater than 1/2 inch in length, width or depth and depressions more than 1/2 inch deep in inverts with a sand cement mortar. Grout joints according to manufacturer's specifications. Clean the interior of the precast structure, removing all dirt, spills, or other foreign matter.

END OF SECTION

DIVISION 04

MASONRY

SECTION 04 20 00

UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes requirements for concrete unit masonry and clay unit masonry in the form of brick.
- B. Related Sections. The following section contains requirements that relate to this section:
 - 1. Section 03 30 00, Cast-In-Place Concrete, for embedded reinforcing steel.
- C. Products installed but not furnished under this section include the following:
 - 1. Reinforcing steel to be embedded in unit masonry is specified in Section 03 30 00, Cast-In-Place Concrete.
 - 2. Steel lintels in unit masonry are specified in Section 05 50 00, Metal Fabrications.
 - 3. Wood nailers and blocking built into unit masonry are specified in Section 06 10 00, Carpentry.
 - 4. Flashings are specified in Section 07 60 00, Flashing and Sheet Metal.
 - 5. Door frames in unit masonry openings are specified in Section 08 11 13, Standard Steel Doors and Frames.
 - 6. Window frames in unit masonry openings are specified in Section 08 51 13, Aluminum Windows.
 - 7. Foam cavity wall insulation specified in Section 07 21 00, Building Insulation.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplemental Conditions or General Provisions and Division 1 Specification sections, apply to this section.

1.3 SUBMITTALS

- A. General. Submit the following in accordance with Conditions of Contract and Division 1 Specification sections.
- B. Product data for each different masonry unit, accessory, and other manufactured product indicated.
- C. Shop drawings for reinforcing detailing fabrication, bending, and placement of unit masonry reinforcing bars. Comply with ACI 315 "Details and Detailing of Concrete Reinforcing" showing bar schedules, stirrup spacing, diagrams of bent bars, and arrangement of masonry reinforcement.

- D. Samples for initial selection purposes of unit masonry in small-scale form showing full extent of colors and textures available for each different exposed masonry unit required.
- E. Material certificates for the following signed by manufacturer and Contractor certifying that each material complies with requirements:
 - 1. Each different cement product required for mortar and grout including name of manufacturer, brand, type, and weight slips at time of delivery.
 - 2. Each material and grade indicated for reinforcing bars.
 - 3. Each type and size of joint reinforcement.
 - 4. Each type and size of anchors, ties, and metal accessories.
- F. Material test reports from a qualified independent testing laboratory employed and paid by Contractor indicating and interpreting test results relative to compliance of the following proposed masonry materials with requirements indicated:
 - 1. Mortar complying with property requirements of ASTM C 270.
 - 2. Grout mix design: Include description of type and proportions of grout ingredients in accordance with ASTM C 476.
 - 3. Masonry units.
- G. Cold-weather construction procedures evidencing compliance with requirements specified in referenced unit masonry standard.
- H. Hot-weather construction procedures evidencing compliance with requirements specified in referenced unit masonry standard.

1.4 QUALITY ASSURANCE

- A. Unit Masonry Standard. Comply with ACI 530.1/ASCE/TMS 602 "Specifications for Masonry Structures," except as otherwise indicated.
 - 1. Revise ACI 530.1/ASCE 6/TMS 602 to exclude Section 1.5, Article 1.6, A.1.b. and to modify Article 1.1, C.5 by deleting requirement for installing vent pipes and conduits built into masonry.
- B. Single-Source Responsibility for Masonry Units. Obtain exposed masonry units of uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from one manufacturer for each different product required for each continuous surface or visually related surfaces.
- C. Single-Source Responsibility for Mortar Materials. Obtain mortar ingredients of uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source and producer for each aggregate.
- D. Field-Constructed Mock-Ups. Prior to installation of unit masonry, erect sample wall panels to further verify selections made under sample submittals and to demonstrate aesthetic effects as well as qualities of materials and execution. Build

mock-ups to comply with the following requirements, using materials indicated for final unit of work:

1. Build mock-ups approximately 4 feet long by 4 feet high by full thickness for each type of exposed unit masonry construction.
2. Where masonry is to match existing, erect panels parallel to existing surface.
3. Notify Engineer one week in advance of the dates and times when mock-ups will be erected.
4. Protect mock-ups from the elements with weather-resistant membrane.
5. Retain and maintain mock-ups during construction in undisturbed condition as standard for judging completed unit masonry construction.
 - a. Accepted mock-ups in undisturbed condition at time of Substantial Completion may become part of completed unit of work.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver masonry materials to project in undamaged condition.
- B. Store and handle masonry units off the ground, under cover, and in a dry location to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion, and other causes. If units become wet, do not place until units are in an air-dried condition.
- C. Store cementitious materials off the ground, under cover, and in dry location.
- D. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.6 PROJECT CONDITIONS

- A. Protection of Masonry. During erection, 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 down both sides and hold cover securely in place.
 2. Where one wythe of multi-wythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 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. Remove immediately any grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and mortar splatter by means of coverings spread 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, from mortar droppings with painted and integral finishes.
- D. Cold-Weather Construction. Comply with referenced unit masonry standard for cold-weather construction and the following:
1. Do not lay masonry units that are wet or frozen.
 2. Remove masonry damaged by freezing conditions.
- E. Hot-Weather Construction. Comply with referenced unit masonry standard.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Comply with referenced unit masonry standard and other requirements specified in this section applicable to each material indicated.

2.2 CLAY MASONRY UNITS

- A. Face Brick Standard: ASTM C 216 and as follows:

1. Grade: SW.
2. Type: FBS.
3. Size. Standard modular (3 inches thick by 2 ¼ inches high by 7 inches long).
4. Color and Texture: Provide face brick of color and texture to match existing adjacent brickwork. Acceptability of proposed brick will be judged by the Engineer from sample panels erected by the Contractor.

2.3 CONCRETE MASONRY UNITS

- A. General. Comply with requirements indicated below applicable to each form of concrete masonry unit required.

1. Provide special shapes where indicated and as follows:
 - a. For lintels, corners, jambs, sash, control joints, headers, bonding, and other special conditions.
 - b. Square-edge units for outside corners, except where indicated as bullnose.
2. Size: Provide concrete masonry units complying with requirements indicated below for size. Units should be manufactured to specified face dimensions within tolerances specified in the applicable referenced ASTM specification for concrete masonry units.
 - a. Concrete Masonry Units: Manufactured to specified dimensions of ___ inch less than nominal widths by nominal heights by nominal lengths indicated on Drawings.

2.6 JOINT REINFORCEMENT

- A. General. Provide joint reinforcement complying with requirements of referenced unit masonry standard and this article, formed from galvanized carbon steel wire, coating class as required by referenced unit masonry standard for application indicated.
- B. Description. Welded-wire units prefabricated with deformed continuous side rods and plain cross rods into straight lengths of not less than 10 feet, with prefabricated corner and tee units, and complying with requirements indicated below:
 - 1. Wire Diameter for Side Rods: 0.1483 inch (9 gauge).
 - 2. Wire Diameter for Cross Rods: 0.1483 inch (9 gauge).
 - 3. For single-wythe masonry, provide single pair of side rods, truss design for continuous diagonal cross rods spaced not more than 16 inches on center.
 - 4. For multi-wythe masonry, provide truss design with diagonal cross rods spaced not more than 16 inches on center and number of side rods as follows:
 - a. Number of Side Rods for Multi-wythe Concrete Masonry: One side rod for each face shell of hollow masonry units more than 4 inches in nominal width plus one side rod for each wythe of masonry 4 inches or less in nominal width.
- C. Available Manufacturers. Subject to compliance with requirements, manufacturers offering joint reinforcement that may be incorporated in the Work include, but are not limited to, the following:
 - 1. AA Wire Products Co.
 - 2. Dur-O-Wal, Inc.
 - 3. Heckman Building Products, Inc.
 - 4. Hohmann & Barnard, Inc.
 - 5. Masonry Reinforcing Corp. of America.
 - 6. National Wire Products Industries.
 - 7. Southern Construction Products, Inc.

2.7 EMBEDDED FLASHING MATERIALS

- A. Sheet Metal Flashing. Fabricate from the following metal complying with requirements specified in Section 07 6000, Flashing and Sheet Metal, and below:
 - 1. Stainless Steel. 0.0156 inch (28 gauge) thick.
 - 2. Copper. 10 oz. weight (0.0135 inch thick) for fully concealed flashing, 16 oz. (0.0216 inch thick) elsewhere.
 - 3. Fabricate through-wall metal flashing embedded in masonry with ribs formed in dovetail pattern at 3-inch intervals along length of flashing to provide a three-way integral mortar bond and weep-hole drainage.

4. Application. Use where flashing is fully or partly concealed in masonry wall.
5. Solder and Sealants for Sheet Metal Flashings. As specified in Section 07 6000, Flashing and Sheet Metal.
6. Adhesive for Flashings. Of type recommended by manufacturer of flashing material for use indicated.

2.8 MISCELLANEOUS MASONRY ACCESSORIES

- A. Nonmetallic Expansion Joint Strips. Premolded filler strips complying with ASTM D 1056, Type 2 (closed cell), Class A (cellular rubber and rubber-like materials with specific resistance to petroleum base oils), Grade 1 (compression-deflection range of 2-5 psi), compressible up to 35 percent, of width and thickness indicated, formulated from polyvinyl chloride.
- B. Bond Breaker Strips. Asphalt-saturated organic roofing felt complying with ASTM D 226, Type 1 (No. 15 asphalt felt).
- C. Weep Holes. Provide one of the following:
 1. Round Plastic Tubing: Medium-density polyethylene, ___ inch outside diameter by 4 inches long.
 2. Aluminum Weep Hole/Vent: One-piece L-shaped units made to fit in a vertical mortar joint from sheet aluminum and consisting of a vertical channel with louvers stamped in web and a flat horizontal; painted prior to installation, in color approved by Engineer to match that of mortar.

2.9 MASONRY VENEER ANCHORS

- A. Two-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
 1. Anchor plates: Not less than 0.075 inch thick, designed for fastening to structural backup through sheathing by two fasteners; provide design with legs that penetrate sheathing and insulation to provide positive anchorage.
 2. Wire ties: Manufacturer's standard shape, 0.1875 inch thick.
 3. Vertical adjustment: Not less than 3½ inches.
 4. Seismic feature: Provide lip, hook, or clip-on end-of-wire ties to engage or enclose not less than one continuous horizontal joint reinforcement wire of 0.1483 inch diameter.

2.10 INSULATION

- A. Foam Fill Insulation. See Section 07 21 00 Building Insulation.

2.11 MASONRY CLEANERS

- A. Job-Mixed Detergent Solution. Solution of trisodium phosphate (½ cup dry measure) and laundry detergent (½ cup dry measure) dissolved in one gallon of water.

2.12 MORTAR AND GROUT MIXES

A. General

1. Do not add admixtures, including coloring pigments, air-entraining agents, accelerators, retarders, water repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
2. Do not use calcium chloride in mortar or grout.

B. Mortar for Unit Masonry. Comply with ASTM C 270, Property Specification for job-mixed mortar and ASTM C 1142 for ready-mixed mortar, of types indicated below:

1. Limit cementitious materials in mortar to Portland cement-lime.
2. Use Type M for all load bearing masonry and in foundation walls where masonry materials occur.
3. Use Type N for all interior non-load bearing masonry.
4. Use Type S for all face brick work, back up, and parging.
5. Type M may be used in lieu of Type N or S.
6. Type S may be used in lieu of Type N.

C. Grout for Unit Masonry. Comply with ASTM C 476 and referenced unit masonry standard.

2.13 SOURCE QUALITY CONTROL

A. Concrete Masonry Unit Tests. For each type, class, and grade of concrete masonry unit indicated, units will be tested by qualified independent testing laboratory for strength, absorption, and moisture content per ASTM C 140.

B. Brick Tests. For each type and grade of brick indicated, units will be tested by qualified independent testing laboratory per ASTM C 67, except 5 bricks will be selected at random for each 100,000 units or fraction thereof installed.

C. Cost of testing specified in Paragraphs A and B above will be included in the Contractor's price and no additional payment will be made therefor.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other specific conditions, and other conditions affecting performance of unit masonry.
- B. Examine rough-in and built-in construction to verify actual locations of piping connections prior to installation.
- C. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Comply with referenced unit masonry standard and other requirements indicated applicable to each type of installation included in Project.
- B. Thickness. Build cavity and composite walls and other masonry construction to the full thickness shown. Build single-wythe walls to the actual thickness of the masonry units, using units of nominal thickness indicated.
- C. Build chases and recesses as shown or required to accommodate items specified in this and other sections of the Specifications.
- D. Leave openings for equipment to be installed before completion of masonry. After installation of equipment, complete masonry to match construction immediately adjacent to the opening.
- E. Cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous pattern and to fit adjoining construction. Use full-size units without cutting where possible.

3.3 CONSTRUCTION TOLERANCES

- A. Comply with construction tolerances of referenced unit masonry standard.

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint widths and for accurate locating of openings, movement-type joints, returns, and offsets. Avoid the use of less-than-half-size units at corners, jambs, and where possible at other locations.
- B. Lay up walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other construction.
- C. Bond Pattern for Exposed Masonry. Lay exposed masonry in the following bond pattern; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
 - 1. One-half running bond with vertical joint in each course centered on units in courses above and below.
- D. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- E. Stopping and Resuming Work. In each course, rack back $\frac{1}{2}$ -unit length; do not tooth. Clean exposed surfaces of set masonry, wet masonry units lightly (if required), and remove loose masonry units and mortar prior to laying fresh masonry.
- F. Built-In Work. As construction progresses, build in items specified under this and other sections of the Specifications. Fill in solidly with masonry around built-in items.
 - 1. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.

2. Fill cores in hollow concrete masonry units under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated, with grout. The grout fill shall be 3 block courses (24 inches).

3.5 MORTAR BEDDING AND JOINTING

- A. Lay hollow concrete masonry units as follows:
 1. With full mortar coverage on horizontal and vertical face shells.
 2. Bed webs in mortar in starting course on footings and in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be filled with grout.
 3. For starting course on footings where cells are not grouted, spread out full mortar bed including areas under cells.
- B. Cut joints flush for masonry walls to be concealed or to be covered by other materials, unless otherwise indicated.

3.6 STRUCTURAL BONDING OF MULTI-WYTHE MASONRY

- A. Use continuous horizontal joint reinforcement installed in horizontal mortar joints for bond tie between wythes.
- B. Corners. Provide interlocking masonry unit bond in each course at corners, unless otherwise shown.
 1. Provide continuity with horizontal joint reinforcement at corners using prefabricated "L" units, in addition to masonry bonding.
- C. Intersecting and Abutting Walls. Unless vertical expansion or control joints are shown at juncture, provide same type of bonding specified for structural bonding between wythes and provide continuity with horizontal joint reinforcement using prefabricated "T" units.
- D. Nonbearing Interior Partitions
 1. Where ceiling is attached to roof truss, build full height to underside of roof truss bottom chord above and install pressure-treated wood filler in joint between top of partition and underside of structure above.
 2. Where suspended ceiling is used, build to not less than 4 inches above ceiling height.

3.7 CAVITIES/AIR SPACES

- A. Keep cavities/air spaces clean of mortar droppings and other materials during construction. Strike joints facing cavities/air spaces flush.

3.8 HORIZONTAL JOINT REINFORCEMENT

- A. General. Provide continuous horizontal joint reinforcement as indicated. Install longitudinal side rods in mortar for their entire length with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcing a minimum of 6 inches.

- B. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
- C. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend reinforcement units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.
- D. Space joint reinforcement 8 inches on-center vertically for the bottom 2 layers and at 16 inches on-center for all subsequent layers.

3.9 MOVEMENT (CONTROL AND EXPANSION) JOINTS

- A. General. Install control and expansion joints in unit masonry where indicated. Build in related items as the masonry progresses. Do not form a continuous span through movement joints unless provisions are made to prevent in-plane restraint of wall or partition movement.
- B. Form control joints in concrete unit masonry as follows:
 - 1. Install preformed control joint gaskets designed to fit standard sash block.
- C. Form control joints in clay unit masonry. Form open joint of not less than ___ inch for installation of backer rod and sealant specified in Section 07 90 00, Joint Sealants. Maintain joint free and clear of mortar.

3.10 LINTELS

- A. Provide masonry lintels where shown and at horizontal openings greater than 16 inches. Provide precast or masonry lintels. Cure precast lintels before handling and installation. Temporarily support masonry lintels.
 - 1. For masonry lintels, use specially formed bond beam units with reinforcement bars placed as indicated and filled with coarse grout.
- B. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

3.11 WEEP HOLES

- A. General. Install weep holes in veneer and cavity walls at lintels, ledges, above through wall flashing, at bottom of walls, other obstructions to the downward flow of water in the wall, and where indicated at 24 inches on center horizontally.
- B. Install weep holes in the head joints in exterior wythes of the first course of masonry immediately above embedded flashings and as follows:
 - 1. Form weep holes with product specified in Part 2.8 of this section.
 - 2. In insulated cavities/air spaces, cover cavity/air space side of open weep holes with copper or plastic insect screening before placing loose-fill masonry insulation in cavity.

3.12 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or if units do not match adjoining units. Install new units to

match adjoining units and in fresh mortar or grout, pointed to eliminate evidence of replacement.

- B. Pointing. During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point-up all joints including corners, openings, and adjacent construction, to provide a neat, uniform appearance prepared for application of sealants.
- C. 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 half of panel uncleaned for comparison purposes. Obtain Engineer'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, polyethylene film, or waterproof masking tape.
 - 4. Clean brick by means of bucket and brush hand-cleaning method described in BIA "Technical Note No. 20 Revised" using job-mixed detergent solution.
 - 5. Clean concrete masonry by means of cleaning method indicated in NCMA TEK 45 applicable to type of stain present on exposed surfaces.
- D. Protection. Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure unit masonry is without damage and deterioration at time of Substantial Completion.

END OF SECTION

DIVISION 05

METALS

SECTION 05 50 00
METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following metal fabrications:

1. Ladders.
2. Ladder safety cages.
3. Loose bearing and leveling plates.
4. Loose steel lintels.
5. Miscellaneous structural steel framing and supports.
 - a. Applications where framing and supports are not specified in other sections.
6. Miscellaneous steel trim.
7. Metal bar gratings.
8. Floor plate and supports.
9. Pipe railings.
10. Metal stairs.
11. Pipe bollards.
12. Anchorage to hardened concrete.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplemental Conditions or General Provisions and Division 1 Specification sections, apply to work of this section.

1.3 DEFINITIONS

A. Definitions in ASTM E 985 for railing-related terms apply to this section.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

A. Structural Performance. Design, engineer, fabricate, and install the following metal fabrications to withstand the following structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections. Apply each load to produce the maximum stress in each respective component of each metal fabrication.

1. Guardrail and Handrail Systems: Capable of withstanding the following loads applied as indicated:

- a. Concentrated load of 200 pounds applied at any point and any direction on the handrail or top rail.
 - b. Uniform load of 50 pounds per linear foot applied in any direction on the handrail or top rail. This load need not be assumed to act concurrently with any concentrated load.
 - c. Concentrated load of pounds applied at any point and any direction on intermediate rails, balusters, and panels fillers.
2. Stair Treads: Capable of withstanding a uniform load of 100 pounds per square foot or a concentrated load of 300 pounds on an area of 4 square inches located in the center of the tread, whichever produces the greater stress.
 3. Stair Platforms: Capable of withstanding a uniform load of 100 pounds per square foot.
 4. Floor Gratings: Capable of withstanding a uniform load of 250 pounds per square foot or a concentrated load of 300 pounds per foot of grating width, whichever produces the greater stress. No grating shall be installed which deflects more than $\frac{1}{4}$ inch under a uniform load of 100 pounds per square foot.

1.5 SUBMITTALS

- A. General. Submit the following in accordance with Conditions of Contract and Division 1 Specification sections.
- B. Product data for products used in miscellaneous metal fabrications, including paint products and grout.
- C. Shop drawings detailing fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other sections.
 1. Where installed metal fabrications are indicated to comply with certain design loadings, include structural computations, material properties, and other information needed for structural analysis that has been signed and sealed by the qualified professional engineer who was responsible for their preparation.
- D. Welder certificates signed by Contractor certifying that welders comply with requirements specified under "Quality Assurance" article.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications. Firm experienced in successfully producing metal fabrications similar to that indicated for this Project, with sufficient production capacity to produce required units without causing delay in the work.
- B. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel," D1.3 "Structural Welding Code -Sheet Steel," and D1.2 "Structural Welding Code - Aluminum."

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- C. Engineer Qualifications. Professional engineer licensed to practice in jurisdiction where Project is located and experienced in providing engineering services of the kind indicated that have resulted in the successful installation of metal fabrications similar in material, design, and extent to that indicated for this Project.
- 1.7 PROJECT CONDITIONS
- A. Field Measurements. Where possible, check actual locations of walls and other construction to which metal fabrications must fit, by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of work.
1. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabrication of products without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to guaranteed dimensions. Allow for trimming and fitting.
- 1.8 SEQUENCING AND SCHEDULING
- A. Sequence and coordinate installation of wall handrails as follows:
1. Mount handrails only on completed walls. Do not support handrails temporarily by any means not satisfying structural performance requirements.

PART 2 - PRODUCTS

2.1 FERROUS METALS

- A. Metal Surfaces, General. For metal fabrications exposed to view upon completion of the Work, provide materials selected for their surface flatness, smoothness, and freedom from surface blemishes. Do not use materials whose exposed surfaces exhibit pitting, seam marks, roller marks, rolled trade names, roughness, and, for steel sheet, variations in flatness exceeding those permitted by reference standards for stretcher-leveled sheet.
- B. Steel Shapes
1. W Shapes. ASTM A 992.
 2. C and S Shapes. ASTM A 36.
 3. CEE and ZEE (purlins and girts). ASTM A 570 Grade 33 (min).
- C. Steel Plates, Angles, and Bars. ASTM A 36.
- D. Rolled Steel Floor Plates. ASTM A 786.
- E. Steel Bars for Gratings. ASTM A 569 or ASTM A 36.
- F. Wire Rod for Grating Cross Bars. ASTM A 510.
- G. Cold-Formed Steel Tubing. ASTM A 500; Grade B, unless otherwise indicated or required for design loading.

- H. Galvanized Steel Sheet. ASTM A 653; Grade A, unless another grade required for design loading, and G90 coating designation unless otherwise indicated.
 - I. Steel Pipe. ASTM A 53; finish, type, and weight class as follows:
 - 1. Galvanized finish for exterior installations and where indicated.
 - 2. Type S, Grade B, standard weight (Schedule 40), unless otherwise indicated, or another weight required by structural loads.
 - J. Gray Iron Castings. ASTM A 48, Class 25 or better.
 - K. Welding Rods and Bare Electrodes. Select in accordance with AWS specifications for the metal alloy to be welded.
- 2.2 STAINLESS STEEL
- A. Bar Stock and Shapes. ASTM A 276, Type 304 or 316.
 - B. Plate. ASTM A 240, Type 304 or 316.
 - C. Bolts and Nuts. ASTM F 593 and ASTM F 594, Type 304 or 316.
- 2.3 ALUMINUM
- A. Extruded Bars and Shapes. ASTM B 221, alloys as follows:
 - 1. 6061-T6 or 6063-T6 for bearing bars of gratings and shapes.
 - 2. 6061-T1 for grating cross bars.
 - B. Aluminum-Alloy Floor (Tread) Plate. ASTM B 632, Alloy 6061-T6.
 - C. Aluminum Sheet. ASTM B 209, Alloy 6061-T6.
 - D. Fasteners for Aluminum Gratings. Use fasteners made of same basic metal as fastened metal or stainless steel fasteners. Do not use metals that are corrosive or incompatible with metals joined.
 - E. Rolled Sections. ASTM B 308, Alloy 6061-T6.
 - F. Pipe. ASTM B 429, Alloy 6061-T6 or 6063-T6.
 - G. Castings. ASTM B 26 or B 85.
 - H. Handrail. ASTM B 221, Alloy 6105-T5.
- 2.4 GROUT
- A. Nonshrink Nonmetallic Grout. Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with CE CRD-C 621. Provide grout specifically recommended by manufacturer for interior and exterior applications of type specified in this section.
 - B. Available Products. Subject to compliance with requirements, non-shrink nonmetallic grouts that may be incorporated in the work include but are not limited to the following:
 - 1. "Bonsal Construction Grout," W. R. Bonsal Co.

2. "Diamond-Crete Grout," Concrete Service Materials Co.
3. "Euco N-S Grout," Euclid Chemical Co.
4. "Kemset," Chem-Masters Corp.
5. "Crystex," L&M Construction Chemicals, Inc.
6. "Masterflow 713," Master Builders.
7. "Sealtight 588 Grout," W. R. Meadows, Inc.
8. "SonogROUT," Sonneborn Building Products Div., Rexnord Chemical Products, Inc.
9. "Stonecrete NM1"; Stonhard, Inc.
10. "Five Star Grout," U. S. Grout Corp.
11. "Vibropruf #11," Lambert Corp.

2.5 FASTENERS

- A. General. Provide zinc-coated steel fasteners unless otherwise indicated. Select fasteners for the type, grade, and class required.
- B. Connectors and Accessories
 1. High Strength Bolts: ASTM A 325.
 2. Unfinished Bolts: ASTM A 307, Grade B, cadmium plated.
 3. Self-Locking Nuts: Prevailing torque type; IFI-100, Grade A.
 4. Flat Washers: ANSI B 27.2.
 5. Lock Washers: Spring type, ANSI B 27.1.
 6. Beveled Washers: Table 1 of "Specifications for Structural Joints Using ASTM A 325 or A 490 Bolts," AISC Steel Construction Manual.
- C. Connection Requirements
 1. Make connections not specifically detailed on Drawings using Tables I and III, Framed Beam Connections, in the latest edition of the AISC manual. The shop fabricated portion of structural connections may be bolted, welded, or riveted. Except for connections detailed on the Drawings or specified otherwise, make all field connections with ASTM A 325 high-strength bolts.
 2. Connections for miscellaneous metal work not included in the AISC definition of structural steel may be made with unfinished bolts. All unfinished bolts shall be equipped with self-locking nuts or lock washers.
 3. Install high-strength bolts using turn-of-nut tightening as described in "Specifications for Structural Joints Using ASTM A 325 or A 490 Bolts" as set forth in the AISC manual. Beveled washers shall be used when the bearing faces of bolted parts have a slope of 1:20 or greater with respect to a plane perpendicular to the bolt axis. Provide a platform or other means of access at each field connection until the connection has been inspected by the Engineer.
 4. Field welded connections will not be acceptable for structural steel unless shown on the Drawings or specifically permitted by the Engineer. Where structural or miscellaneous steel connections are welded, all butt and miter welds shall be continuous and where exposed to view shall be ground smooth. In addition, intermittent welds shall have an effective length of at least 2 inches and shall be spaced not more than 6 inches apart.

- D. OSHA Standards. Connections shown on the Drawing or as specified in this or related sections indicate the details pertinent to performance of the structure or assembly. When erection means and methods dictate installation of additional temporary bolts or additional temporary bracing in order to adhere to OSHA regulations, the additional bolts and bracing shall be at the expense of the Contractor. Additional bolts and bracing shall be removed when permissible in the erection process and damaged areas repaired unless permitted by the Engineer to remain in place.

2.6 PAINT AND GALVANIZING

- A. Shop surface preparation and painting of elements not shown to be galvanized shall comply with applicable requirements of Section 09 91 00, Painting.
- B. Steel members, fabrications, and assemblies shown to be galvanized after fabrication shall be treated as follows:
 - 1. Hot dip galvanize in accordance with ASTM A 123.
 - 2. Zinc used for galvanizing shall conform with ASTM B 6.
 - 3. Weight of zinc coating to conform to requirements specified under "Weight of Coating" in ASTM A 123.
 - 4. Safeguard against steel embrittlement in conformance with ASTM A 143.
 - 5. Safeguard against warpage or distortion of steel members in conformance with ASTM A 384. Notify Engineer of potential warpage problems which may require modification in design before proceeding with fabrication or treating.
 - 6. Finish and uniformity of zinc coating and adherence of coating to comply with ASTM A 123.
 - 7. Give a passivating treatment to galvanized elements which are not to be further coated or which may be stored in open, exterior locations for long periods prior to erection. Do not use chromate passivation on items to be painted after erection.
 - 8. Do not treat galvanized or passivated surfaces which are to be painted with oils or other chemicals which might interfere with coating adhesion.
- C. Protection of Aluminum in Contact with Other Materials
 - 1. Coat aluminum surfaces to be placed in contact with other metals, except stainless steel, or concrete with two coats of a high-build coal tar coating.
 - 2. Coating to be Tnemec "46-465 H.B. Tnemecol," Corchem Corporation "Corchem 146 High Build Coal Tar," or approved equal.
 - 3. Solvent clean and otherwise prepare all surfaces in accordance with the coating manufacturer's recommendations prior to application.
 - 4. Each coat to provide a dry film thickness of at least 10 mils.

2.7 LADDERS

- A. General. Fabricate ladders for the locations shown, with dimensions, spacings, details and anchorages as indicated. Comply with requirements of ANSI A14.3.
- B. Side Rails. Continuous channel or similar extruded shape, with eased edges, spaced 18 inches apart unless a specific spacing is shown on the Drawings.
- C. Bar Rungs. Round solid bars or tubes, ¾-inch diameter, spaced 12 inches on center.
- D. Fit rungs in centerline of side rails, weld and grind smooth on outer rail faces.
- E. Support each ladder at top and bottom and at intermediate points spaced not more than 12' 0" on center, or as shown on Drawings.
 - 1. Size brackets to support design dead and live loads indicated and to hold centerline of ladder rungs clear of the wall surface by not less than 7 inches.
 - 2. Extend side rails and rungs at least 42 inches above top access level. Where "step-through" access is indicated, extend side rail 42 inches. Goose-neck the extended rails back to the structure to provide secure ladder access.
- F. Provide non-slip surface on top of each rung, either by coating the rung with aluminum oxide granules set in epoxy resin adhesive, or by using a "flat top" rung with an abrasive top surface.

2.8 LADDER SAFETY CAGES

- A. General. For ladders more than 20 feet in height, fabricate ladder safety cages to comply with ANSI A14.3; assemble by welding or riveting.
- B. Primary Hoops. Aluminum bars, 5/16 inch x 4 inches, for top, bottom, and for cages longer than 20 feet, intermediate hoops spaced not more than 20' 0" on center.
- C. Secondary Intermediate Hoops. Aluminum bars, 5/16 inch x 2 inches, hoops spaced not more than 4'0" on center between primary hoops.
- D. Vertical Bars. Aluminum bars, 5/16 inch x 2 inches, secured to each hoop, spaced approximately 9 inches on center.
- E. Fasten assembled safety cage to ladder rails and adjacent construction as indicated.

2.9 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction, made flat, free from warps or twists, and of required thickness and bearing area. Drill plates to receive anchor bolts and for grouting as required. Galvanize after fabrication.

2.10 LOOSE STEEL LINTELS

- A. Fabricate loose structural steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.
- B. Weld adjoining members together to form a single unit where indicated.

- C. Size loose lintels for equal bearing of one inch per foot of clear span but not less than 8 inches bearing at each side of openings, unless otherwise indicated.
- D. Galvanize loose steel lintels located in exterior walls.

2.11 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General. Provide steel framing and supports for applications indicated or which are not a part of structural steel framework, as required to complete work.
- B. Fabricate units to sizes, shapes, and profiles indicated and required to receive adjacent other construction retained by framing and supports. Fabricate from structural steel shapes, plates, and steel bars of welded construction using mitered joints for field connection. Cut, drill, and tap units to receive hardware, hangers, and similar items.
 - 1. Equip units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units must be installed after concrete is placed.
 - a. Except as otherwise indicated, space anchors 24 inches on center and provide minimum anchor units in the form of steel straps 1¼ inches wide x ¼ inch x 8 inches long.

2.12 METAL BAR GRATINGS

- A. General. Produce metal bar gratings of description indicated per metal bar grating standard "Standard Specifications for Metal Bar Grating and Metal Bar Grating Treads" published in ANSI/NAAMM A202.1 "Metal Bar Grating Manual."
- B. Fabricate welded steel and stainless steel gratings to comply with requirements indicated below:
 - 1. Mark/Size: Unless otherwise indicated on the Drawings, W-19-4 (welded with bearing bars 1 3/16 inch on center and cross bars 4 inches on center).
- C. Fabricate pressure-locked rectangular bar aluminum gratings to comply with requirements indicated below:
 - 1. Mark/Size: Unless otherwise indicated on the Drawings, P-19-4 (pressure-locked with bearing bars 1-3/16 inch on center and cross bars 4 inches on center)/ rectangular bearing bar sizes as indicated.
- D. Steel Finish: Hot-dip galvanized with a coating weight of not less than 1.8 oz. per sq. ft. of coated surface.
- E. Aluminum Finish: Mill.
- F. Fabricate removable grating sections 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 attachment to supports.
- G. Fabricate cutouts in grating sections for penetrations indicated. Arrange layout of cutouts to permit grating removal without disturbing items penetrating gratings.
 - 1. Edge band openings in grating that interrupt two or more bearing bars with bars of same size and material as bearing bars.

2. Do not notch bearing bars at supports to maintain elevation.
- H. Available Manufacturers. Subject to compliance with requirements, manufacturers offering metal bar gratings that may be incorporated in the Work include, but are not limited to, the following:
1. Alabama Metal Industries Corp.
 2. Barnett/Bates Corp.
 3. Blaw-Knox Grating Div., Blaw-Knox Corp.
 4. IKG Industries.
 5. Klemm Corp.
 6. Ohio Gratings, Inc.
 7. Reliance Steel Products, Inc.
 8. Seidelhuber Metal Products, Inc.
 9. Trueweld, Inc.

2.13 PREFABRICATED GRATING TREADS

- A. Fabricate from 1½ inch aluminum I-bar grating to provide a tread width as shown on the Drawings within a tolerance of ±¼ inch.
- B. Tread length to be as shown on the Drawings.
- C. Tread to incorporate a slip resistant nosing.
- D. Mount treads to stringers with stainless steel bolts sized in accordance with the tread manufacturer's recommendations.

2.14 STEEL FLOOR PLATE

- A. Fabricate raised pattern steel floor plates from rolled steel plate ¼-inch in thickness and in pattern as indicated; if not indicated, as selected from manufacturer's standard patterns.
- B. Include steel angle stiffeners and fixed and removable sections as indicated.
 1. Provide two steel bar drop handles for lifting plates, one at each end of each removable section.

2.15 ALUMINUM FLOOR (TREAD) PLATE

- A. Fabricate raised pattern tread plates from aluminum-alloy rolled tread plate in pattern 1 of ¼-inch thickness.
- B. Include aluminum angle stiffeners and fixed and removable sections as indicated.
 1. Provide two aluminum bar drop handles for lifting plates, one at each end of each removable section.

2.16 ALUMINUM PIPE RAILINGS AND HANDRAILS

- A. General. Fabricate pipe railings and handrails to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of pipe, post spacings, and anchorage, but not less than that required to support structural loads.
- B. Aluminum Finish. Class I clear anodized finish, unless otherwise indicated.

- C. Interconnect railing and handrail members by butt-welding, welding with internal connectors, or assembling with flush type fittings using concealed or non-projecting pins and fasteners, at fabricator's option, unless otherwise indicated.
- D. Provide slip joints to facilitate removal of pipe railing at all intersections, changes in direction, or at intervals not to exceed 25 feet in straight runs of railing. The slip joint shall be designed and constructed to provide strength equivalent to a straight section of pipe.
- E. Form changes in direction of railing members as follows:
 - 1. By insertion of prefabricated elbow fittings.
 - 2. By mitering at elbow bends.
 - 3. By bending.
 - 4. By any method indicated above, applicable to change of direction involved.
- F. Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross-section of pipe throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of pipe.
- G. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated.
- H. Close exposed ends of pipe by welding 3/16-inch-thick aluminum plate in place or by use of prefabricated fittings, except where clearance of end of pipe and adjoining wall surface is ¼ inch or less.
- I. Toe Boards. Toe plate shall conform to OSHA standards. Toe plate shall be a minimum of 4 inches high and shall be an extrusion that attaches to the posts with clamps that will allow for expansion and contraction between posts. Toe plates shall be set ¼-inch above the walking surface. Toe plates shall be provided on handrails as required by OSHA and/or as shown on Drawings. Toe plates shall be shipped loose in stock lengths for field installation.
- J. Brackets, Flanges, Fittings, and Anchors. Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnections of pipe and attachment of railings and handrails to other work. Furnish inserts and other anchorage devices for connecting railings and handrails to concrete or masonry work.
 - 1. For railing posts set in concrete, fabricate sleeves from steel pipe not less than 6 inches long and with an inside diameter not less than ½ inch greater than the outside diameter of post, with steel plate closure welded to bottom of sleeve.
 - 2. For surface mounted railing posts, provide prefabricated aluminum mounting brackets with stainless steel anchors. Coat aluminum surfaces in contact with concrete with bituminous coating.
 - 3. For removable railing posts, fabricate slip-fit sockets from aluminum pipe whose inside diameter is sized for a close fit with posts and to limit deflection of post without lateral load, measured at top, to not more than 1/12 of post height. Provide socket covers designed and fabricated to resist accidental dislodgement. Coat exterior surfaces of sleeves with bituminous coating.

- K. Provide guard chains across all pipe railing openings where shown, specified, or required. Chain links shall be ¼-inch stainless steel of welded construction, 12 links to the foot. One end shall be connected to a ¼-inch stainless steel eye bolt in the stanchion and the other end shall be connected by means of a heavy, stainless steel swivel eye, snap hook to a similar eye bolt in the opposite stanchion.

2.17 STEEL FRAMED STAIRS

- A. General. Construct stairs to conform to sizes and arrangements indicated. Join pieces together by bolting, unless otherwise indicated. Provide complete stair assemblies, including metal framing, hangers, columns, railings, newels, balusters, struts, clips, brackets, bearing plates, and other components necessary for the support of stairs and platforms, and as required to anchor and contain the stairs on the supporting structure.
 - 1. Fabricate treads and platforms of exterior stairs to accommodate slopes to drain in finished traffic surfaces.
- B. Stair Framing. Fabricate stringers of structural steel channels as indicated. Provide closures for exposed ends of stringers. Construct platforms of structural steel channel headers and miscellaneous framing members as indicated. Bolt or weld headers to strings, newels, and framing members to strings and headers; fabricate and join so that bolts, if used, do not appear on finish surfaces.
- C. Floor Grating Treads and Platforms. Provide patterns, spacing, and bar sizes indicated; fabricate to comply with NAAMM "Metal Bar Grating Manual."
- D. Fabricate grating treads with nosing on one edge and with angle or plate carrier at each end for stringer connections. Secure treads to stringers with stainless steel bolts.
- E. Fabricate grating platforms with nosing matching that on grating treads at all landings. Provide toe plates at open-sided edges of grating platform. Secure grating to platform frame with stainless steel clips and bolts.
- F. Stair Railings and Handrails. Comply with applicable requirements specified elsewhere in this section for pipe railings and handrails.

2.18 ALTERNATING TREAD ALUMINUM STAIRS

- A. Cast aluminum treads, landings, and mounting base shall be shielded metal arc welded to a single extruded box-like stringer.
- B. Guards and handrails shall be contoured for body guidance and underarm support, and shall have inclined hand side portions for free sliding of the hands unimpeded by the handrail supports.
- C. Acceptable Manufacturer (or approved equal):
 - 1. Lapeyre Stair, Inc., 5117 Toler Street, Harahan, LA 70123.

2.19 PIPE BOLLARDS

- A. Fabricate pipe bollards from Schedule 40 steel pipe. Cap bollards with ¼-inch minimum thickness steel base plate.

- B. Fabricate sleeves for bollard anchorage from steel pipe with ¼-inch-thick steel plate welded to bottom of sleeve.
- C. Fill bollards with Class A concrete as specified in Section 03 30 00, Cast-In-Place Concrete.

2.20 ANCHORAGE TO HARDENED CONCRETE

- A. Dowels or anchors placed in existing or hardened concrete shall be stainless steel Type 316, ASTM F 593 and ASTM F 594, threaded rod with hex nuts, unless shown otherwise.
- B. Epoxy Adhesive
 - 1. Two component, 100% solid (containing no solvents), non-sag paste, insensitive to moisture, grey in color.
 - 2. NSF Standard 61 for use in conjunction with drinking water systems.
 - 3. ASTM C 881-90; Type IV; Grade 3; Class A, B, and C with the exception of gel time.
 - 4. Maximum shrinkage during cure per ASTM D 2566 of 0.00051 in./in.
 - 5. Compressive strength, ASTM D 695: 10,300 psi minimum.
 - 6. Shelf life: 3 years minimum.
 - 7. Water solubility: None.
 - 8. Heat deflection temperature, ASTM D648: 140°F minimum.
 - 9. Epoxy adhesive shall be Epcon C-6, manufactured by ITW Ramset.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, including concrete inserts, sleeves, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.
- B. Center nosings on tread widths with noses flush with riser faces and tread surfaces.
- C. Set sleeves in concrete with tops flush with finish surface elevations; protect sleeves from water and concrete entry.

3.2 FABRICATION, GENERAL

- A. Form metal fabrications from materials of size, thickness, and shapes indicated but not less than that needed to comply with performance requirements indicated. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support. Use type of materials indicated or specified for various components of each metal fabrication.
- B. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
- C. Allow for thermal movement resulting from the following maximum change (range) in ambient temperature in the design, fabrication, and installation of installed metal assemblies to prevent buckling, opening up of joints, and overstressing of welds and

fasteners. Base design calculations on actual surface temperatures of metals due to both solar heat gain and nighttime sky heat loss.

1. Temperature Change (Range): 100°F (55.5°C).
- D. Shear and punch metals cleanly and accurately. Remove burrs.
- E. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- F. Remove sharp or rough areas on exposed traffic surfaces.
- G. Weld corners and seams continuously to 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.
 4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surface matches those adjacent.
- H. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use.
- J. Shop Assembly: Preassemble items 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.
- K. Cut, reinforce, drill and tap miscellaneous metal work as indicated to receive finish hardware, screws, and similar items.
- L. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

3.3 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction. Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors as required.
- B. Cutting, Fitting, and Placement. Perform cutting, drilling, and fitting required for installation of miscellaneous metal fabrications. Set metal fabrication accurately in

location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

- C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete masonry or similar construction.
 - D. Fit exposed connections accurately together to form hairline joints. Weld or bolt, as indicated, 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 which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.
 - E. Field Welding. Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work, 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.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surface matches those adjacent.
 - F. 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.
 - G. Epoxy Anchors
 - 1. Verify number, size, depth, and location of anchors or dowels to be installed.
 - 2. Comply with temperature and moisture limitation as recommended by the manufacturer.
 - 3. Drill holes in concrete to the depth specified on the Drawings using methods as instructed by the epoxy manufacturer. The diameter of holes shall be as instructed by the epoxy manufacturer for the anchor or dowel being installed. Clean holes as instructed by the epoxy manufacturer.
 - 4. Install epoxy in strict accordance with the manufacturer's instructions using guns with self-mixing nozzles provided by the manufacturer. Verify epoxy is mixed prior to placement into the hole using methods per manufacturer's instructions. Insert dowel or anchor into the hole and hold steady as instructed by the manufacturer.
- 3.4 SETTING LOOSE PLATES
- A. Clean concrete and masonry bearing surfaces of any bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of bearing plates.
 - B. Set loose leveling and bearing plates on wedges, or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts.

Do not remove wedges or shims, but if protruding, cut off flush with the edge of the bearing plate before packing with grout.

1. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.5 INSTALLATION OF METAL BAR GRATINGS

- A. General. Install gratings to comply with recommendations of NAAMM grating standard referenced under Part 2 that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.
- B. Secure 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.

3.6 INSTALLATION OF PIPE RAILINGS AND HANDRAILS

- A. Adjust railings prior to anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated, or if not indicated, as required by design loadings. Plumb posts in each direction. Secure posts and railing ends to building construction as follows:
 1. Anchor posts in concrete by means of pipe sleeves preset and anchored into concrete. After posts have been inserted into sleeves, fill annular space between post and sleeve solid with non-reactive setting cement, mixed and placed to comply with anchoring material manufacturer's directions.
 2. Install removable railing sections where indicated in slip-fit metal sockets cast into concrete. Accurately locate sockets to match post spacing.
- B. Secure handrails to wall with wall brackets and end fittings. Provide bracket with not less than 1½-inch 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 and wall return fittings to building construction as follows:
 1. Use type of bracket with pre-drilled hole for exposed bolt anchorage.
 2. For concrete and masonry anchorage, use stainless steel epoxy set anchors.

3.7 INSTALLATION OF BOLLARDS

- A. Anchor bollards in concrete by means of pipe sleeves preset and anchored into concrete. After bollards have been inserted into sleeves, fill annular space between bollard and sleeve solid with nonshrink, nonmetallic grout, mixed and placed to comply with grout manufacturer's directions.

3.8 ADJUSTING AND CLEANING

- A. Touch-Up Painting. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and recoat exposed areas in accordance with Section 09 91 00, Painting, if included, or in accordance with Engineer's instructions.

END OF SECTION

DIVISION 06

WOOD, PLASTICS & COMPOSITES

SECTION 06 10 00

ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Framing with dimension lumber.
2. Wood furring, nailers and blocking.
3. Sheathing.
4. Exterior and interior standing and running trim and rails.
5. Exterior and interior miscellaneous wood ornamental elements.

B. Related Sections. The following sections contain requirements that relate to this section:

1. Section 06 17 53, Prefabricated Metal-Plate-Connected Wood Trusses.

1.2 DEFINITIONS

A. Carpentry includes all carpentry and other woodwork, both exposed and unexposed, not specified as part of other sections.

1.3 SUBMITTALS

A. General. Submit the following in accordance with Conditions of Contract and Division 1 Specification sections.

B. Product data for the following products, as applicable:

1. Plywood and other engineered wood products.
2. Underlayment.
3. Insulating sheathing.
4. Construction adhesives.

C. Material certificates for dimensional lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use as well as design values approved by the Board of Review of American Lumber Standards Committee.

D. Wood treatment data as follows including chemical treatment manufacturer's instructions for handling, storing, installation, and finishing of treated material:

1. For each type of preservative treated wood product include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.
2. For water-borne treated products include statement that moisture content of treated materials was reduced to levels indicated prior to shipment to project site.

3. For fire-retardant-treated wood products include certification by treating plant that treated material complies with specified standard and other requirements.
4. Material test reports from qualified independent testing laboratory indicating and interpreting test results relative to compliance of fire-retardant-treated wood products with requirements indicated.
5. Warranty of chemical treatment manufacturer for each type of treatment.

1.4 QUALITY ASSURANCE

- A. Single-Source Responsibility for Fire Retardant Treated Wood. Obtain each type of fire-retardant-treated wood products from one source for both treatment and fire-retardant formulation.
- B. Exposed Materials. Comply with applicable requirements of "Architectural Woodwork Quality Standards" published by the Architectural Woodwork Institute (AWI), except as otherwise indicated.
- C. Preservative-Treated Wood. Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency certifying level and type of treatment in accordance with AWPA standards.

1.5 DELIVERY, STORAGE, AND PROTECTION

- A. Delivery and Storage. Keep materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber as well as plywood and other panels; provide for air circulation within and around stacks and under temporary coverings including polyethylene and similar materials.
 1. For lumber and plywood pressure treated with waterborne chemicals, place spacers between each bundle to provide air circulation.
- B. Protection. Protect woodwork during transit, delivery, storage, and handling to prevent damage, soilage, and deterioration.

1.6 PROJECT CONDITIONS

- A. Field Measurements. Where woodwork is indicated to be fitted to other construction, check actual dimensions of other construction by accurate field measurements before manufacturing woodwork. Coordinate manufacturing schedule with construction progress to avoid delay of work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Grades and species specified here are minimum standards to be used unless otherwise noted on plans.
- B. Lumber Standards and Grading. The following grading rules and standards, latest editions, apply to all materials furnished under this section:
 1. Softwood Lumber. Standard grading and dressing rules approved under U.S. Product Standard PS 20.

2. Southern Pine. Standard grading rules as published by Southern Pine Inspection Bureau.
 3. Hardwoods. Standard grading rules as published by National Hardwood Lumber Association.
 4. Redwood. Standard specifications for grades of California redwood lumber as published by Redwood Inspection Service.
 5. Douglas Fir. Standard grading rules as published by West Coast Lumber Inspection Bureau or the Western Wood Products Association.
 6. Douglas Fir Plywood. U.S. Product Standard PS-1 and American Plywood Association (APA) PRP-108.
 7. Southern Pine Plywood. U.S. Product Standard PS-1 and APA PRP-108.
 8. Hardwood Plywood. U.S. Product Standard PS-51 or U.S. Commercial Standard CS-35.
- C. Grade Stamps. Provide lumber and plywood with each piece factory-marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill. Plywood shall bear the DFPA grade and trademark of the American Plywood Association.
- D. Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required by PS 20, for moisture content specified for each use.
1. Provide seasoned lumber with 19 percent maximum moisture content at time of dressing and shipment for sizes 2 inches or less in nominal thickness, unless otherwise indicated.

2.2 DIMENSION LUMBER

- A. For all furring, blocking, girts, purlins, and stud framing, provide the following grade and species:
1. No. 2 grade.
 2. Spruce-Pine-Fir (SPF) or approved equal or greater.
- B. Structural load bearing members:
1. No. 2 grade (min).
 2. Southern Pine or Douglas Fir.

2.3 MISCELLANEOUS LUMBER

- A. General. Provide lumber for support or attachment of other construction including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, furring, grounds, stripping, and similar members.
- B. Fabricate miscellaneous lumber from dimension lumber of sizes indicated and into shapes shown.

- C. Moisture content. 19 percent maximum for lumber items not specified to receive wood preservative treatment.
- D. Grade. "Standard" grade light-framing-size lumber of any species or board-size lumber as required. "No. 3 Common" or "Standard" grade boards per WCLIB or WWPA rules or "No. 2 Boards" per SPIB rules.

2.4 PLYWOOD

- A. General. Where plywood is indicated for the following concealed types of applications, provide APA Performance-Rated Panels complying with requirements designated under each application for grade designation, span rating, exposure durability classification, edge detail (where applicable), and thickness.
 - 1. Roof Sheathing. APA RATED SHEATHING.
 - a. Exposure Durability Classification: EXPOSURE 1.
 - b. Span Rating: As required to suit rafter spacing indicated.
 - 2. Plywood Backing Panels. For mounting electrical or telephone equipment, provide fire-retardant-treated plywood panels with grade designation, APA C-D PLUGGED EXPOSURE 1, in thickness indicated, or, if not otherwise indicated, not less than 15/32 inch.

2.5 FASTENERS

- A. General. Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
- B. Nails, Wire, Brads, and Staples. FS FF-N-105.
 - 1. Use hot-dipped galvanized or coated nails in redwood.
- C. Power Driven Fasteners. National Evaluation Report NER-272.
- D. Wood Screws. ANSI B18.6.1.
- E. Lag Bolts. ANSI B18.2.1.
- F. Bolts. Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and where indicated, flat washers.

2.6 PRESERVATIVE WOOD TREATMENT BY PRESSURE PROCESS

- A. General. Where lumber or plywood is indicated as preservative-treated wood or is specified herein to be treated, comply with applicable requirements of AWWA standards C2 (Lumber) and C9 (Plywood). Mark each treated item with the AWPB of SPIB Quality Mark Requirements.
- B. Pressure-treat above-ground items with water-borne preservatives to a minimum retention of 0.25 pcf. For interior uses, after treatment, kiln-dry lumber and plywood to a maximum moisture content, respectively, of 19 percent and 15 percent. Treat indicated items and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
 3. Wood framing members less than 18 inches above grade.
 4. Wood floor plates installed over concrete slabs directly in contact with earth.
- C. Pressure-treat wood members in contact with the ground or fresh water with water-borne preservatives to a minimum retention of 0.40 pcf.
 - D. Complete fabrication of treated items prior to treatment, where possible. If cut after treatment, coat cut surfaces to comply with AWPA M4. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

2.7 FIRE-RETARDANT TREATMENT BY PRESSURE PROCESS

- A. General. Where fire-retardant-treated wood is indicated, pressure impregnate lumber and plywood with fire-retardant chemicals to comply with AWPA C20 and C27, respectively, for treatment type indicated; identify "fire-retardant-treated wood" with appropriate classification marking of Underwriters Laboratories, Inc., U.S. Testing, Timber Products Inspection, Inc., or other testing and inspecting agency acceptable to authorities having jurisdiction.
- B. Interior Type A. For interior locations use fire-retardant chemical formulation that produces treated lumber and plywood with the following properties under conditions present after installation:
 1. No reduction takes place in bending strength, stiffness, and fastener holding capacities below values published by manufacturer of chemical formulation that are based on tests by a qualified independent testing laboratory of treated wood products identical to those indicated for this project under elevated temperature and humidity conditions simulating installed conditions.
 2. No other form of degradation occurs due to acid hydrolysis or other causes related to manufacture and treatment.
 3. No corrosion of metal fasteners results from their contact with treated wood.
- C. Inspect each piece of treated lumber or plywood after drying and discard damaged or defective pieces.

PART 3 - EXECUTION

3.1 WORKMANSHIP

- A. General: Rough carpentry shall produce joints true, tight, and well nailed with members assembled in accordance with the Drawings and with pertinent codes and regulations.

3.2 INSTALLATION, GENERAL

- A. Use common wire nails, unless otherwise indicated. Use finishing nails for finish work. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood; predrill as required.

3.3 WOOD GROUNDS, NAILERS, BLOCKING, AND SLEEPERS

- A. Install wood grounds, nailers, blocking, and sleepers where shown and where required for screeding or attachment of other work. Form to shapes as shown and cut as required for true line and level of work to be attached. Coordinate location with other work involved.
- B. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.

3.4 INSTALLATION – LUMBER AND DECKING

- A. Install framing members of size and spacing indicated.
- B. Secure decking perpendicular to framing members with ends staggered over firm bearing where possible.
- C. Maintain deck joints of 1/16 inch.
- D. Surface Flatness: $\pm 1/4$ -inch in 10 feet maximum.
- E. Anchor and nail shall comply with "Fastening Schedule" in chapter 23 of the applicable building code.
- F. Do not splice structural members between supports.

END OF SECTION

SECTION 06 17 53

PREFABRICATED METAL-PLATE-CONNECTED WOOD TRUSSES

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes hip and girder trusses at hip ends of roof, if required.
- B. Roof sheathing is specified in Section 06 10 00, Carpentry.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions or General Provisions and Division 1 Specification sections, apply to this section.

1.3 DEFINITIONS

- A. Prefabricated metal-plate-connected wood trusses include planar structural units consisting of metal-plate-connected members that are fabricated from dimension lumber and that have been cut and assembled prior to delivery to the project site.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification sections.
- B. Product data for lumber, metal connector plates, hardware, fabrication process, and fasteners.
- C. Shop drawings indicating species, species group, sizes, and stress grades of lumber to be used; pitch, span, camber, configuration, and spacing for each type of truss required; type, size, material, finish, design values, and location of metal connector plates; and bearing details.
 - 1. Provide design analysis indicating loading, assumed allowable stress, stress diagrams and calculations, and other information needed for review that have been signed and sealed by the qualified professional engineer responsible for their preparation and registered in the state in which the project is located.
 - 2. Provide shop drawings that have been signed and stamped by a qualified professional engineer.
- D. Product certificate, signed by officer of fabricating firm, certifying that metal-plate-connected wood trusses supplied for project comply with specified requirements.

1.5 QUALITY ASSURANCE

- A. TPI Standards. Comply with applicable requirements and recommendations of the following Truss Plate Institute (TPI) publications:
 - 1. "National Design Standard for Metal Plate Connected Wood Truss Construction."

- B. Connector Plate Manufacturer's Qualifications. Must be a TPI Plate Manufacturer Member.
- C. Wood Structural Design Standard. Comply with applicable requirements of the American Wood Council "National Design Specification for Wood Construction."
- D. Single-Source Engineering Responsibility. Provide trusses engineered by the metal plate connector manufacturer to support superimposed dead and live loads as required by the building code, with design approved and certified by a qualified professional engineer.
- E. Engineer Qualifications. A professional engineer legally authorized to practice in jurisdiction where project is located and experienced in providing engineering service of the kind indicated that has resulted in the installation of metal-plate-connected wood trusses similar to those of this project and with a record of successful in-service performance.
- F. Fabricator's Qualifications. A firm that is experienced in prefabricating metal-plate-connected wood trusses similar to those of this project that have a record of successful in-service performance.
- G. Single Source Responsibility for Connector Plates. Provide metal connector plates from a single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Handle and store trusses with care and comply with manufacturer's instructions and TPI recommendations to avoid damage from bending, overturning, or other cause which trusses are not designed to resist or endure.

1.7 SEQUENCING AND SCHEDULING

- A. Time delivery and erection of trusses to avoid extended on-site storage and to avoid delaying work of other trades whose work must follow erection of trusses.

PART 2 - PRODUCTS

2.1 LUMBER

- A. Factory mark each piece of lumber with type, grade, mill, and grading agency.
- B. Lumber Standard. Manufacture lumber to comply with PS 20 "American Softwood Lumber Standard" and with applicable grading rules of inspecting agencies certified by American Lumber Standards Committee's (ALSC) Board of Review.
- C. Inspection Agencies. Inspection agencies and the abbreviations used to reference them to lumber grades and species include the following:
 1. SPIB - Southern Pine Inspection Bureau.
 2. WWPA - Western Wood Products Association.
- D. Nominal sizes are indicated, except as shown by detail dimensions.
- E. Provide dressed lumber, S4S, manufactured to actual sizes required by PS 20 to comply with requirements indicated below:

1. Moisture Content: Seasoned, with 19 percent maximum moisture content at time of dressing and shipment for sizes 2 inches or less in nominal thickness, unless otherwise indicated.
2. Grade and Species: Provide dimension lumber of any species for truss chord and web members capable of supporting required loads without exceeding allowable design values according to the above referenced Wood Structural Design Standard.

2.2 METAL CONNECTOR PLATES

- A. General. Fabricate connector plates from metal complying with requirements indicated in this article.
- B. Hot-Dip Galvanized Steel Sheet. Structural (physical) quality steel sheet complying with ASTM A 446, Grade A; zinc coated by hot-dip process to comply with ASTM A 525, Designation G60; minimum coated metal thickness indicated but not less than 0.036 inch.
- C. Electrolytic Zinc-Coated Steel Sheet, Structural (physical) quality steel sheet complying with ASTM A 591, Coating Class C, and for structural properties, with ASTM A 446, Grade A; zinc coated by electro-deposition; with minimum coated metal thickness indicated but not less than 0.047 inch.
- D. Aluminum-Zinc Alloy-Coated Steel Sheet. Structural (physical) quality steel sheet complying with ASTM A 792, Coating Designation AZ 50, and, for structural properties, with ASTM A 446, Grade A; aluminum-zinc alloy-coated by hot-dip process; with minimum coated metal thickness indicated but not less than 0.036 inch.
- E. Stainless Steel Sheet. Chromium nickel steel sheet complying with ASTM A 167, Type 304, and for structural properties, ASTM A 446, Grade A; with minimum metal thickness indicated but not less than 0.035 inch.
- F. Any metal indicated above.

2.3 FASTENERS

- A. General. Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 1. Where truss members are exposed to weather or to high relative humidities, provide fasteners with a hot-dip zinc coating per ASTM A 153 or of AISI, Type 304 stainless steel.
- B. Nails, Wire, Brads, and Staples. FS FF-N-105.
- C. Power Driven Fasteners. ICC-ES Evaluation Report ESR-1539
- D. Wood Screws. ANSI B18.6.1.
- E. Lag Bolts. ANSI B18.2.1.
- F. Bolts. Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and where indicated, flat washers.

2.4 METAL FRAMING ANCHORS

- A. General. Provide metal framing anchors of type, size, metal, and finish indicated that comply with requirements specified including the following:
 - 1. Current Evaluation/Research Reports: Provide products for which reports exist from a model code organization acceptable to authorities having jurisdiction that evidence compliance of metal framing anchors for application indicated with the building code in effect for this project.
 - 2. Allowable Design Loads: Provide products for which manufacturer publishes allowable design loads that are determined from empirical data or by rational engineering analysis and that are demonstrated by comprehensive testing performed by a qualified independent testing laboratory.
 - 3. Metal Hurricane Connectors: Provide anchors according to ANSI A58.1 to anchor each truss end to wall plates.
- B. Galvanized Steel Sheet: Steel sheet zinc-coated by hot-dip process on continuous lines prior to fabrication to comply with ASTM A 525 for Coating Designation G60 and with ASTM A 446, Grade A (structural quality); ASTM A 526 (commercial quality); or ASTM A 527 (lock-forming quality); as standard with manufacturer for type of anchor indicated.

2.5 FABRICATION

- A. Cut truss members to accurate lengths, angles and sizes to produce close-fitting joints with wood-to-wood bearing in assembled units.
- B. Fabricate metal connector plates to size, configuration, thickness, and anchorage details required to withstand design loadings for types of joint designs indicated, including allowance for design camber when positioning members.
- C. Assemble truss members in design configuration indicated using jigs or other means to ensure uniformity and accuracy of assembly with joints closely fitted to comply with tolerances specified in TPI " **National Design Standard for Metal Plate Connected Wood Truss Construction.**" Position members to produce design camber indicated.
- D. Connect truss members by means of metal connector plates accurately located and securely fastened to each side of wood members by means indicated or approved.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General. Erect and brace trusses to comply with applicable requirements of referenced TPI standards.
- B. Where trusses do not fit, return them to fabricator and replace with trusses of correct size; do not alter trusses in the field.
- C. Erect trusses with plane of truss webs vertical (plumb) and parallel to each other, located accurately at design spacings indicated.
- D. Hoist trusses in place by means of lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.

- E. Anchor trusses securely at all bearing points to comply with methods and details indicated.
- F. Install permanent bracing and related components to enable trusses to maintain design spacing, withstand live and dead loads including lateral loads, and to comply with other indicated requirements.
- G. Do not cut or remove truss members.

END OF SECTION

DIVISION 07

THERMAL AND MOISTURE PROTECTION

SECTION 07 21 00

THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the following:
 - 1. Insulation under slabs-on-grade.
 - 2. Building insulation.
 - 3. Foam cavity wall insulation.

- B. Related Sections. The following sections contain requirements that relate to this section:
 - 1. Section 04 20 00, Unit Masonry, for insulation installed in cavity walls and masonry cells.

1.2 DEFINITIONS

- A. Thermal Resistivity. Where the thermal resistivities of insulation products are designated by "r-values," they represent the reciprocal of thermal conductivity (k-values). Thermal conductivity is the rate of heat flow through a homogenous material exactly 1 inch thick. Thermal resistivities are expressed by the temperature difference in degrees Fahrenheit between the two exposed faces required to cause 1 BTU to flow through 1 square foot per hour at mean temperatures indicated.

1.3 SUBMITTALS

- A. General. Submit the following in accordance with conditions of contract and Division 1 Specification sections.
- B. Product data for each type of insulation product specified.
- C. Product test reports from and based on tests performed by qualified independent testing laboratory evidencing compliance of insulation products with requirements including r-values (aged values for plastic foam insulations), fire performance characteristics, perm ratings, water absorption ratings, and other properties, based on comprehensive testing of current products.
- D. Research reports or evaluation reports of the model code organization acceptable to authorities having jurisdiction that evidence compliance of plastic foam insulations with building code in effect for project.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials in manufacturer's original packaging.
- B. Storage: Store and protect products in accordance with manufacturer's instructions. Store with seals and labels intact and legible. Store inside and in a dry location.

Protect insulation materials from moisture and soiling. Provide ventilation to prevent condensation and degradation of products.

- C. Inspection: Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: For required thermal resistivity, see plans, sections, and details.
- B. Loose-Fill Insulation: Glass-Fiber
 - 1. Maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84 and ASTM C 764.
- C. Batt Insulation: Mineral-fiber blanket thermal insulation.
 - 1. Foil Faced: ASTM C 665, Type III, Class B preformed glass fiber batt type, foil faced one side with maximum flame/smoke properties of 75/450 in accordance with ASTM E84.
- D. Extruded Polystyrene Insulation: Provide continuous extruded polystyrene insulation (sheathing), unfaced. Each insulation board must be labeled with manufacturer's name, product brand name, ASTM material specification reference, and identification of the third-party inspection agency used for building code qualification.
 - 1. Type IV per ASTM C578
 - 2. Compressive Strength: 25 psi, minimum per ASTM D1621
 - 3. Thermal Resistance (180-day real-time aging as mandated by ASTM C578, measured per ASTM C518 at mean temperature of 75F): R-5.0 per inch of thickness, with 90% lifetime limited warranty on thermal resistance.
 - 4. Water Absorption (ASTM C272): Maximum.0.30 percent by volume.
 - 5. Surface Burning Characteristics (ASTM E84): Flame spread less than 25; smoke developed less than 450, certified by independent third-party testing agency.
- E. Foamed-In-Place Masonry Insulation. Two component thermal insulation produced by combining a plastic resin and catalyst foaming agent surfactant which, when properly ratioed and mixed, together with compressed air produce a cold-setting foam insulation in the hollow cores of hollow unit masonry walls.
 - 1. Fire-Resistance Ratings: Minimum 4-hour fire resistance wall rating (ASTM E-119) for 8- and 12-inch concrete masonry units when used in standard 2-hour rated CMUs.
 - 2. Surface Burning Characteristics: Maximum flame spread, smoke developed, and fuel contributed of 0, 5 and 0 respectively.

3. Combustion Characteristics: Must be noncombustible, Class A building material.
4. Thermal Values: "R" value of 4.91/inch at 32°F mean; ASTM C-177.
5. Sound Abatement: Minimum Sound Transmission Class ("STC") rating of 53 and a minimum Outdoor Indoor Transmission Class ("OITC") rating of 44 for 8-inch wall assembly (ASTM E 90).
6. Shrinkage less than 2%.

2.2 VAPOR RETARDERS

- A. Polyethylene Vapor Retarder. ASTM D 4397, 6.0 mils thick, with a maximum permeance rating of 0.13 perm.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine substrates, flashing conditions, penetrations, adjoining construction and the conditions under which work is to be installed. Verify that surfaces are dry and free of oil, grease, dust, rust, or other contaminant.
- B. Clean substrates of substances harmful to insulations or vapor retarders, including removal of projections that might puncture vapor retarders.
- C. Close off openings in cavities receiving poured-in-place insulation to prevent the escape of insulation. Provide bronze or stainless steel screen (inside) where openings must be maintained for drainage or ventilation.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's instructions applicable to products and application indicated. If printed instructions are not available or do not apply to project conditions, consult manufacturer's technical representative for specific recommendations before proceeding with installation of insulation.
- B. Extend insulation full thickness as indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions, and fill voids with insulation. Remove projections that interfere with placement.
- C. Apply a single layer of insulation of required thickness, unless otherwise shown or required to make up total thickness.

3.3 INSTALLATION OF LOOSE FILL INSULATION

- A. Install loose fill insulation in accordance with ASTM C 1015.
- B. Install to uniform, level thickness. Do not compact.

3.4 INSTALLATION OF BATT INSULATION

- A. Install batt insulation in accordance with ASTM C 1320.

- B. If eave ventilation baffles are required, install ventilation baffles at eaves to hold insulation down from roof sheathing and provide positive ventilation from eave to attic space.
- C. Install in exterior walls, roof and ceiling spaces without gaps or voids. Fluff insulation to full thickness for specified R-value before installation. Do not compress insulation.
- D. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- E. Fit insulation tight in spaces and tight to exterior side of mechanical and electrical services within the plane of insulation.
- F. install with vapor retarder membrane facing warm side of building spaces. Lap ends and side flanges of membrane over or between framing members. Tape seal butt ends, lapped flanges, and tears or cuts in membrane. Secure insulation in place using one of the following methods:
 - 1. Friction fit.
 - 2. Staple or nail facing flanges in place as needed.
 - 3. Tape in place.
 - 4. Retain in place with spindle fasteners.
 - 5. Retain in place with wire mesh secured to framing members.

3.5 INSTALLATION OF EXTRUDED POLYSTYRENE CONTINUOUS INSULATION

- A. Verify manufacturer recommended cure time for air and water barrier system before installing continuous insulation board.
- B. Install extruded polystyrene (XPS) insulation board in maximum sizes to minimize joints.
- C. Locate joints square to framing members. Center joints over framing. Provide additional framing as necessary.
- D. Stagger joints a minimum of one stud space from adjacent joints.
- E. Insulation board edges shall be butted together tightly and fit around openings and penetrations. Install square edges to fit square and tight.
- F. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation.
- G. Apply single layer of insulation boards to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.
- H. Attach to structure per manufacturer's instructions.

3.6 INSTALLATION OF CAVITY-WALL AND MASONRY-CELL INSULATION

- A. Install foamed-in-place insulation from interior, or as specified, prior to installation of interior finish work and after all masonry and structural concrete work is in place. Comply with manufacturer's instructions.

3.7 INSTALLATION OF VAPOR RETARDERS

- A. General. Extend vapor retarder to extremities of areas to be protected from vapor transmission.
- B. Seal overlapping joints in vapor retarders with adhesives or tape per vapor retarder manufacturer's printed directions. Seal butt joints and fastener penetrations with tape of type recommended by vapor retarder manufacturer. Locate all joints over framing members or other solid substrates.
- C. Firmly attach vapor retarders to substrates with mechanical fasteners or adhesives as recommended by vapor retarder manufacturer.
- D. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with tape of type recommended by vapor retarder manufacturer to create an airtight seal between penetrating objects and vapor retarder.
- E. Repair any tears or punctures in vapor retarders immediately before concealment by other work. Cover with tape or another layer of vapor retarder.

3.8 PROTECTION

- A. General. Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

SECTION 07 40 00

METAL ROOFING AND WALL PANELS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Exposed fastener metal roof panels, with related metal trim and accessories.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions, and Division 1 Specification Sections apply to this Section.
- B. Section 06 10 00 - Carpentry
- C. Section 06 17 53 - Prefabricated Wood Trusses
- D. Section 07 60 00 - Flashing and Sheet Metal
- E. Section 07 71 23 - Gutters and Downspouts
- F. Section 07 90 00 – Joint Sealants

1.3 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. American Society for Testing and Materials (ASTM):
 - 1. ASTM A 792/ - Standard Specification for Steel Sheet, 55 % Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
 - 2. ASTM C 645 - Specification for Nonstructural Steel Framing Members.
 - 3. ASTM D 4214 - Test Methods for Evaluating Degree of Chalking of Exterior Paint Films.
 - 4. ASTM E 1646 - Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference.
 - 5. ASTM E 1680 - Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems.

- D. Underwriters Laboratories, Inc. (UL):
 - 1. UL 580 - Tests for Uplift Resistance of Roof Assemblies.

1.4 QUALITY ASSURANCE

- A. Manufacturer/Source: Provide metal roof panel assembly and accessories from a single manufacturer providing fixed-base roll forming, and accredited under IAS AC 472 Part B.
- B. The Contractor shall be responsible for ensuring that all components installed are properly connected to other related components for proper functioning of the system.
- C. Manufacturer Qualifications: Approved manufacturer listed in this Section with minimum five years of experience in manufacture of similar products in successful use in similar applications.
- D. Installer Qualifications: Experienced Installer with minimum of five years of experience with successfully completed projects of a similar nature and scope.

1.5 SUBMITTALS

- A. Submit complete shop drawings to the Engineer in accordance with the requirements of the General Specifications.
 - 1. 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.
 - a. Indicate points of supporting structure that must coordinate with metal panel system installation.
 - b. Include data indicating compliance with performance requirements.
 - c. Include structural data indicating compliance with requirements of authorities having jurisdiction.
- B. Product Data: Manufacturer's data sheets for specified products.
- C. Samples for Initial Selection: For each exposed product specified including sealants. Provide representative color charts of manufacturer's full range of colors.
- D. Samples for Verification: Provide 12-inch-long section of each metal panel profile. Provide color chip verifying color selection.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect products of metal panel system during shipping, handling, and storage to prevent staining, denting, deterioration of components or other damage. Protect panels and trim bundles during shipping.
 - 1. Deliver, unload, store, and erect metal panel system and accessory items without misshaping panels or exposing panels to surface damage from weather or construction operations.

2. Store in accordance with Manufacturer's written instructions. Provide wood collars for stacking and handling in the field.

1.7 WARRANTY

- A. Manufacturer's Warranty: On manufacturer's standard form, in which manufacturer agrees to repair or replace metal panel assemblies that fail within one year from date of Substantial Completion.
- B. Panel Finish Warranty: On Manufacturer's standard form, in which Manufacturer agrees to repair or replace metal panels that evidence deterioration of factory-applied finish within twenty (20) years from date of Substantial Completion, including:
 1. Fluoropolymer Two-Coat System:
 - a. Color fading more than five (5) Hunter units per ASTM D 2244.
 - b. Chalking in excess of numerical rating of eight (8) per ASTM D 4214.
 - c. Not crack, chip, peel or exhibit any other mechanical failure of paint to adhere to the substrate.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. MBCI Metal Roof and Wall Systems
- B. Dimensional Metals, Inc. (DMI)
- C. Englert

2.2 PERFORMANCE REQUIREMENTS

- A. General: Provide metal roof panel system meeting performance requirements as determined by application of specified tests by a qualified testing facility on manufacturer's standard assemblies.
- B. Thermal Movements: Allow for thermal movements from variations in both ambient and internal temperatures. Accommodate movement of support structure caused by thermal expansion and contraction. Allow for deflection and design for thermal stresses caused by temperature differences from one side of the panel to the other.
- C. Structural Performance: Provide metal panel assemblies capable of withstanding the effects of loads and stresses within limits and under conditions indicated on plans.

2.3 METAL PANEL MATERIALS

- A. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792, structural quality, Grade 50, Coating Class AZ50, prepainted by the coil-coating process per ASTM A 755

2.4 METAL ROOF PANELS

- A. Large Tapered-Rib-Profile, Exposed Fastener Metal Roof Panels: Structural metal roof panel consisting of formed metal sheet with trapezoidal major ribs with intermediate

stiffening ribs symmetrically placed between major ribs, installed by lapping edges of adjacent panels.

1. Basis of Design: MBCI, PBR Panel.
2. Coverage Width: 36 inches.
3. Major Rib Spacing: 12 inches on center.
4. Rib Height: 1-1/4 inch.
5. Nominal Coated Thickness: 0.022 inch/26 gage.
6. Panel Surface: Smooth.
7. Exterior Finish: Fluoropolymer two-coat system.
8. Color: As selected by owner.

2.5 METAL ROOF PANEL ACCESSORIES

- A. General: Provide complete metal roof panel assembly incorporating ridge, eave, rake, valley, and parapet trims, copings, fascias, gutters and downspouts, and miscellaneous flashings, in manufacturer's standard profiles. Provide required fasteners, closure strips, support plates, and sealants as indicated in manufacturer's written instructions.
- B. Flashing and Trim: Match material, thickness, and finish of metal panel face sheet.
- C. Panel Fasteners: Self-tapping screws and other acceptable fasteners recommended by roof panel manufacturer.
 1. Exposed Fasteners: Long life fasteners with EPDM or neoprene gaskets, with heads matching color of metal panels by means of factory-applied coating.
- D. Snow Guards: With attachment type approved by metal roof panel manufacturer.

2.6 FABRICATION

- A. General: Provide factory fabricated and finished metal panels and accessories meeting performance requirements, indicated profiles, and structural requirements.
- B. Panel Lengths: Form panels in continuous lengths for full length of detailed runs, except where otherwise indicated on approved shop drawings.
- C. 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.

2.7 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.
 1. Basis of Design: MBCI, Signature 300.

- 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.

PART 3 - EXECUTION

3.1 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 in 20 foot in any direction.
 - b. 3/8 inch over any single roof plane.
- B. Correct out-of-tolerance work and other deficient conditions prior to proceeding with metal roof panel system installation.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, 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 60 00 "Flashing and Sheet Metal."

3.3 METAL PANEL INSTALLATION

- A. Exposed Fastener 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. Panel Sealants: Install manufacturer's recommended tape sealant at panel sidelaps and endlaps.
- C. Panel Fastening: Attach panels to supports using screws, fasteners, and sealants recommended by manufacturer and indicated on approved shop drawings.
 - 1. Fasten metal panels to supports at each location indicated on approved shop drawings, with spacing and fasteners recommended by manufacturer.
 - 2. Provide weatherproof jacks for pipe and conduit penetrating metal panels of types recommended by manufacturer.

3. Dissimilar Materials: Where elements of metal panel system will come into contact with dissimilar materials, treat faces and edges in contact with dissimilar materials as recommended by manufacturer.

3.4 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. 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. 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 07 90 00 "Joint Sealants."

3.5 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 engineer or owner's representative.

END OF SECTION

SECTION 07 60 00

FLASHING AND SHEET METAL

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the following:
 - 1. Metal counter flashing and base flashing (if any).
 - 2. Metal wall flashing and expansion joints.
 - 3. Drip edge, fascia cover, gutters and downspouts.
 - 4. Trim and other exposed metal work.
- B. Integral masonry flashings are specified as masonry work in Section 04 20 00, Unit Masonry.

1.2 SUBMITTALS

- A. General. Submit the following in accordance with Conditions of Contract and Division 1 Specification sections.
- B. Product Data, Flashing, Sheet Metal, and Accessories. Manufacturer's technical product data, installation instructions and general recommendations for each specified sheet material and fabricated product.
- C. Samples. Two 12-inch-long samples of factory-fabricated products exposed as finished work. Provide complete with specified factory finish.
- D. Shop drawings showing layout, profiles, thickness and dimensions, methods of joining, and anchorage details, including major counter flashings, trim/fascia units, and other exposed metal work. Provide layouts at ¼-inch scale and details at 3-inch scale.

1.3 PROJECT CONDITIONS

- A. Coordinate work of this section with interfacing and adjoining work for proper sequencing of each installation. Ensure best possible weather resistance and durability of work and protection of materials and finishes.

PART 2 - PRODUCTS

2.1 SHEET METAL FLASHING AND TRIM MATERIALS

- A. Zinc-Coated Steel. Commercial quality with 0.20 percent copper, ASTM A 526 except ASTM A 527 for lock-forming, G90 hot-dip galvanized, mill phosphatized where indicated for painting; 0.0359-inch thick (20 gauge) except as otherwise indicated.
- B. Stainless Steel. AISI Type 302/304, complying with ASTM A 167, 2D annealed finish, soft, except where harder temper required for forming or performance; 0.0156-inch thick (28 gauge) except as otherwise indicated.

- C. Copper. ASTM B 370; temper H00 (cold-rolled) except where temper 060 is required for forming; 16 oz. (0.0216-inch thick) except as otherwise indicated. Concealed thru-wall copper flashing shall weigh not less than 5 ounces per square foot and shall be coated with asphalt-impregnated glass fabric on both sides.
- D. Sheet Aluminum. ASTM B 209, alloy 3003, temper H14, AA-C22A41 clear anodized finish; 0.032-inch thick (20 gauge) except as otherwise indicated.

2.2 ROOF DRAINAGE SHEET METAL FABRICATIONS

A. Gutters and Downspouts:

- 1. Fabricate from 24 gage pre-painted, metallic-coated steel.
- 2. Drainage systems to be complete with end pieces, outlet tubes, hangers, drip edges and other accessories as required.
- 3. Gutters:
 - a. 6" K-Style (minimum), unless noted otherwise on the drawings.
 - b. Fabricate in minimum 96-inch- long sections. Furnish flat-stock gutter spacers and gutter brackets fabricated from same metal as gutters, of size recommended by SMACNA but not less than twice the gutter thickness.
 - c. Fabricate expansion joints, expansion-joint covers, and gutter accessories from same metal as gutters.
- 4. Downspouts:
 - a. 3"x4" rectangular (minimum, unless noted) complete with mitered elbows.
 - b. Furnish with metal hangers, from same material as downspouts.

2.3 MISCELLANEOUS MATERIALS AND ACCESSORIES

- A. Solder. For use with steel or copper, provide 50-50 tin/lead solder (ASTM B 32), with rosin flux.
- B. Solder. For use with stainless steel, provide 60-40 tin/lead solder (ASTM B 32), with acid-chloride type flux, except use rosin flux over tinned surfaces.
- C. Fasteners. Same metal as flashing/sheet metal or other non-corrosive metal as recommended by sheet manufacturer, except that fasteners with aluminum flashing shall be stainless steel. Match finish of exposed heads with material being fastened.
- D. Bituminous Coating. SSPC - Paint 12, solvent-type bituminous mastic, nominally free of sulfur, compounded for 15-mil dry film thickness per coat.
- E. Mastic Sealant. Polyisobutylene; nonhardening, nonskinning, non-drying, non-migrating sealant.

- F. Elastomeric Sealant. Generic type recommended by manufacturer of metal and fabricator of components being sealed and complying with requirements for joint sealants as specified in Section 07 90 00, Joint Sealants.
- G. Epoxy Seam Sealer. Two-part noncorrosive metal seam cementing compound, recommended by metal manufacturer for exterior/interior nonmoving joints including riveted joints.
- H. Adhesives. Type recommended by flashing sheet manufacturer for waterproof/weather-resistant seaming and adhesive application of flashing sheet.
- I. Paper Slip Sheet. 5-lb. rosin-sized building paper.
- J. Polyethylene Underlayment. Minimum 6-mil carbonated polyethylene film resistant to decay when tested in accordance with ASTM E 154.
- K. Reglets. Metal or plastic units of type and profile indicated, compatible with flashing indicated, noncorrosive.
- L. Metal Accessories. Provide 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.
- M. Elastic Flashing Filler. Closed-cell polyethylene or other soft closed-cell material recommended by elastic flashing manufacturer as filler under flashing loops to ensure movement with minimum stress on flashing sheet.
- N. Roofing Cement. ASTM D 2822, asphaltic.

2.4 FABRICATED UNITS

- A. General Metal Fabrication. Shop-fabricate work to greatest extent possible. Comply with details shown and with applicable requirements of SMACNA "Architectural Sheet Metal Manual" and other recognized industry practices. Fabricate for waterproof and weather-resistant performance, with expansion provisions for running work, sufficient to permanently prevent leakage, damage, or deterioration of the work. Form work to fit substrates. Comply with material manufacturer instructions and recommendations for forming material. Form exposed sheet metal work without excessive oil-canning, buckling, and tool marks, true to line and levels indicated, with exposed edges folded back to form hems.
- B. Seams. Fabricate nonmoving seams in sheet metal with flat-lock seams. For metal other than aluminum, trim edges to be seamed, form seams, and solder. Form aluminum seams with epoxy seam sealer; rivet joints for additional strength where required.
- C. Expansion Provisions. Where lapped or bayonet-type expansion provisions in work cannot be used or would not be sufficiently water/weatherproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
- D. Sealant Joints. Where movable, non-expansion type joints are indicated or required for proper performance of work, form metal to provide for proper installation of elastomeric sealant, in compliance with SMACNA standards.

- E. Separations. Provide for separation of metal from noncompatible metal or corrosive substrates by coating concealed surfaces at locations of contact, with bituminous coating or other permanent separation as recommended by manufacturer/fabricator.
- F. Aluminum Extrusion Units. Fabricate extruded aluminum running units with formed or extruded aluminum joint covers for installation behind main members where possible. Fabricate mitered and welded corner units.

PART 3 - EXECUTION

3.1 INSTALLATION REQUIREMENTS

- A. Install all flashing and sheet metal work in accordance with the "Architectural Sheet Metal Manual" by SMACNA.
- B. Install work watertight, without waves, warps, buckles, fastening stresses or distortion, allowing for expansion and contraction.
- C. Hem exposed edges except edges forming drip lips.
- D. Angle bottom edges of exposed vertical surfaces away from finished surface to form drips.
- E. Thru-wall flashing shall start ½ inch from outside of wall and shall be turned up not less than 2 inches and shall be anchored in interior block wall mortar joint. Flashing shall be laid in a thin bed of mortar and topped with a thin bed of mortar. Joints shall be lapped at least 4 inches and sealed with plastic cement.
- F. Lintel and sill flashing shall extend beyond ends of lintel or sill 6 inches and shall be turned up at the ends to form a pan.

3.2 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.
- B. Protection. Advise Contractor of required procedures for surveillance and protection of flashings and sheet metal work during construction to ensure that work will be without damage or deterioration other than natural weathering at time of Substantial Completion.

END OF SECTION

SECTION 07 71 23

GUTTERS AND DOWNSPOUTS

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. This section covers all equipment, materials, accessories, and labor required to assemble, install, test, and place into satisfactory service the gutters, downspouts, and precast concrete splash pads as specified herein and shown on the Drawings.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions, and Division 1 Specification Sections apply to this Section.

1.3 RELATED WORK

- A. Section 07 40 00 - Metal Roof & Siding Panels
- B. Section 07 60 00 - Flashing and Sheet Metal

1.4 QUALITY ASSURANCE

A. GENERAL

- 1. The Contractors shall be responsible for ensuring that all equipment installed is properly connected to other related equipment for proper functioning of the system.

B. MANUFACTURER'S QUALIFICATIONS

- 1. The Manufacturer of work of this section shall have five (5) years minimum proven experience in such work and shall have satisfactorily completed three (3) jobs of similar size and type within the last five (5) years.

1.5 REFERENCES

- A. SMACNA – Sheet Metal and Air Conditioning Contractor's National Association.

1.6 SUBMITTALS

A. SHOP DRAWINGS AND ENGINEERING DATA

- 1. Submit complete shop drawings to the Engineer in accordance with the requirements of the General Specifications.

2. Submit complete engineering data to the Engineer in accordance with the requirements of the General Specifications.

B. OPERATION AND MAINTENANCE DATA

1. Submit complete operation and maintenance data on the gutters and downspouts to the Owner in accordance with the requirements of the General Specifications.

1.7 STORAGE AND PROTECTION

- A. Store and protect the gutters and downspouts and accessories in accordance with the requirements of the General Specifications.

1.8 GUARANTEE

- A. Provide a guarantee against defective equipment and workmanship in accordance with the requirements of the General Conditions.

1.9 MEASUREMENT AND PAYMENT

- A. Payment for this work will include all equipment, materials, and labor necessary to perform the work under this specification as specified herein and as shown on the Drawings, and shall be included in the price of the Contract.

PART 2 – PRODUCTS

2.1 SYSTEM COMPONENTS

A. MATERIALS

1. Aluminum Sheet:
 - a. Gutters: Fabricate from minimum 0.040 thick aluminum.
 - b. Downspouts: Fabricate from minimum 0.040 thick aluminum.

B. GUTTERS

1. Product/Manufacturer: Gutter shall be 5-inch K-style.
2. Fabricate gutters in continuous lengths. Prepunch gutters at 12 inches O.C. to provide for thermal movement after installation.

3. Provide manufacturer's standard support brackets and interior straps for installation at 30 inches O.C.
4. The gutter system shall incorporate elastomeric expansion joints to accommodate thermal movement without restricting water flow. Locate expansion joints as recommended by the gutter manufacturer.

C. DOWNSPOUTS

1. Downspout shall be formed in 3-inch by 4-inch rectangle.
2. Fabricate downspouts in 10'-0" lengths, factory offset on one end to provide for a $\frac{3}{4}$ -inch telescope joint. Downspout shall have a factory mounted back which is not sealed to allow seepage of water in overflow condition. Elbows for downspouts shall be of welded construction.

D. FINISH

1. Finish gutters, downspouts, support brackets and other aluminum components with a high performance organic spray coating meeting AAMA 605.2-90 requirements.
 - a. Multi-coat thermo-cured 70 percent Polyvinylidene Fluoride (PVDF).
2. Color: As selected by Owner from manufacturer's standard colors.

E. ACCESSORIES

1. Anchorage Devices: Type recommended by fabricator.
2. Gutter Supports: Brackets of compatible metal in color and finish to match gutter. No gutter nails allowed.
3. Downspout Supports: Brackets of compatible metal in color and finish to match downspout.
4. Fasteners: Aluminum or stainless steel with soft neoprene washers. Finish exposed fasteners same as flashing metal. Use fasteners appropriate for applicable substrate.
5. Protective Back Coating: Bituminous coating.
6. Sealant: As recommended by gutter system manufacturer.

F. SPLASH PADS

1. Splash Pads: Precast concrete type, at locations indicated, sloped to drain away from structure; minimum 3,000 psi at 28 days, with minimum 5 percent air entrainment.

G. FABRICATION

1. Fabricate with required connection pieces.
2. Form sections square, true, and accurate in size, in maximum possible lengths, free of distortion or defects detrimental to appearance or performance.
3. Hem exposed edges of metal.
4. Fabricate gutter and downspout accessories.
5. Apply bituminous protective backing on surfaces in contact with dissimilar materials.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install gutters, downspouts, and accessories in accordance with manufacturer's instructions and as required to ensure positive drainage to downspouts. Where manufacturer's instructions are not provided, comply with SMACNA requirements and recommendations.
- B. Join lengths with seams watertight. Flash and seal gutters to downspouts and accessories.
- C. Install gutter support brackets 30 inches O.C. directly to roof sheathing under the metal roofing.
- D. Install inside straps at 30 inches O.C., alternating with support brackets.
- E. Provide and cap end termination.
- F. Seal joints with a bead of sealant.
- G. Slope gutters a maximum of ¼-inch/40 feet.
- H. Seal metal joints watertight.

- I. Connect downspouts into storm sewer or onto splash pads as indicated on the Drawings.

END OF SECTION

SECTION 07 90 00

JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes joint sealants for the following locations:
1. Exterior joints in vertical surfaces and nontraffic horizontal surfaces as indicated below:
 - a. Control and expansion joints in cast-in-place and precast concrete.
 - b. Control and expansion joints in unit masonry.
 - c. Joints between different materials listed above.
 - d. Perimeter joints between materials listed above and frames of doors and windows.
 2. Interior joints in vertical surfaces and horizontal nontraffic surfaces as indicated below:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Joints between tops of non-load-bearing unit masonry walls and underside of cast-in-place or precast concrete slabs and beams.
 - c. Vertical control joints on exposed surfaces of interior unit masonry and concrete walls and partitions.
 - d. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and wall penetrations.
 - e. Perimeter joints of plumbing fixtures.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplemental Conditions or General Provisions and Division 1 Specification sections, apply to this section.
- B. Related Sections. The following section contains requirements that relate to this section:
1. Section 08 81 00, Glass and Glazing, for sealants used in glazing.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. Provide joint sealants for interior applications that have been produced and installed to establish and maintain airtight continuous seals that are water resistant and cause no staining or deterioration of joint substrates.

1.4 SUBMITTALS

- A. General. Submit the following in accordance with Conditions of Contract and Division 1 Specification sections.
- B. Product data from manufacturers for each joint sealant product required.

- C. Certificates from manufacturers of joint sealants attesting that their products comply with specification requirements and are suitable for the use indicated.
- D. Compatibility and adhesion test reports from elastomeric sealant manufacturer indicating that materials forming joint substrates and joint sealant backings have been tested for compatibility and adhesion with joint sealants. Include sealant manufacturer's interpretation of test results relative to sealant performance and recommendations for primers and substrate preparation needed to obtain adhesion.

1.5 QUALITY ASSURANCE

- A. Single Source Responsibility for Joint Sealant Materials. Obtain joint sealant materials from a single manufacturer for each different product required.
- B. Product Testing. Provide comprehensive test data for each type of joint sealant based on tests conducted by a qualified independent testing laboratory on current product formulations within a 24-month period preceding date of Contractor's submittal of test results to Engineer.
 - 1. Test elastomeric sealants for compliance with requirements specified by reference to ASTM C 920. Include test results for hardness, stain resistance, adhesion and cohesion under cyclic movement (per ASTM C 719), low-temperature flexibility, modulus of elasticity at 100 percent strain, effects of heat aging, and effects of accelerated weathering.
- C. Preconstruction Field Testing. Prior to installation of joint sealants, field-test their adhesion to joint substrates as follows:
 - 1. Locate test joints where indicated or, if not indicated, as directed by Engineer.
 - 2. Conduct field tests for each application indicated below:
 - a. Each type of elastomeric sealant and joint substrate indicated.
 - b. Each type of non-elastomeric sealant and joint substrate indicated.
 - 3. Notify Resident Project Representative one week in advance of the dates and times when mock-ups will be erected.
 - 4. Test joint sealants by hand pull method described below:
 - a. Install joint sealants in 5-foot joint lengths using same materials and methods for joint preparation and joint sealant installation required for completed work. Allow sealants to cure fully before testing.
 - b. Make knife cuts horizontally from one side of joint to the other followed by 2 vertical cuts approximately 2 inches long at side of joint and meeting horizontal cut at top of 2-inch cuts. Place a mark 1 inch from top of 2-inch piece.
 - c. Use fingers to grasp 2-inch piece of sealant just above 1-inch mark; pull firmly down at a 90-degree angle or more while holding a ruler along side of sealant. Pull sealant out of joint to the distance recommended by sealant manufacturer for testing adhesive capability, but not less than that equaling specified maximum movement capability in extension; hold this position for 10 seconds.

- d. Report whether or not sealant in joint connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate.
- e. Evaluation of Field 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.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.7 PROJECT CONDITIONS

- A. Environmental Conditions. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside the limits permitted by joint sealant manufacturer.
 - 2. When joint substrates are wet.
- B. Joint Width Conditions. Do not proceed with installation of joint sealants where joint widths are less than allowed by joint sealant manufacturer for application indicated.
- C. Joint Substrate Conditions. Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Compatibility. Provide joint sealants, joint fillers, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
- B. Colors. Provide color of exposed joint sealants to comply with selections made by the Engineer from the manufacturer's full range of standard colors.

2.2 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealant Standard. Provide manufacturer's standard chemically curing elastomeric sealants that comply with ASTM C 920 and other requirements indicated on each Elastomeric Joint Sealant Schedule at the end of this section,

including those requirements referencing ASTM C 920 classifications for type, grade, class, and uses.

1. Additional Movement Capability: Where additional movement capability is specified in the Elastomeric Joint Sealant Schedule, provide products with the capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, to withstand the specified percentage change in the joint width existing at time of installation and remain in compliance with other requirements of ASTM C 920 for uses indicated.
2. Sealants for immersion use shall be approved for potable water contact in accordance with NSF 61.

B. Available Products. Subject to compliance with requirements, elastomeric sealants that may be incorporated in the work include, but are not limited to, the products specified in the Elastomeric Joint Sealant Schedule of this section.

2.3 JOINT SEALANT BACKING

A. General. Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Plastic Foam Joint Fillers. Preformed, compressible, resilient, nonstaining, nonwaxing, nonextruding strips of flexible plastic foam of material indicated below and of size, shape, and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

1. Open-cell polyurethane foam.
2. Closed-cell polyethylene foam, nonabsorbent to liquid water and gas, nonoutgassing in unruptured state.
3. Proprietary, reticulated, closed-cell polymeric foam, nonoutgassing, with a density of 2.5 pcf and tensile strength of 35 psi per ASTM D 1623, and with water absorption less than 0.02 gms/cc per ASTM C 1083.
4. Any materials indicated above.

C. Elastomeric Tubing Joint Fillers. Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, capable of remaining resilient at temperatures down to -26°F (-32°C). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.

2.4 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 in any way joint substrates and adjacent nonporous

surfaces, and formulated to promote optimum adhesion of sealants with joint substrates.

- C. Masking Tape. Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 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 joint sealant performance. Do not proceed with installation of joint sealants until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints. Clean out joints immediately before installing joint sealants to comply with recommendations of joint sealant manufacturer 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 concrete, masonry, unglazed surfaces of ceramic tile, and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, 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 from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air.
 3. Remove laitance and form release agents from concrete.
 4. Clean metal, glass, porcelain enamel, glazed surfaces of ceramic tile, and other nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- B. Joint Priming. Prime joint substrates where indicated or where recommended by joint sealant manufacturer based on preconstruction joint sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's recommendations. 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 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.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General. Comply with joint sealant manufacturer's printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.
- B. Sealant Installation Standard. Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Installation of Sealant Backings. Install sealant backings to comply with the following requirements:
 - 1. Install joint fillers of type indicated to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - a. Do not leave gaps between ends of joint fillers.
 - b. Do not stretch, twist, puncture, or tear joint fillers.
 - c. Remove absorbent joint fillers that have become wet prior to sealant application and replace with dry material.
- D. Installation of Sealants. Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at the same time sealant backings are installed.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated, to eliminate air pockets, and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.
 - 1. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
 - 2. Provide flush joint configuration per Figure 5B in ASTM C 1193, where indicated.
 - a. Use masking tape to protect adjacent surfaces of recessed tooled joints.

3.4 CLEANING

- A. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove

damaged or deteriorated joint sealants immediately so that installations with repaired areas are indistinguishable from original work.

3.6 ELASTOMERIC JOINT SEALANT SCHEDULE

Use	Base Polymer	Type	Grade	Class	Use Exposure	Use Substrate	Product
Exterior General Building/ Architectural Sealant and Nontraffic Concrete joints (Non-Immersion), Masonry Control Joints	Polyurethane	M	NS	25	NT	M,G,A	Pecora Dynatrol II
Concrete Joints Immersed or Potable Water/Wastewater Contact	Polysulfide	M	NS	25	NT	I	Pecora Synthacalk GC-2 Plus
Interior General Building/Architectural Sealant	Polyurethane	M	NS	12 ½	NT	M,G,A	Pecora Dynaflex
Traffic Concrete Joints	Polyurethane	S	NS	25	T	M,G,A	Pecora Urexpam NR-201

END OF SECTION

DIVISION 08

OPENINGS

SECTION 08 11 13

STANDARD STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the following products manufactured in accordance with SDI recommended standards:
 - 1. Doors: Seamless, hollow or composite construction standard steel doors for interior and exterior locations.
 - 2. Frames: Pressed steel frames for doors, transoms, sidelights, mullions, interior glazed panels, and other interior and exterior openings of welded unit type.
 - 3. Assemblies: Provide standard steel door and frame assemblies as required for the following:
 - a. Labeled and fire rated.
 - b. Thermal rated (insulated).
 - 4. Provide factory primed doors and frames to be field painted.

1.2 RELATED SECTIONS

- A. Painting primed doors and frames is specified in Section 09 91 00, Painting.
- B. Door hardware is specified in Section 08 71 00, Door Hardware.
- C. Glass and glazing are specified in Section 08 81 00, Glass and Glazing.
- D. Building in of anchors and grouting of frames in masonry construction is specified in Section 04 20 00, Unit Masonry.

1.3 SUBMITTALS

- A. General. Submit the following in accordance with conditions of contract and Division 1 Specification sections.
- B. Product data for each type of door and frame specified, including details of construction, materials, dimensions, hardware preparation, core, label compliance, sound ratings, profiles, and finishes.
- C. Shop drawings showing fabrication and installation of standard steel doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of door and frame hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.
 - 1. Provide schedule of doors and frames using same reference numbers for details and openings as those on contract drawings.
 - 2. Indicate coordinates of glazing frames and stops with glass and glazing requirements.

- D. Label Construction Certification. For door assemblies required to be fire-rated and exceeding limitations of labeled assemblies, submit manufacturer's certification that each door and frame assembly has been constructed to conform to design, materials, and construction equivalent to requirements for labeled construction.

1.4 QUALITY ASSURANCE

- A. Provide doors and frames complying with Steel Door Institute's "Recommended Specifications - Standard Steel Doors and Frames" ANSI/SDI-100 and as herein specified.
- B. Fire-Rated Door Assemblies. Units that comply with NFPA 80, are identical to door and frame assemblies whose fire resistance characteristics have been determined per ASTM E 152, and which are labeled and listed by UL, Factory Mutual, Warnock Hersey, or other testing and inspecting organization acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames cardboard-wrapped or crated to provide protection during transit and job storage. Provide additional protection to prevent damage to finish of factory-finished doors and frames.
- B. Inspect doors and frames upon delivery for damage. Minor damages may be repaired provided refinished items are equal in all respects to new work and acceptable to Engineer; otherwise, remove and replace damaged items as directed.
- C. Store doors and frames at building site under cover. Place units on minimum 4-inch-high wood blocking. Avoid use of non-vented plastic or canvas shelters which could create humidity chamber. If cardboard wrapper on door becomes wet, remove carton immediately. Provide ¼-inch spaces between stacked doors to promote air circulation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Available Manufacturers. Subject to compliance with requirements, manufacturers offering standard steel doors and frames which may be incorporated in the work include, but are not limited to, the following:
- B. Manufacturer. Subject to compliance with requirements, provide standard steel doors and frames by one of the following:
 - 1. Standard Steel Doors and Frames
 - a. Amweld Building Products, Inc.
 - b. Ceco Corp.
 - c. Copco Door Co.
 - d. Curries Company.
 - e. Deansteel Manufacturing Co.
 - f. Fenestra Corp.
 - g. Kewanee Corp.
 - h. Mesker Door Co.
 - i. Pioneer Industries.

- j. Premier Products, Inc. (Formerly Dittco).
- k. Republic Builders Products.
- l. Steelcraft Manufacturing Co.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheets. Commercial quality carbon steel, complying with ASTM A 366 and ASTM A 568.
- B. Supports and Anchors. Fabricate of not less than 18-gauge sheet steel; galvanized where used with galvanized frames.
- C. Inserts, Bolts, and Fasteners. Manufacturer's standard units. Where items are to be built into exterior walls, hot-dip galvanize in compliance with ASTM A 153, Class C or D as applicable.
- D. Shop Applied Paint. Apply after fabrication.
 - 1. Primer: Rust-inhibitive enamel or paint, either air-drying or baking, suitable as a base for specified finish paints complying with ANSI A250.10, "Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames."

2.3 DOORS

- A. Provide metal doors of SDI grades and models specified below or as indicated on Drawings or schedules:
 - 1. Interior Doors: ANSI/SDI-100, Grade II, heavy-duty, Model 3 or 4, minimum 18-gauge cold-rolled sheet steel faces.
 - 2. Exterior Doors: ANSI/SDI-100, Grade III, extra heavy-duty, Model 4, minimum 16-gauge galvanized steel faces.
 - 3. All doors to be 1¾-inch thickness unless otherwise shown on the Drawings.
- B. Door Louvers. Provide sightproof stationary louvers for interior doors where indicated, constructed of inverted V-shaped or Y-shaped blades formed of 24-gauge cold-rolled steel set into minimum 20-gauge steel frame.

2.4 FRAMES

- A. Provide metal frames for doors, transoms, sidelights, borrowed lights, and other openings, of types and styles as shown on Drawings and schedules. Conceal fastenings, unless otherwise indicated. Fabricate frames of minimum 16-gauge cold-rolled steel.
 - 1. Fabricate frames with mitered, coped, or welded corners.
 - 2. Form exterior frames from 16-gauge galvanized steel.
- B. Door Silencers. Except on weatherstripped frames, drill stops to receive 3 silencers on strike jambs of single-door frames and 2 silencers on heads of double-door frames.
- C. Plaster Guards. Provide minimum 26-gauge steel plaster guards or mortar boxes at back of hardware cutouts where mortar or other materials might obstruct hardware operation and to close off interior of openings.

2.5 FABRICATION

- A. Fabricate steel door and frame units to be rigid, neat in appearance and free from defects, warp, or buckle. Wherever practicable, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory-assembled before shipment, to assure proper assembly at project site. Comply with ANSI/SDI-100 requirements.
 - 1. Internal Construction: Manufacturer's standard honeycomb, polyurethane, polystyrene, unitized steel grid, vertical steel stiffeners, or rigid mineral fiber core with internal sound deadener on inside of face sheets where appropriate in accordance with SDI standards.
 - 2. Clearances: Not more than $\frac{1}{2}$ inch at jambs and heads, except between non-fire-rated pairs of doors not more than $\frac{1}{4}$ inch. Not more than $\frac{3}{4}$ inch at bottom.
- B. Fabricate exposed faces of doors and panels, including stiles and rails of nonflush units, from only cold-rolled steel.
- C. Tolerances. Comply with SDI 117 "Manufacturing Tolerances Standard Steel Doors and Frames."
- D. Fabricate frames, concealed stiffeners, reinforcement, edge channels, louvers and moldings from either cold-rolled or hot-rolled steel.
- E. Fabricate exterior doors, panels, and frames from galvanized sheet steel in accordance with SDI-112. Close top and bottom edges of exterior doors as integral part of door construction or by addition of minimum 16-gauge inverted steel channels.
- F. Exposed Fasteners. Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.
- G. Thermal-Rated (Insulating) Assemblies. At exterior locations and elsewhere as shown or scheduled, provide doors fabricated as thermal insulating door and frame assemblies and tested in accordance with ASTM C 236 or ASTM C 976 on fully operable door assemblies.
 - 1. Unless otherwise indicated, provide thermal-rated assemblies with U factor of 0.10 Btu/(hr x sq ft x deg F.) or better.
- H. Sound-Rated (Acoustical) Assemblies. Where shown or scheduled, provide door and frame assemblies fabricated as sound-reducing type, tested in accordance with ASTM E 90, and classified in accordance with ASTM E 413.
 - 1. Unless otherwise indicated, provide acoustical assemblies with sound ratings of STC 33 or better.
- I. Hardware Preparation. Prepare doors and frames to receive mortised and concealed hardware in accordance with final Door Hardware Schedule and templates provided by hardware supplier. Comply with applicable requirements of ANSI A 115 Series Specifications for door and frame preparation for hardware.
- J. Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied hardware may be done at project site.

- K. Locate hardware as indicated on final shop drawings or, if not indicated, in accordance with "Recommended Locations for Builder's Hardware on Standard Steel Doors and Frames," published by Door and Hardware Institute.
- L. Shop Painting. Clean, treat, and paint exposed surfaces of steel door and frame units, including galvanized surfaces.
- M. Glazing Stops. Minimum 20-gauge steel or 0.040-inch-thick aluminum.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General. Install standard steel doors, frames, and accessories in accordance with final shop drawings, manufacturer's data, and as herein specified.
- B. Placing Frames. Comply with provisions of SDI-105 "Recommended Erection Instructions for Steel Frames," unless otherwise indicated.
 - 1. Except for frames located at existing concrete, masonry or drywall installations, place frames prior to construction of enclosing walls and ceilings. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
 - 2. In masonry construction, locate 3 wall anchors per jamb adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Acceptable anchors include masonry wire anchors and masonry tee anchors.
 - 3. At existing concrete or masonry construction, provide 3 completed opening anchors per jamb adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb, set frames and secure to adjacent construction with bolts and masonry anchorage devices.
 - 4. Install fire-rated frames in accordance with NFPA Standard No. 80.
 - 5. In metal stud partitions, install at least 3 wall anchors per jamb at hinge and strike levels. In closed steel stud partitions, attach wall anchors to studs with screws.
 - 6. In in-place drywall partitions install knock down slip-on drywall frames.
- C. Door Installation. Fit hollow metal doors accurately in frames, within clearances specified in ANSI/SDI-100.
 - 1. Install fire-rated doors with clearances as specified in NFPA Standard No. 80.

3.2 ADJUST AND CLEAN

- A. Prime Coat Touch-up. Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.
- B. Protection Removal. Immediately prior to final inspection, remove protective plastic wrappings from prefinished doors.
- C. Final Adjustments. Check and readjust operating hardware items, leaving steel doors and frames undamaged and in complete and proper operating condition.

END OF SECTION

SECTION 08 33 23

OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 SCOPE

- A. The work covered by this section consists of furnishing all labor, equipment, and materials required to furnish, install, and place into satisfactory operation rolling steel doors, including operators, guides, brackets, and accessories, as specified herein and/or shown on the Drawings.

1.2 SHOP DRAWINGS AND ENGINEERING DATA

- A. Submit complete shop drawings and engineering data to the Engineer in accordance with the requirements of Section 01 33 23, Shop Drawings, Product Data, and Samples.

1.3 STORAGE AND PROTECTION

- A. Store and protect the doors in accordance with the requirements of Section 01 66 00, Storage and Protection.

1.4 SHOP PAINTING

- A. Clean, shop prime, and shop paint doors and accessories in accordance with the requirements of Section 09 91 00, Painting.

1.5 OPERATION AND MAINTENANCE DATA

- A. Submit complete operation and maintenance data on the doors in accordance with the requirements of Section 01 78 23, Operating and Maintenance Data.

1.6 GUARANTEE

- A. Provide a guarantee against defective or deficient equipment and workmanship in accordance with the requirements of Section 01 78 36, Warranties and Bonds.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Design rolling steel doors for a wind load of not less than 20 psf and to conform to the applicable standards of the American Rolling Door Institute. Sizes of doors to be as shown on the Drawings.
- B. Furnish rolling steel doors with a continuous chain operator and design for face mounting, unless otherwise shown or specified.
- C. Design rolling steel doors for a frequency of operation of not less than 10 times a day.

2.2 CURTAIN AND GUIDES

- A. Construct the curtain with interlocking flat slats assembled together to form a water shedding surface on the weather side. Slats to be minimum 20 gauge, galvanized, open hearth, copper bearing, cold rolled steel, formed in easy curves without sharp bends. Slats shall be provided with malleable iron end-locks riveted with two rivets to both ends of alternate slats. Galvanize by hot-dip process with minimum zinc coating weight of 1.25 ounces per square foot per ASTM A 525. Reinforce bottom of curtain with two steel angles placed back-to-back. Provide a compressible neoprene weather seal on bottom of curtain. Provide vinyl weather stripping at jambs on the interior and exterior of the door. Provide lintel seal consisting of a nylon brush seal fitted at the door header to impede the air flow at the lintel and to keep birds out of the coil.
- B. Provide malleable iron windlocks at ends of slats to engage lockbars in guides and lock the curtain where required.
- C. Construct guides from minimum 3/16-inch-thick structural steel to form a slot of sufficient depth to retain curtain in guides against heavy wind pressure. For doors requiring windlocks, guides must be provided with lockbars for windlocks. Guides to be continuous from top to bottom and anchored to the wall at intervals not to exceed 36 inches with 3/8-inch bolts.
- D. Furnish top of guides with removable, bell-mouthed curtain guides and malleable iron curtain stops.
- E. Insulate slats with closed cell urethane insulation sandwiched between galvanized steel slat facing sheets where an insulated door is specified.
- F. Furnish slats with slotted 6-inch by 1 1/4-inch openings glazed with clear plexiglass where vision panels are specified. Vision panels to be weathertight.

2.3 COIL BARREL AND HOOD

- A. The curtain to be counterbalanced at each position in its vertical travel by helical torsion springs enclosed within the steel coil barrel. Springs to be of oil-tempered steel, cold formed and heat treated. Anchor springs to a single, solid torsion rod and hold in position by a common adjusting wheel accessible from the outside.
- B. Design coil barrel so that deflection under load does not exceed 0.03 inch per foot of opening width. Ends of coil barrel to be completely closed with heavy cast iron plugs machined to fit inside of pipe. Support coil barrel on self-aligning, permanently lubricated, and sealed ball bearings.
- C. Coil brackets to be of high-grade iron or steel designed to house ends of the coil and form an end closure support for the hood.
- D. Enclose coil in a contoured hood constructed of not less than 24-gauge galvanized sheet steel. Hood to have stiffening rolls at top and bottom edges and be adequately supported. Furnish an interior, neoprene sheet hood baffle in the hood.

2.4 CHAIN OPERATOR

- A. Gears to be of high tensile strength, gray iron castings conforming to Federal Specification QQ-1-652 and made from machine cut patterns.

- B. Chain to be continuous and cadmium plated or galvanized. Provide a chain locking device for locking door. Provide a chain guide on chain sprocket to guide chain.
- C. Design operator so that a pull of not more than 35 pounds is required to raise door.

2.5 ELECTRIC MOTOR OPERATOR

- A. Electric motor operator to be of the heavy-duty type and shall incorporate a high-starting torque motor, a totally enclosed oil bath lubricated worm gear reduction unit with self-locking gearing, a totally enclosed self-adjusting solenoid-operated brake, floor engaged emergency hand chain, electrical cut-out switch to prevent motor operation during chain operation, adjustable totally enclosed limit switch assembly, and a reversing magnetic starter in a NEMA 4 enclosure. Design electric motor operator to operate the door at a speed of 0.7 to 1.0 foot per second. Operator to be UL listed in accordance with UL Bulletin 325.
- B. Gear reducer to feature a hardened steel worm, bronze worm gear, and anti-friction bearings. Connect output shaft of gear reducer to a chain sprocket for operating the door.
- C. Motor to be of the totally enclosed, fan cooled, ball bearing type with electrical characteristics as shown on the Drawings. Minimum motor horsepower to be 1½ hp. Protect motor against overloads by suitable protective devices on the operator.
- D. The operator to be controlled by a NEMA 12, heavy-duty, oil-tight pushbutton control station with OPEN, CLOSE, and OFF buttons. Design control station for operation in a control voltage of 24 volts.
- E. Equip starter with a 24-volt control power transformer. Operator to be completely pre-wired with all external electrical connections made in a conveniently located terminal enclosure.
- F. Equip curtain with an electric, reversing, compressible door bottom edge device designed to serve as both a safety device and a weather seal.

2.6 FINISH

- A. All galvanized surfaces to be phosphate treated for paint adherence. Provide curtain with a baked-on gray enamel finish inside and out.
- B. Clean and shop prime all nongalvanized ferrous surfaces of door, frame, and guides.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install rolling steel doors in accordance with the Drawings and approved manufacturer's shop drawings.
- B. After installation, the ability of the rolling door to operate properly and smoothly without jamming, excessive noise, or excessive chain pull shall be demonstrated to the satisfaction of the Engineer. The Contractor shall at his own expense adjust or modify the door as required to achieve satisfactory operation.

- C. Following installation, field prime and paint all exposed ferrous surfaces except the curtain with Epoxy System Ferrous Metal Finish in accordance with the requirements of Section 09 91 00, Painting.

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the following:
1. Hinges.
 2. Key control system.
 3. Lock cylinders and keys.
 4. Lock and latch sets.
 5. Exit devices.
 6. Push/pull units.
 7. Closers.
 8. Miscellaneous door control devices.
 9. Protection plates.
 10. Weatherstripping for exterior doors.
 11. Thresholds.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplemental Conditions or General Provisions and Division 1 Specification sections, apply to this section.
- B. Related Sections. The following sections contain requirements that relate to this section:
1. Section 08 16 13, Fiberglass Doors and Frames, for silencers integral with hollow metal frames.

1.3 SUBMITTALS

- A. General. Submit the following in accordance with Conditions of Contract and Division 1 Specification sections.
- B. Product data including manufacturer's 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.
- C. Final hardware schedule coordinated with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
1. Final Hardware Schedule Content: Based on hardware indicated, organize schedule into "hardware sets" indicating complete designations of every item required for each door or opening. Include the following information:
 - a. Type, style, function, size, and finish of each hardware item.
 - b. Name and manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of each hardware set cross referenced to indications on Drawings both on floor plans and in door and frame schedule.

- e. Explanation of all abbreviations, symbols, and codes contained in schedule.
- f. Mounting locations for hardware.
- g. Door and frame sizes and materials.

1.4 QUALITY ASSURANCE

- A. Single Source Responsibility. Obtain each type of hardware (latch and lock sets, hinges, closers, etc.) from a single manufacturer.

1.5 MAINTENANCE

- A. Maintenance Tools and Instructions. Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers. Subject to compliance with requirements, provide products by one of the following:
 - 1. Butts and Hinges
 - a. Hager Hinge Company.
 - b. Stanley Hardware, Division of Stanley Works.
 - 2. Pivots
 - a. Hager Hinge Company.
 - b. Stanley Hardware, Division of Stanley Works.
 - 3. Cylinders and Locks
 - a. Sargent Manufacturing Company.
 - b. Yale Security Inc.
 - 4. Bolts
 - a. Hager Hinge Company.
 - b. Stanley Hardware, Division of Stanley Works.
 - 5. Exit/Panic Devices
 - a. Sargent Manufacturing Company.
 - b. Yale Security Inc.
 - 6. Push/Pull Units
 - a. Hager Hinge Company.
 - 7. Overhead Closers
 - a. Sargent Manufacturing Company.
 - b. Yale Security Inc.

2.2 SCHEDULED HARDWARE

- A. Requirements for each type of finish hardware are indicated in the "Hardware Schedule" at the end of this section.

2.3 MATERIALS AND FABRICATION

- A. Base Metals. Produce hardware units of basic metal and forming method indicated using manufacturer's standard metal alloy, composition, temper, and hardness, but in no case of lesser (commercially recognized) quality than specified for applicable hardware units for finish designations indicated.
- B. Fasteners. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation. Do not provide hardware that has been prepared for self-tapping sheet metal screws, except as specifically indicated.
- C. Furnish screws for installation with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. 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 as closely as possible including "prepared for paint" surfaces to receive painted finish.
- D. Provide concealed fasteners for hardware units that are exposed when door is closed except to the extent 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 their use is the only means of reinforcing the work adequately to fasten the hardware securely. Where thru-bolts are used as a means of reinforcing the work, provide sleeves for each thru-bolt or use hex screw fasteners.

2.4 HINGES, BUTTS, AND PIVOTS

- A. Templates. Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.
- B. Screws. Provide Phillips flat-head screws complying with the following requirements:
 - 1. For metal doors and frames install machine screws into drilled and tapped holes.
 - 2. Finish screw heads to match surface of hinges or pivots.
- C. Hinge Pins. Except as otherwise indicated, provide hinge pins as follows:
 - 1. Out-Swing Exterior Doors: Nonremovable pins.
 - 2. Interior Doors: Nonrising pins.
 - 3. Tips: Flat button and matching plug, finished to match leaves.
 - 4. Bearings: Hinges shall be 2 race ball bearing type as a minimum.
- D. Metals. Unless otherwise noted, hinges and butts shall be stainless steel for all doors.

2.5 LOCK CYLINDERS AND KEYING

- A. Review the keying system with the Owner and Engineer and provide the type required (master, grandmaster or great-grandmaster), either new or integrated with Owner's existing system.
- B. Equip locks with manufacturer's special 6-pin tumbler cylinder with construction masterkey feature that permits voiding of construction keys without cylinder removal.

- C. Metals. Construct lock cylinder parts from stainless steel.
- D. Key Material. Provide keys of nickel silver only.
- E. Key Quantity. Furnish 3 change keys for each lock, 5 master keys for each master system, and 5 grandmaster keys for each grandmaster system.
 - 1. Deliver keys to Owner.

2.6 LOCKS, LATCHES, AND BOLTS

A. Strikes

- 1. Provide manufacturer's standard wrought box strike for each latch or lock bolt, with curved lip extended to protect frame, finished to match hardware set, unless otherwise indicated.
- 2. Provide flat-lip strikes for locks with 3-piece, anti-friction latchbolts as recommended by manufacturer.

B. Lock Throw

- 1. Provide -inch minimum throw of latch on pairs of doors.
- 2. Provide ½-inch minimum throw of latch for other bored and preassembled types of locks.
- 3. Provide ¾-inch minimum throw of latch for mortise locks.
- 4. Provide 1-inch minimum throw for all dead bolts.
- 5. Comply with UL requirements for throw of bolts and latch bolts on rated fire openings.

C. Handles. Provide lever handle not less than 4½ inches long. Provide round roses not less than 2½ inches in diameter. The overall projection of the assembled rose and handle shall be at least 2 inches.

D. Dead Bolts. Provide auxiliary cylinder-type dead bolt locks above the primary operating lever on exterior doors and other doors where specifically called for on the Drawings. Dead bolt locks shall be keyed both sides. The style of the dead bolt locks shall match the lever and rose.

E. Extension Bolts. Provide flush-mount, lever-actuated extension bolts at the top and bottom of the lockset side-rail of the non-active leaf of double doors. Bolts shall be 12 inches long with a ½-inch-diameter head and a ¾-inch throw. Provide each extension bolt complete with frame mounted strike and door mounted guide.

F. Materials. Fabricate lockset and bolt components from stainless steel.

2.7 PUSH/PULL UNITS

A. Exposed Fasteners. Provide stainless steel, oval-head screw fasteners for installation.

2.8 CLOSERS AND DOOR CONTROL DEVICES

- A. Size of Units. Except as otherwise specifically indicated, comply with the manufacturer's recommendations for size of door control unit depending on size of door, exposure to weather, and anticipated frequency of use.
 - 1. Where parallel arms are indicated for closers, provide closer unit one size larger than recommended for use with standard arms.
- B. Access-Free Manual Closers. Unless otherwise indicated on the Drawings, provide adjustable units complying with ANSI A 117.1 provisions for door opening force and delayed action closing.
- C. Provide gray resilient parts for exposed bumpers.

2.9 DOOR TRIM UNITS

- A. Fasteners. Provide manufacturer's standard exposed fasteners for door trim units consisting of either machine screws or self-tapping screws.
- B. Fabricate protection plates not more than 1½ inches less than door width on hinge side and not more than ½ inch less than door width on pull side by 12 inches high.
 - 1. Metal Plates: Stainless steel, 0.050 inch (U.S. 18 gauge).

2.10 WEATHERSTRIPPING AND SEALS

- A. General. Provide continuous weatherstripping on exterior doors and interior doors between areas on different HVAC systems. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.
- B. Replaceable Seal Strips. Provide only those units where resilient or flexible seal strip is easily replaceable and readily available from stocks maintained by manufacturer.
- C. Weatherstripping at Jambs and Heads. Provide bumper-type resilient insert and metal retainer strips, surface applied unless shown as mortised or semi-mortised, and of following metal, finish, and resilient bumper material:
 - 1. Extruded aluminum with clear anodized finish, 0.062-inch minimum thickness of main walls and flanges; except simulated bronze finish for doors with brass hardware as shown on the schedule.
 - 2. Sponge neoprene conforming to MIL R 6130, Class II (Closed Cell), Grade C (67°F to 170°F, low temperature).
- D. Weatherstripping at Door Bottoms. Provide threshold consisting of contact-type resilient insert and metal housing of design and size shown and one of the following metal, finish, and resilient seal strips:
 - 1. Extruded aluminum with clear anodized finish, 0.062-inch minimum thickness of main walls and flanges or extruded bronze (brass) finished to match doors; 0.050-inch minimum thickness of main walls and flanges.
 - 2. Flexible vinyl wiper or sweep seal strip.

- E. Astragals shall be provided on double door sets. Astragals shall be fabricated from the same base material as the door and frame. Mechanical fasteners for astragals shall be stainless steel. Provide weatherstripping with the astragal meeting the requirements of this section.

2.11 THRESHOLDS

- A. General. Except as otherwise indicated, provide aluminum threshold suitable for doors specified elsewhere in these Specifications.
- B. Exterior Hinged or Pivoted Doors. Provide units not less than 4 inches wide, formed to accommodate change in floor elevation where indicated, fabricated to accommodate door hardware and to fit door frames, and as follows:
 - 1. For in-swinging doors provide units with interlocking lip and interior drain channel; include hook on bottom edge of door and drain pan.
 - 2. For out-swinging doors provide units with interlocking lip and with hook on bottom edge of door to act as weather bar.

2.12 HARDWARE FINISHES

- A. Provide a satin finish on all stainless steel hardware components.
- B. Provide a natural anodized finish on aluminum thresholds.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mount hardware units at heights indicated in following applicable publications, except as specifically indicated or required to comply with governing regulations and except as otherwise directed by Engineer.
 - 1. "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute.
- B. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation or application of surface protection with finishing work specified in the Division 9 sections. Do not install surface-mounted items until finishes have been completed on the substrates involved.
- C. Set units level, plumb, and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- D. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- E. Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant complying with requirements specified in Section 07 90 00, Joint Sealants.

- F. Weatherstripping and Seals. Comply with manufacturer's instructions and recommendations to the extent installation requirements are not otherwise indicated.

3.2 ADJUSTING, CLEANING, AND DEMONSTRATING

- A. Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly or as intended for the application made.
 - 1. Where door hardware is installed more than one month prior to acceptance or occupancy of a space or area, return to the installation during the week prior to acceptance or occupancy and make final check and adjustment of all hardware items in such space or area.
 - 2. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.
- B. Clean adjacent surfaces soiled by hardware installation.
- C. Instruct Owner's personnel in the proper adjustment and maintenance of door hardware and hardware finishes.

3.3 HARDWARE SCHEDULE

- A. General. Provide hardware for each door to comply with requirements of this section and the following schedule of hardware sets.

HARDWARE SCHEDULE

Hardware Set	Finish Hardware
1	3-Hinges 1-Bored cylinder lockset with dead bolt and strike 1-Door closer 2-Silencers (installed on frame) 1-Kickplate 1-Aluminum threshold
2	3-Hinges 1-Mortise lockset and strike 2-Silencers 1-Kickplate 1-Aluminum threshold
3	3-Hinges 1-Mortise lockset and strike 2-Silencers 1-Kickplate
4	3-Hinges 1-Mortise lockset and strike 1-Door closer

- 2-Silencers
- 1-Kickplate

- 5
- 3-Hinges
- 1-Cylinder lockset with dead bolt and strike
- 1-Door closer
- 2-Silencers
- 1-Kickplate
- 1-Aluminum threshold

END OF SECTION

SECTION 08 81 00

GLASS AND GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. Extent of glass and glazing work is indicated on Drawings and schedules.
- B. Section is applicable to all windows and doors with windows furnished either "unglazed" or "preglazed."

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplemental Conditions or General Provisions and Division 1 Specification sections, apply to this section.

1.3 SYSTEM DESCRIPTION

- A. Provide glass and glazing that has been produced, fabricated and installed to withstand normal thermal movement, wind loading and impact loading (where applicable), without failure including loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, deterioration of glass and glazing materials and other defects in the work.
 - 1. Normal thermal movement is defined as that resulting from an ambient temperature range of 120°F (67°C) and from a consequent temperature range within glass and glass framing members of 180°F (100°C).
 - 2. Deterioration of insulating glass is defined as failure of hermetic seal due to other causes than breakage which results in intrusion of dirt or moisture, internal condensation or fogging, deterioration of protected internal glass coating, if any, resulting from seal failure, and any other visual evidence of seal failure or performance.
 - 3. Deterioration of laminated glass is defined as the development of manufacturing defects including edge separation or delamination which materially obstructs vision through glass.
 - 4. Deterioration of coated glass is defined as the development of manufacturing defects including peeling, cracking or other indications of deterioration in metallic coating due to normal conditions of use.

1.4 SUBMITTALS

- A. Product Data. Submit manufacturer's technical data for each glazing material and fabricated glass product required, including installation and maintenance instructions.
- B. Certificate. Submit certificates from respective manufacturers attesting that glass and glazing materials furnished for project comply with requirements.
- C. Compatibility and Adhesion Test Report. Submit statement from sealant manufacturer indicating that glass and glazing materials have been tested for compatibility and adhesion with glazing sealants and interpreting test results relative to material

performance, including recommendations for primers and substrate preparation needed to obtain adhesion.

1.5 QUALITY ASSURANCE

- A. Glazing Standards. Comply with recommendations of Flat Glass Marketing Association (FGMA) "Glazing Manual" and "Sealant Manual" except where more stringent requirements are indicated. Refer to those publications for definitions of glass and glazing terms not otherwise defined in this section or other referenced standards.
- B. Fire Resistance Rated Wire Glass. Provide wire glass products that are identical to those tested per ASTM E 163 (UL 9) and are labeled and listed by UL or other testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Insulating Glass Certification Program. Provide insulating glass units permanently marked either on spacers or at least one component pane of units with appropriate certification label of the Insulating Glass Certification Council (IGCC).
- D. Single Source Responsibility for Glass. To ensure consistent quality of appearance and performance, provide materials produced by a single manufacturer or fabricator for each kind and condition of glass indicated and composed of primary glass obtained from a single source for each type and class required.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect glass and glazing materials during delivery, storage and handling to comply with manufacturer's directions and as required to prevent edge damage to glass, and damage to glass and glazing materials from effects of moisture including condensation, of temperature changes, of direct exposure to sun, and from other causes.
 - 1. Where insulating glass units will be exposed to substantial altitude changes, avoid hermetic seal ruptures by complying with insulating glass fabricator's recommendations for venting and sealing.

1.7 PROJECT CONDITIONS

- A. Environmental Conditions. Do not proceed with glazing when ambient and substrate temperature conditions are outside the limits permitted by glazing material manufacturer or when joint substrates are wet due to rain, frost, condensation or other causes.
 - 1. Install liquid sealants at ambient and substrate temperatures above 40°F (4.4°C).

1.8 WARRANTY

- A. General. Warranties shall be in addition to, and not a limitation of, other rights the Owner may have under the Contract Documents.
- B. Manufacturer's Special Project Warranty on Insulating Glass. Provide written warranty signed by manufacturer of insulating glass agreeing to furnish f.o.b. point of manufacture, freight allowed project site, within specified warranty period indicated below, replacements for those insulating glass units developing manufacturing defects. Manufacturing defects are defined as failure of hermetic seal of air space

(beyond that due to glass breakage) as evidenced by intrusion of dirt or moisture, internal condensation or fogging, deterioration of protected internal glass coatings, if any, and other visual indications of seal failure or performance; provided the manufacturer's instructions for handling, installing, protecting and maintaining units have been complied with during the warranty period.

1. Warranty Period: Manufacturer's standard but not less than 10 years after date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

- A. Primary Glass Standard. Provide primary glass which complies with ASTM C 1036 requirements, including those indicated by reference to type, class, quality, and, if applicable, form, finish, mesh and pattern.
- B. Safety Glass Standard. Provide tempered safety glass which complies with ASTM C 1048 and CPSC 16 CFR Part 1201 requirements, including those indicated by reference to kind, condition, type, quality, class, and, if applicable, form, finish, and pattern.
- C. Sizes. Fabricate glass to sizes required for glazing openings indicated, with edge clearances and tolerances complying with recommendations of glass manufacturer.
- D. Glass usage shall comply with the following, unless otherwise indicated on the Drawings.
 1. Windows: Nominal 1-inch-thick, tinted, sealed insulation glass units.
 2. Exterior Doors: Nominal 1-inch-thick, tinted, safety glass, sealed insulated glass units.
 3. Interior Non-Rated Doors
 - a. Between spaces served by the same HVAC system: Nominal ¼-inch-thick, clear, safety glass.
 - b. Between spaces served by different HVAC systems: Nominal 1-inch-thick, clear, safety glass, sealed insulated glass units.
 4. Fire Rated Doors: Nominal ¼-inch-thick, clear, safety glass, wire glass.

2.2 PRIMARY GLASS PRODUCTS

- A. Clear Float Glass. Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select); Federal Specification DD-G-451d, ¼-inch thick with daylight transmittance of not less than 88 percent.
- B. Tinted Float Glass. Type I (transparent glass, flat), Class 2 (tinted heat absorbing and light reducing), Quality q3 (glazing select), and as follows:
 1. Gray: Manufacturer's standard tint, with visible light transmittance of 41-43 percent and shading coefficient of 0.67 to 0.69 percent for ¼-inch-thick glass.

2. Refer to coated glass product requirements for tint and performance characteristics of coated tinted glass for single glazing relative to visible light transmittance, U-values, shading coefficient and visible reflectance.
3. Refer to requirements for sealed insulating glass units for performance characteristics of assembled units composed of tinted glass, coated or uncoated, relative to visible light transmittance, U-values, shading coefficient and visible reflectance.

C. Wired Glass. Type II (patterned and wired glass, flat), Class 1 (translucent), Quality q8 (glazing); complying with ANSI Z97.1; ¼-inch-thick; of form and mesh pattern indicated below:

1. Polished Wire Glass: Form 1 (wired, polished both sides), Mesh m1 (diamond).

2.3 HEAT-TREATED GLASS PRODUCTS

- A. Manufacturing Process. Manufacture heat-treated glass by vertical (tong-held) or horizontal (roller hearth) process, at manufacturer's option, except horizontal process where indicated as "tongless" or "free of tong marks."
- B. Uncoated Clear Heat-Treated Float Glass. Condition A (uncoated surfaces), Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select), Kind FT (fully tempered) where indicated.

2.4 COATED GLASS PRODUCTS FOR SINGLE GLAZING APPLICATIONS

- A. General. Performance characteristics designated for coated glass products are nominal values based on manufacturer's published test data for ¼-inch-thick glass products, unless otherwise indicated. Refer to primary and heat-treated glass product requirements relating to properties of glass products to which coatings are applied.
 1. U-values indicated are expressed in the number of Btu's per hour per sq. ft. per degree F difference.
 2. Provide heat-treated coated float glass of kind and where indicated or, if not otherwise indicated, provide heat-strengthened units where recommended by manufacturer for application indicated and tempered where coated safety glass is designated or required.
 3. Tinted Float Glass Coated on First Surface: Gray. Manufacturer's standard tint, with visible light transmittance of 17 to 20 percent, summer daytime U-value of 1.08 to 1.10, winter nighttime U-value of 1.11 to 1.13, shading coefficient of 0.44 to 0.48, and outdoor visible reflectance of 35 to 45 percent.
 4. Tinted Float Glass Coated on Second Surface: Gray. Manufacturer's standard tint, with visible light transmittance of 17 to 23 percent, summer daytime U-value of 1.10 to 1.13, winter nighttime U-value of 1.10 to 1.13, shading coefficient of 0.48 to 0.53, and outdoor visible reflectance of 10 to 13 percent.

2.5 SEALED INSULATING GLASS UNITS

- A. General. Provide preassembled units consisting of organically sealed panes of glass enclosing a hermetically sealed dehydrated air space and complying with ASTM E 774 for performance classification indicated as well as with other requirements

specified for glass characteristics, air space, sealing system, sealant, spacer material, corner design and desiccant.

1. For properties of individual glass panes making up units, refer to product requirements specified elsewhere in this section applicable to types, classes, kinds, and conditions of glass products indicated.
 2. Provide heat-treated panes of kind and at locations indicated or, if not indicated, provide heat-strengthened panes where recommended by manufacturer for application indicated and tempered where indicated or where safety glass is designated or required.
 3. Performance characteristics designated for coated insulating glass are nominal values based on manufacturer's published test data for units with ¼-inch-thick panes of glass and ½-inch-thick air space.
 4. Performance classification per ASTM E 774: Class A.
 5. Thickness of each pane: ¼ inch.
 6. Air space thickness: ½ inch.
 7. Sealing system: Dual seal.
 - a. Primary sealant: polyisobutylene.
 - b. Secondary sealant: polyurethane.
 8. Spacer material: Aluminum or galvanized steel.
 9. Desiccant: Manufacturer's standard; either molecular sieve or silica gel or blend of both.
 10. Corner construction: Manufacturer's standard corner construction.
- B. Uncoated Insulating Glass Units. Manufacturer's standard units complying with the following requirements.
1. Exterior Pane: Tinted float glass.
 - a. Kind FT (fully tempered).
 2. Interior Pane of Glass: Clear float glass.
 - a. Kind FT (fully tempered).
 3. Performance Characteristics: Visible light transmittance of 46 to 47 percent, summer daytime U-value of 0.56 to 0.57, winter nighttime U-value of 0.49, shading coefficient of 0.56 to 0.58 and outdoor reflectance of 8 percent.

2.6 ELASTOMERIC GLAZING SEALANTS AND PREFORMED GLAZING TAPES

- A. General. Provide products of type indicated and complying with the following requirements:
1. Compatibility: Select glazing sealants and tapes of proven compatibility with other materials with which they will come into contact, including glazing products, seals of insulating glass units, and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience.

2. Suitability: Comply with recommendations of sealant and glass manufacturers for selection of glazing sealants and tapes which have performance characteristics suitable for applications indicated and conditions at time of installation.
 3. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealant of base polymer indicated which complies with ASTM C 920 requirements, including those for type, grade, class, and uses.
 4. Colors: Provide color of exposed sealants indicated or, if not otherwise indicated, as selected by Engineer from manufacturer's standard colors.
- B. Two-Part Polysulfide Glazing Sealant. Type M; Grade NS; Class 25; Uses NT, M, G, A, and as applicable to uses indicated, O.

2.7 GLAZING GASKETS

- A. Lock-Strip Gaskets. Neoprene extrusions of size and shape indicated, fabricated into frames with molded corner units and zipper lock strips, complying with ASTM C 542; black.
- B. Cellular Elastomeric Preformed Gaskets. Extruded or molded closed cell, integral-skinned neoprene of profile and hardness required to maintain watertight seal; complying with ASTM C509, Type II; black.

2.8 MISCELLANEOUS GLAZING MATERIALS

- A. Compatibility. Provide materials with proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers. Type recommended by sealant or gasket manufacturer.
- C. Setting Blocks. Neoprene, EPDM or silicone blocks as required for compatibility with glazing sealants, 80 to 90 Shore A durometer hardness.
- D. Spacers. Neoprene, EPDM or silicone blocks, or continuous extrusions, as required for compatibility with glazing sealant, of size, shape, and hardness recommended by glass and sealant manufacturers for application indicated.
- E. Edge Blocks. Neoprene, EPDM or silicone blocks as required for compatibility with glazing sealant, of size and hardness required to limit lateral movement (side-walking) of glass.
- F. Compressible Filler Rods. Closed-cell or waterproof-jacketed rod stock of synthetic rubber or plastic foam, flexible and resilient, with 5 to 10 psi compression strength for 25 percent deflection.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Require glazier to inspect work of glass framing erector for compliance with manufacturing and installation tolerances, including those for size, squareness, offsets at corners; for presence and functioning of weep system; for existence of minimum required face or edge clearances; and for effective sealing of joinery. Obtain glazier's written report listing conditions detrimental to performance of glazing work. Do not allow glazing work to proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members to receive glass, immediately before glazing. Remove coatings which are not firmly bonded to substrates. Remove lacquer from metal surfaces where elastomeric sealants are indicated for use.

3.3 GLAZING, GENERAL

- A. Comply with combined printed recommendations of glass manufacturers, of manufacturers of sealants, gaskets and other glazing materials, except where more stringent requirements are indicated, including those of referenced glazing standards.
- B. Protect glass from edge damage during handling and installation; use a rolling block in rotating glass units to prevent damage to glass corners. Do not impact glass with metal framing. Use suction cups to shift glass units within openings; do not raise or drift glass with a pry bar. Rotate glass with flares or bevels along one horizontal edge which would occur in vicinity of setting blocks so that these are located at top of opening. Remove from project and dispose of glass units with edge damage or other imperfections of kind that, when installed, weaken glass and impair performance and appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

3.4 GLAZING

- A. Install setting blocks of proper size in sill rabbet, locate one quarter of glass width from each corner, but with edge nearest corner not closer than 6 inches from corner, unless otherwise required. Set blocks in thin course of sealant which is acceptable for heel bead use.
- B. Provide spacers inside and out, of correct size and spacing to preserve required face clearances, for glass sizes larger than 50 united inches (length plus height), except where gaskets or glazing tapes with continuous spacer rods are used for glazing. Provide $\frac{1}{8}$ -inch minimum bite of spacers on glass and use thickness equal to sealant width, except with sealant tape use thickness slightly less than final compressed thickness of tape.
- C. Provide edge blocking to comply with requirements of referenced glazing standard, except where otherwise required by glass unit manufacturer.
- D. Provide compressible filler rods or equivalent back-up material, as recommended by sealant and glass manufacturers, to prevent sealant from extruding into glass channel

weep systems and from adhering to joints back surface as well as to control depth of sealant for optimum performance, unless otherwise indicated.

- E. Force sealants into glazing channels to eliminate voids and to ensure complete "wetting" or bond of sealant to glass and channel surfaces.
- F. Tool exposed surfaces of sealants to provide a substantial "wash" away from glass. Install pressurized tapes and gaskets to protrude slightly out of channel, so as to eliminate dirt and moisture pockets.
- G. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage to ensure that gasket will not "walk" out when installation is subjected to movement.
- H. Miter cut wedge-shaped gaskets at corners and install gaskets in manner recommended by gasket manufacturer to prevent pull away at corners; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.5 PROTECTION AND CLEANING

- A. Protect exterior glass from breakage immediately upon installation by use of crossed streamers attached to framing and held away from glass. Do not apply markers to surfaces of glass. Remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove immediately by method recommended by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less often than once a month, for build-up of dirt, scum, alkali deposits or staining. When examination reveals presence of these forms of residue, remove by method recommended by glass manufacturer.
- D. Remove and replace glass which is broken, chipped, cracked, abraded or damaged in other ways during construction period, including natural causes, accidents, and vandalism.
- E. Wash glass on both faces not more than 4 days prior to date scheduled for inspections intended to establish date of substantial completion in each area of project. Wash glass by method recommended by glass manufacturer.

END OF SECTION

DIVISION 09

FINISHES

SECTION 09 91 00

PAINTING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Under this section furnish all materials, equipment, and labor to accomplish all painting necessary or convenient to the Contractor for the satisfactory completion of the work included under these Contract Documents. The words "paint" and "painting" used in this specification apply to and also describe the use and application of protective coatings.
- B. In general, the work included under this section shall include the surface preparation, shop priming, field priming, and/or field painting of all surfaces identified in Part 3.5, Protective Coating Schedule, of this section. These surfaces include, but are not limited to, the following:
 - 1. Wood
 - 2. Ferrous metals (except stainless steel or pre-finished surfaces)
 - 3. Galvanized metal
 - 4. Concrete and masonry
 - 5. Gypsum wallboard and plaster
 - 6. Non-corrosion resistant piping and pipe insulation, including:
 - a. Cast or ductile iron
 - b. Copper
 - c. Steel pipe
- C. Aluminum, fiberglass, polyvinyl chloride, stainless steel, and/or other corrosion-resistant metal surfaces (excluding piping) shall not be painted unless specifically called for on the Drawings or in these Contract Documents.

1.2 QUALITY ASSURANCE

- A. Submit to the Engineer for his review the following information concerning the materials the Contractor proposes to use in work covered by this item:
 - 1. A list of all components (paints or other materials) to be used in each painting system required herein.
 - 2. A complete descriptive specification of each component.
 - 3. Only those systems and components which are judged acceptable by the Engineer shall be utilized in the work covered by this item. No materials shall be delivered to the job site until the Engineer has evaluated their acceptability.
- B. All products submitted shall be lead- and chromate-free formulations and comply to current VOC emission regulations. Manufacturers technical data sheets must contain the following information:

1. Manufacturer's name
 2. Type of paint or other generic identification
 3. Manufacturer's stock number
 4. Color (if any)
 5. Type of gloss
 6. Minimum flash point
 7. Percent solids by volume
 8. Recommended dry film thickness per coat
 9. Theoretical coverage rates
 10. Instructions for mixing, thinning, or reducing (as applicable)
 11. Manufacturer's application recommendations
 12. Safety and storage information
 13. Viscosity at ambient temperature
 14. Average dry times (dry to touch, dry to recoat) at ambient temperature.
 15. Recommended thinners and maximum thinning permissible to meet current VOC regulations.
 16. Recommended primer if applicable
 17. Application method (brush, roll, conventional or airless spray)
 18. VOC level of coating
 19. Instructions for mixing multiple component materials
- C. Obtain the Engineer's review of the first finished room, space, area, item, or portion of work of each surface type and color specified. The first room, space, area, item, or portion of work which is acceptable to the Engineer shall serve as the project standard for all surfaces of similar type and color. Where spray application is utilized, the area to be reviewed shall not be smaller than 100 square feet.
- D. An authorized representative of the coatings manufacturer shall be present at the start-up and periodically during painting operations. Such representative shall instruct and observe the Contractor's workmanship and shall, at the completion of the work, certify in writing to the Engineer that the manufacturer's application recommendations were followed.
- E. Contractor Qualification. Contractor must provide documentation that he has previously performed this type of work and provide job references as required by the Engineer. Provide a written guarantee against defective materials and workmanship in accordance with these Specifications.

1.3 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver all paint, primers, varnishes, and sealers to the job site in their original, unopened containers not exceeding 5-gallon capacity each, unless otherwise specified herein. With the permission of the Engineer, the manufacturer may use and ship in agitator barrels. Paint containers shall not be opened until they have been inspected and approved by the Engineer.
- B. Store paint and related materials and equipment in a suitable location on the project site away from work areas and other storage areas. Strictly adhere to all applicable health, safety, and fire regulations controlling the storage of paint and related materials. Store and handle all materials in accordance with the manufacturer's recommendations.
- C. Each container shall be marked with the manufacturer's name, product number, and batch number. The labels shall also show mixing and thinning instructions, and recommended dry film thickness of each product. Use thinner recommended by the manufacturer. The use of accelerators must be approved by the Engineer. Any substitutions of generic thinners must be approved by the Engineer.

1.4 JOB CONDITIONS

- A. Strictly follow the manufacturer's recommendations concerning environmental conditions under which a material can be applied. No finishes shall be applied in areas where dust is being generated.
- B. Cover or otherwise protect the finished work of other trades, surfaces not being painted concurrently, and/or surfaces which are not to be painted. Any injury or damage to such surfaces shall be remedied at Contractor's expense to the satisfaction of the Engineer before final acceptance, and no separate payment therefor will be made.

1.5 TESTING EQUIPMENT

- A. Furnish and make available to the Engineer the following items of testing equipment for use in determining if the requirements of this Specification section are being satisfied. The specified items of equipment shall be available for the Engineer's use at all times when field painting or surface preparation is in progress.
 - 1. Wet film gauge
 - 2. Surface thermometer
 - 3. Spring micrometer with surface profile tape
 - 4. Set of Steel Structures Painting Council Visual Standards (SSPC-VIS 1-89)
 - 5. Holiday (pin hole) detector (low voltage)
 - 6. Sling-psychrometer and psychrometric tables
 - 7. Magnetic dry film gauge (Type 1 or Type 2) with appropriate calibration shims or plates.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. The specific products and manufacturers listed for each general product classification in Part 2.2, Materials List, of this section are given only to identify the generic type, quality, and general composition required for each product. Furnish similar products of other manufacturers subject to the review of the Engineer in accordance with the provisions of Part 1.2, Quality Assurance, of this section. The utilization of named products as given in Part 2.2, Material List, of this section does not excuse the Contractor from complying with the provisions of Part 1.2.
- B. All materials used in successive field coats shall be produced by the same manufacturer. Material used in the first field coat over shop painted or previously painted surfaces shall cause no wrinkling, lifting, or other damage to underlying paint.

2.2 MATERIAL LIST

Primers and Finishes. Subject to compliance with requirements, provide one of the following:

TYPE

A. Fillers, Sealers, and Surfacing

FS-1 Concrete/Steel

- "63-1500 Filler and Surfacer," Tnemec
- "Carboguard 501," Carboline
- "Steel-Seam FT910," Sherwin-Williams

FS-2 Masonry Filler

- "54-660 Masonry Filler," Tnemec
- "Sanitile 600," Carboline
- "Kem Cati-Coat HS Epoxy Filler/Sealer," Sherwin-Williams

FS-3 Concrete

- "Series 434 Perma-Shield H2S," Tnemec
- "Steel-Seam FT910," Sherwin-Williams

FS-4 Drywall Sealer

- "51-792 PVA Sealer," Tnemec
- "Carbocrylic 120," Carboline
- "Preprite 200," Sherwin-Williams

FS-5 Concrete Masonry, Block and Brick Sealer

"Series 663 Prime-A-Pell H₂O," Chemprobe/Tnemec*

"Enviroseal Double 7 H.D., or PBT," Degussa

"Concrete and Masonry Sealer," THORO

*Use Series 662 Prime-A-Pell Plus for horizontal applications.

B. Primers

P-1 Waterborne Acrylic

"Series 287 Enviro-Pox," Tnemec

"Carbocrylic 120," Carboline

"DTM Bonding Primer," Sherwin-Williams

P-2 Latex

"DTM Primer/Finish," Sherwin-Williams

P-3 Interior Wood Stain

"Interior Oil Stain," Sherwin-Williams

P-4 High Temperature - Zinc Rich

"90E-92 Tneme-Zinc," Tnemec

"Carbozinc 11 or 11HS," Carboline

"Zinc Clad II Ethyl Silicates," Sherwin-Williams

P-5 High Levels of Hydrogen Sulfide - Vinyl Ester

"Series 120-5002 Vinester," Tnemec

"Plastite 4007," Carboline

"Corobond Conductive Vinyl Ester Primer," Sherwin-Williams

P-6 Immersion, Non-potable Water

"Series N69 Hi-Build Epoxoline II," Tnemec

"Carboguard 671," Carboline

"Cor-Cote SC Sewer-Cote," Sherwin-Williams

P-7 Immersion, Potable Water

"Series N140 Pota-Pox," Tnemec

"Carboguard 561," Carboline

"Macropoxy 646NSF," Sherwin-Williams

P-8 Non-immersion (Exterior)

"Series N69 Hi-Build Epoxoline II," Tnemec

"Carboguard 890," Carboline

"Tile Clab HS," Sherwin-Williams

P-9 Concrete Floors - Epoxy

"Series 201 Epoxoprime," Tnemec
"Semstone 110," Carboline
"General Polymers 3579 Clear," Sherwin-Williams

C. Finishes

F-1 Acrylic

"Series 1028/1029-Color ENDURATONE," Tnemec
"Sanitile 155*** or Carbocrylic 3359**," Carboline
"ProMar 200 Flat or 200 S/G," Sherwin-Williams
*Matte, **Semi-gloss, ***Satin

F-2 Latex

"A-100 Satin," Sherwin-Williams

F-3 INTERIOR WOOD VARNISH

"Marrethane Satin Varnish," Sherwin-Williams
"Wood Classics Polyurethane Varnish," Sherwin-Williams

F-4 Immersion (Potable Water - NSF Approved)

"Series N140 Pota-Pox," Tnemec
"Carboguard 561," Carboline
"Macropoxy 846NSF," Sherwin-Williams

F-5 Immersion (Non-potable Water)

"Series N69 Hi-Build Epoxoline II," Tnemec
"Carboguard 691," Carboline
"Dura-Plate 235," Sherwin-Williams
"Macropoxy 646," Sherwin-Williams

F-6 High Levels of Hydrogen

"Series 435 Perma-Glaze," Tnemec
"Cor-Cote SC Sewer-Cote," Sherwin-Williams

F-7 High Levels of Hydrogen Sulfide - Novolac Epoxy

"Series 275 Stranlock," Tnemec

F-8 Non-immersion (Exterior/Interior)

"84-Color Ceramlon ENV" Tnemec
"Carboguard 890," Carboline
"Macropoxy 646 Fast Cure," Sherwin-Williams

F-9 Exterior - Urethane

"Series 1074*/1075** Endura-Shield II*," Tnemec
"Carbothane 134HG* or 133 HB**," Carboline

"Arolon 218 HS, PDS 5.22," Sherwin-Williams
*Gloss, **Semi-gloss (Specify)

F-10 Below Grade - Coal Tar Epoxy

"46H-413 Hi-Build Tneme-Tar," Tnemec
"Bitumastic 300M," Carboline
"Hi-Mil Sher-Tar PDS 4.71," Sherwin-Williams

F-11 Exterior Concrete - Modified Epoxy

"52-Color Tneme-Crete," Tnemec
"Sanitile 755," Carboline

F-12 Below Grade - Modified Polyurethane

"Series 262 Elasto-Shield," Tnemec
"Polibrid 705," Carboline
"Sher-Flex," Sherwin-Williams

F-13 Concrete Floors - Epoxy (Light Traffic Only)

"Series 205 Terra-Tread FC," Tnemec
"Carboguard 890," Carboline
"Macropoxy 646 Fast Cure," Sherwin-Williams

F-14 Concrete Floors - Aggregate Filled Epoxy

"Series 237 Power Tread," Tnemec
"Sanitile 945SL AFC," Carboline
"Armorseal 650 with Broadcast," Sherwin-Williams

F-15 Concrete Floors - Ceramic/Quartz Filled Epoxy

"Series 222 Deco-Tread," Tnemec
"Sanitile 925," Carboline
"Ceramic Carpet," Sherwin-Williams/General Polymers

F-16 Concrete Floors - Color Epoxy Finish

"Series 280 Tneme-Glaze," Tnemec
"Sanitile 945SL," Carboline
"Cor-Cote HP," Sherwin-Williams

F-17 Concrete Floors - Clear Epoxy Finish

"Series 284 Deco-Clear," Tnemec
"Sanitile 925," Carboline
"Cor-Cote HP Clear," Sherwin-Williams

F-18 Concrete Floors - Polyurethane Finish

"Series 290/291-Color CRU," Tnemec

F-19 Concrete Floors - Clear Sealer

"Series 629 CT Denisifyer," Tnemec

F-20 High Temperature - Silicone (with Primer) (Up to 1000°F)

"Series 39 Silicone Aluminum," Tnemec

"Thermaline 4700 Aluminum," Carboline

"Hi-Temp 1050 ZP Primer and 1000V Series," Sherwin-Williams

2.3 COLORS

- A. Color Cards. Submit color cards for all paints, stains, or other materials to the Engineer for review and color selection. Only those colors which have been reviewed and accepted by the Engineer shall be utilized in work covered by this section.

2.4 PIPE AND EQUIPMENT IDENTIFICATION

A. Pipe Color Code

1. Pipe: Color code all pipes, including insulated pipe, in accordance with the schedule given below. Where applicable, colors shall comply with the specifications described in Section 3, "Color Definitions," of ANSI Z53.1. Other colors shall be selected by the Engineer in accordance with Part 2.3, Colors, of this section.
2. Stripes where required shall consist of 6-inch-wide bands completely around the pipe located 36 inches on centers. On pipe runs less than 36 inches in length, one color band shall be located at the center of the run.
3. On corrosion-resistant piping provide color bands 12-inches long at intervals not exceeding 12-feet on center and at the center of shorter runs. For codes requiring stripes, provide a 4-inch wide stripe at the center of the 12-inch color band.
4. Color Schedule

Material	Color
<u>Hazardous</u>	
Acid	Yellow with Black Stripes
Chlorine	Yellow
Ferric Chloride	Yellow with Red Stripes
Hydraulic Fluid Piping	Yellow with Blue Stripes
Lime Slurry	Yellow with Green Stripes
<u>Air Systems</u>	
Instrument Air	Green with White Stripes
Process Air	Green
Vacuum	Green with Red Stripes

<u>Flammable</u>	
Digester Gas	Orange
Fuel Oil	Orange with Blue Stripes
<u>Process Water</u>	
Plant Water	Red with Black Stripes
Seal Water	Red
Wash Water (High Pressure)	Red with Yellow Stripes
Cooling Water	Red with White Stripes
<u>Sludge</u>	
Blended Sludge	Tan with Blue Stripes
Digested Sludge	Tan with Green Stripes
Primary Sludge	Tan with Orange Stripes
Return or Recirculated Sludge	Tan
Transfer Piping	Tan with Red Stripes
Waste Activated Sludge	Tan with Black Stripes
<u>Vents</u>	
Digester Gas Vents	Aluminum with Orange Stripes
Fuel Oil Vents	Aluminum with Blue Stripes
<u>Sanitary Vents</u>	
Other Vents	Aluminum with Black Stripes Aluminum with Green Stripes
<u>Process Piping</u>	
Heating and Heat Recovery Piping (Steam)	Gray with Red Stripes
Supernatant, Decant, or Filtrate	Gray
Overflow	Black
Raw Sewage (Sanitary)	Black
<u>Miscellaneous</u>	
Electrical Conduit	Aluminum*
Oxygen	White
Potable Water	Blue
Roof Drains	Gray with Blue Stripes

*Where electrical conduit is exposed in a finished room or area, the conduit shall be painted to match room finish.

B. Pipe Labels

- Legends: After piping has been installed and painting of pipe work has been completed as provided for above, label all pipe work with prefabricated, pre-legended, wrap around plastic/(other material) labels. Labels shall meet ANSI A131. Legends shall be descriptive of the function of the pipe, such as "ACID." Provide two labels, one label on each side of the pipe, at a suitable location along each pipe run. For long runs of pipe, provide labels at intervals not exceeding 20 feet. Locate the label on the pipe so that it will be in direct line of vision. Label may be omitted from one side if view is obstructed from that side. Where the flow in a pipe shall be at all times in one direction only, then a flow arrow shall be placed in front of each label on the pipe. Labels shall be

manufactured by Lab Safety or Bradley, Inc. The lettering and arrows shall be of same height. The size of lettering shall be as follows:

Outside Diameter of Pipe or Covering	Size of Letters
3/4" to 1 1/4"	1/2"
1 1/2" to 2"	3/4"
2 1/2" to 6"	1 1/4"
8" to 10"	2 1/2"
Over 10"	3 1/2"

2. Tag: For pipes smaller than 3/4 inch in outside diameter, use a laminated plastic or aluminum tag with the lettering etched or stamped and filled in with black or contrasting enamel.
3. Legends and Flow Arrows: Label background colors shall match piping colors. Legends shall be all capital, block lettering and black in color. Flow arrows shall be black in color. The above outline of intent designates the general extent of the identification work and is not exclusive of other similar work such as identification of pumps and other equipment as may be directed by the Engineer. Following the completion of the work under this item, deliver to the Owner two sets of all labels used.
4. Equipment Labels: Where specified in these Contract Documents or directed by the Engineer, paint stencil legends, in the same manner as a pipe of appropriate size on the individual units of equipment such as blowers, pumps, collector drives, compressors, silencers etc. All push buttons, starters, switches, etc., when remote from the equipment controlled and/or power packs, shall have labels of the engraved plastic type affixed to or adjacent to the remote switch, push button, starter, etc.

2.5 MIXING AND TINTING

- A. All paints and other materials shall be mixed and tinted by the paint manufacturer prior to delivery to the job site, when possible.
- B. Strictly adhere to the manufacturer's recommendations when job site mixing and/or tinting is required. The Contractor shall be solely responsible for the proper conduct of all on-site mixing and/or tinting.

PART 3 - EXECUTION

3.1 CONTRACTOR'S INSPECTION

- A. Examine all surfaces scheduled to receive paint or other finishes for conditions that will adversely affect execution, permanence, or quality of work covered by this item. Surfaces which cannot be put into an acceptable condition through preparatory work as included in Part 3.2, Preparation of Surfaces, shall be immediately brought to the attention of the Engineer.

- B. Do not proceed with surface preparation or coating application until surface conditions are suitable.

3.2 PREPARATION OF SURFACES

A. Surface Preparation Specifications

1. General. Where abrasive blasting is specified, a low free silica abrasive with a silica content of <5% shall be used. Mineral slag by-products may not be used. Abrasive blasting should produce a surface profile of not less than 1.5 mils or greater than 3.5 mils.
2. SSPC-SP 1 "Solvent Cleaning": Solvent cleaning is a method for removing all visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants from steel surfaces.
3. SSPC-SP 2 "Hand Tool Cleaning": Hand tool cleaning is a method of preparing steel surfaces by the use of non-power hand tools. Hand tool cleaning removes all loose mill scale, loose rust, paint, and other loose detrimental foreign material. It is not intended that adherent mill scale, rust, and paint be removed by this process. Mill scale, rust, and paint are considered tightly adherent if they cannot be removed by lifting them with a dull putty knife.
4. SSPC-SP 3 "Power Tool Cleaning": Power tool cleaning is a method of preparing steel surfaces by the use of power assisted hand tools. Power tool cleaning removes loose rust, paint, and other loose detrimental foreign matter. It is not intended that adherent mill scale, rust, and paint be removed by this process. Mill scale, rust, and paint are considered adherent if they cannot be removed by lifting with a dull putty knife.
5. SSPC-SP 5 "White Metal Blast Cleaning": A white metal blast cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products and other foreign matter.
6. SSPC-SP 6 "Commercial Blast Cleaning": A commercial blast cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products and other foreign matter, except for staining. Staining shall be limited to no more than 33 percent of each square inch of surface area and may consist of light shadows, slight streaks or minor discolorations caused by stains of rust, stains of mill scale or stains of previously applied paint. Slight residues of rust and paint may also be left in the bottoms of pits if the original surface is pitted.
7. SSPC-SP 7 "Brush-Off Blast Cleaning": A brush-off blast cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, loose mill scale, loose rust and loose paint. Tightly adherent mill scale, rust and paint may remain on the surface. Mill scale, rust and paint are considered tightly adherent if they cannot be removed by lifting with a dull putty knife.
8. SSPC-SP 10 "Near-White Blast Cleaning": A near-white blast cleaned surface, when viewed without magnification, shall be free of all visible oil,

grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products and any other foreign matter, except for staining. Staining shall be limited to no more than 5 percent of each square inch of surface area and may consist of light shadows, slight streaks or minor discolorations caused by stains of rust, stains of mill scale or stains of previously applied paint.

9. SSPC-SP 11 "Power Tool Cleaning to Bare Metal": The removal of all visible oil, grease, dirt, mill scale, rust, paint, oxide, corrosion products, and other foreign matter. Slight residues of rust and paint may be left in the lower portion of pits if the original surface is pitted. Differs from SSPC-SP 3 in that it requires more thorough cleaning and a surface profile not less than 1 mil (25 microns).
10. NAPF 500-03-01 "Solvent Cleaning": Solvent cleaning is a method for removing all oil, small deposits of asphalt paint, grease, soil, drawing and cutting compounds and other soluble contaminants from iron surfaces.
11. NAPF 500-03-04 "Abrasive Blast Cleaning of Ductile Iron Pipe": An abrasive blast cleaned, exterior pipe surface when viewed without magnification, shall be free of all visible dirt, dust, loose annealing oxide, loose rust, loose mold coating and other foreign matter. All oils, small deposits of asphalt paint, and grease shall have been removed by solvent cleaning per NAPF 500-03-01. After the entire surface to be coated has been struck by the blast media, tightly adherent annealing oxide, mold coating and rust staining may remain on the surface provided they cannot be removed by lifting with a dull putty knife.
12. SSPC-SP 13/NACE 6 "Surface Preparation of Concrete": A joint standard that gives requirements of the surface preparation of concrete by mechanical, chemical, or thermal methods prior to the application of a bonding protective coating system. Use the following methods of surface preparation as recommended by the coatings manufacturer or as specified herein:
 - a. Surface cleaning as described in ASTM D 4258 to include vacuum cleaning, air blast cleaning, and water cleaning to remove dirt, loose material, and/or dust; detergent water cleaning and/or steam cleaning to remove oil and grease from concrete.
 - b. Dry, wet or vacuum-assisted abrasive blasting as described in ASTM D 4259 to remove contaminants, laitance, and weak concrete, to expose subsurface voids, and to produce a sound concrete surface with adequate profile and surface porosity.
 - c. Impact-tool methods including scarifying, scabbing and rotary peening and/or power tool methods including circular grinding, sanding, and wire brushing as described in ASTM D 4259 to remove existing coatings laitance, weak concrete and protrusions in concrete. These methods may require abrasive blasting (b. above) to produce a uniform, sound concrete surface with adequate profile and surface porosity that is suitable for the specified protective coating system.
 - d. Acid-etching will not be approved.

B. Shop Priming and Painting

1. Coat interior, inaccessible surfaces of equipment with an epoxy system suitable for the lifetime of the equipment at anticipated operating conditions and temperatures, unless otherwise specified or accepted.
2. Coat exterior and accessible interior surfaces with an appropriate epoxy system unless otherwise specified or accepted.

C. Wood surfaces to be primed and/or painted shall be prepared in accordance with the following requirements prior to application of primer or paint:

1. Exterior or Interior, Painted: Surface must be dry, clean, and free of contaminants. Rough areas shall be sanded to a smooth, even surface and then vacuum cleaned. Knots, pitch pockets, and/or resinous sapwood shall be sealed with shellac, not over 2 pounds cut, prior to the application of primer. Holes, cracks, open joints, and other defects shall be puttied smooth following the application of the primer. Putty used shall be compatible in all respects with the primer and finish coating.
2. Interior, Stained: Surface shall be thoroughly cleaned, sanded, and dusted. Final sanding shall be in the direction of the grain only. Dust shall be removed by vacuuming.

D. Ferrous Metal (Excluding Stainless Steel)

1. Immersion Surfaces: "Near-White Blast Cleaning" in accordance with SSPC-SP 10 (NACE No. 2). Abrasive blasting shall achieve an anchor pattern or blast profile of between 30 and 40 percent of the dry film thickness of the first applied coat of primer or paint.
2. Non-Immersion Surfaces: "Commercial Blast Cleaning" in accordance with SSPC-SP 6 (NACE No. 3). Abrasive blasting shall achieve an anchor pattern or blast profile of between 30 and 40 percent of the dry film thickness of the first applied coat of primer or paint.
3. High Temperature System: "Near White Blast Cleaning" in accordance with SSPC-SP 10 (NACE No. 2). Abrasive blasting shall achieve an anchor pattern or blast profile of between 30 and 40 percent of the dry film thickness of the first applied coat of primer or paint.
4. Field Preparation of Shop Primed Surfaces: "Solvent Cleaning" in accordance with SSPC-SP 1. Shop primed ferrous metal surfaces which have been damaged or which show signs of corrosion shall be sand blasted and/or cleaned in accordance with the specification given above for the particular finish coating to be applied prior to the application of the field primer or finish coating.

E. Ductile and Cast Iron

1. Immersion, Interior and Exterior Exposed: "Solvent Cleaning" and "Abrasive Blast Cleaning of Ductile Iron Pipe" in accordance with NAPF 500-03-01 and -04, respectively. Abrasive blasting shall achieve an anchor pattern or blast profile as recommended by the coatings manufacturer.

2. Field Preparation of Shop Primed Surfaces: "Solvent Cleaning" in accordance with NAPF 500-04-01. Shop primed iron surfaces which have been damaged or which show signs of corrosion shall be abrasive blasted and/or cleaned in accordance with the specifications given above for both asphaltic and non-asphaltic coating systems.

F. Nonferrous Metals

1. Galvanized Metal: Surfaces shall be clean, dry, and free of contaminants. Manufacturer or fabricator-applied silicate pretreatment shall be removed by sanding. The surface should always be wiped with an acceptable solvent for removing oil and grease. New galvanized metal should receive a SSPC-SP 7 Brush-Off Blast to ensure good adhesion. The white deposit on weathered galvanized metal should be removed with detergent and water and rinsed well with clean water.
2. Aluminum: The surface should always be wiped with an acceptable solvent for removing oil and grease. Light sanding or light abrasive blast cleaning, and/or a phosphoric etch should be used on aluminum that is not anodized or alodized to assure good adhesion. Etching solutions should be used according to manufacturers recommendations.
3. Copper Piping: Surfaces shall be cleaned with a mild phosphoric acid cleaner followed by water washing. Dull surfaces shall be buffed or polished to a bright color. Primer shall be applied while surface is clean and bright.

- G. Stainless Steel Piping: Surfaces shall be clean, dry, and free of contaminants. Oils, greases, waxes, etc., shall be removed by solvent cleaning in accordance with SSPC-SP 1. Surfaces shall be roughened by hand sanding or light blast cleaning.

H. Nonmetallic Piping

1. Polyvinyl Chloride (PVC) Piping: Surface shall be roughened by hand sanding or light blast cleaning. Oils, greases, waxes, etc., shall be removed by solvent cleaning.
2. Fiberglass Piping: Surfaces shall be roughened by hand sanding or light blast cleaning. Oils, greases, waxes, etc., shall be removed by solvent cleaning.
3. Pipe Insulation: Surface shall be dry, clean, and free of all contaminants. Soiled areas shall be cleaned by wire brushing, dusting, and vacuum cleaning. Sections of insulation covering contaminated with oil, grease, wax, or other materials which would affect the proper bonding of the finish shall be removed and replaced.

- I. Concrete and Masonry: Surfaces shall be allowed to cure completely before painting. Steel troweled or other smooth concrete surfaces shall be abrasive blast cleaned per SSPC SP 13/NACE 6. Concrete surfaces shall be cleaned of all dust, dirt, form oil, curing compounds and other foreign matter. Concrete floors shall be cleaned with a process equal to Shot Blasting with a Blastrac Unit. Cleaned floors shall have the granular appearance of fine sandpaper and shall be re-cleaned to attain uniformity, if required. Form release compounds used in poured concrete construction should be removed with a suitable solvent as recommended by the manufacturer of such compounds.

- J. Gypsum Wallboard and Plaster: Surface shall be dry and free of dust, dirt, powdery residues, grease, oil, wax, or other contaminants. Small cracks or holes shall be filled with shackling compound. Shackling compound, where used, shall be thoroughly dry and sanded smooth before the application of any coating.

3.3 APPLICATION

- A. Apply finish coatings with suitable brushes, rollers, or spray equipment per manufacturers instructions.
 - 1. Rate of application shall not exceed the paint manufacturer's recommendation for the surface being coated.
 - 2. Brushes, rollers, and spraying equipment shall be kept clean, dry, and free of contaminants at all times.
 - 3. Stain shall be applied by brush or clean, dry cloth. Wipe or dry brush until desired toning is achieved. If deeper tone is required, repeat application after first coat is thoroughly dry.
 - 4. Coatings shall be applied in accordance with paint manufacturer's recommendations and may be subject to inspection at all times by representatives of the Owner or manufacturer.
 - 5. All spray equipment may be inspected by the Engineer's resident project representative (RPR) or Owner's representative before paint application begins.
 - 6. A moisture trap shall be placed in air line supply between the compressor and the pressure pot, airless pump, and/or blow down hoses.
 - 7. Operational regulators and gauges shall be provided for pressure tanks or airless pumps.
 - 8. All spent abrasive and dust from blasting operations shall be removed from surfaces prior to painting application.
 - 9. Blasted surfaces shall be coated with one coat of primer during the same day that blasting is done.
 - 10. Priming shall not be applied closer than 6 inches to a non-blasted area. Any subsequent blasting operation shall not result in abrasive particles embedded in the paint film.
 - 11. No painting shall take place when the temperature is below 50°F, or when the surface temperature is within 5°F of the dewpoint, or when the relative humidity is above 85%, unless approved by the Engineer.
 - 12. Spray gun must be held perpendicular to the surface being coated, and handled in such a manner that dry over spray is held to a minimum.
 - 13. When paint is being applied to the interior of tanks or confined areas, sufficient explosion proof blowers or fans shall be installed to provide adequate ventilation. Adhere to the paint manufacturer's recommendations for forced air

ventilation during application and curing. When isocyanate catalyzed coatings are being applied, positive pressure air supplied respirators must be used.

14. Cover or otherwise protect the finished work of other trades and surfaces which are not to be painted. Any injury or damage to such surfaces shall be remedied to the satisfaction of the Engineer at the expense of the Contractor before final acceptance and payment will be made.
15. All materials used in successive field coats shall be produced by the same manufacturer.

B. Field painting shall be in the number of coats specified in Part 3.5, Painting Schedule, of this section. Shop or field-applied priming coats shall not be considered as one of the required field finish coats.

1. Individual field finish coats shall be tinted differently in order to distinguish each coat from preceding or succeeding coats.
2. Strictly comply with the coating manufacturer's recommendation for drying time between coats.
3. The Engineer shall inspect each coat before additional coats are applied. Only inspected coats will be considered in determining the number of coats applied.

C. Finish Coats. Finish coats shall be smooth, free of brush marks, streaks, runs, laps or pile-up of paint, and skipped or missed areas. Moldings, trim, and other ornaments shall be left clean and true to details with no undue amount of paint in corners and depressions. The edges of paint adjoining other materials or colors shall be clean and sharp with no overlapping. Where any portion of the finish of a wall has been damaged or is not acceptable, the entire wall shall be refinished.

3.4 TESTING AND INSPECTION

A. Ambient Conditions. Prior to and during paint application, the following ambient conditions shall be measured to confirm that all conditions are within specified limits:

1. Air temperature and relative humidity to be measured with a sling or battery operated psychrometer. The dew point shall be determined from approved psychrometric tables using measured wet- and dry-bulb thermometer readings.
2. Surface temperature to be measured with a surface temperature thermometer.

B. Surface Profile. Prior to paint application and after abrasive blasting, the surface to be painted shall be checked with surface profile tape to determine if the depth of profile specified has been achieved.

C. Film Thickness

1. Wet Film Thickness. The wet film thickness of each coat of paint shall be verified by measuring with an approved wet film thickness gauge as it is applied.
2. Dry Film Thickness. The dry film thickness (DFT) of each coat of paint and the entire system shall be measured with a Type 1 or Type 2 magnetic dry film

thickness gauge in accordance with SSPC-PA 2. Five spot measurements (3 readings constitute 1 spot measurement) shall be taken for each 100 square feet area as outlined in SSPC-PA 2, Section 3.

- D. Holiday Testing. The paint on all interior tank surfaces and submerged steel shall be tested with a Tinker & Razor, or equivalent, low voltage, wet sponge holiday detector after the paint has cured for at least 5 days. Locations where holidays are detected shall be marked for repair and retested and after repair work has been completed.

3.5 PROTECTIVE COATING SCHEDULE

- 1. Primers and finishes shall be applied in accordance with the following schedule for the surface and exposure specified:

PROTECTIVE COATING SCHEDULE

Generic Type	Surface Preparation	First Coat (Primer)	DFT Mils	Second Coat	DFT Mils	Third Coat	DFT Mils	Total DFT Mils (min)	Total Coats
Plaster and Gypsum Wallboard									
Interior Exposed	Clean and Dry	F-1, P-2	2-3	F-1	2-3	F-1	2-3	5	2-3
	Clean and Dry	FS-4	1-2	F-8	2-3	F-8	2-3	7	3
Wood									
Interior or Exterior Exposed	Clean and Dry	P-1	2-3	F-1	2-3	F-1	2-3	8, 7	3
	Clean and Dry	P-2	1.5-2	F-2	1.5-2	F-2	1.5-2	5	3
Ferrous Metal¹									
Exterior Exposed ²	SSPC-SP6	P-8	4-6	F-8	4-6	F-9 ⁷	2-3	10	3
Interior Exposed ²	SSPC-SP6	F-8	3-5	F-8	4-6	F-8	4-6	11	3
Immersion	SSPC-SP10	P-6, P-7 ³	3-5	F-4 ³ , F-5	4-6	F-4 ³ , F-5	4-6	11	3
Below Grade/Underground	SSPC-SP10	P-6 ⁷	3-5	F-10	16-20			22	1 or 2
Interior/Immersion Severe	SSPC-SP5	P-5	12-18	F-6	12-18			28	2
	SSPC-SP10	F-7	40					40	1
Interior/Exterior Exposed High Temperature ²	SSPC-SP10	P-4	2-4	F-20	1-1.5	F-20 ⁹	1-1.5	5.5	2 or 3
Galvanized Steel									
Exterior Exposed ²	ASTM D6386	F-8	3-5	F-9 ⁷	2-3			6	2
Interior Exposed ²	ASTM D6386	F-8	2-3	F-8	2-3			5	2
Immersion	ASTM D6386	P-6	3-5	F-4 ³ , F-5	2-3			6	2
Ductile or Cast Iron									
Exterior Exposed ²	NAPF 500-03-04 ⁴	F-8	3-5	F-8	4-6	F-9	2-3	12	3
Interior Exposed ²	NAPF 500-03-04 ⁴	F-8	3-5	F-8	4-6			9	2
Immersion	NAPF 500-03-04 ⁴	F-4 ³ , F-5	3-5	F-4 ³ , F-5	4-6			9	2
Below Ground	NAPF 500-03-04 ⁴	F-10	3-5	F-10	16-20			19-25	2 or 1
	Modified Polyurethane	Optional F-5 ⁷	3-5	F-12	50			55	2
PVC, Fiberglass									
Exterior Exposed ²	Scarify	F-8	2-3	F-9	2-3			4-6	2
Interior Exposed ²	Scarify	F-5	2-3	F-5	2-3			4-6	2

	Generic Type	Surface Preparation	First Coat (Primer)	DFT Mils	Second Coat	DFT Mils	Third Coat	DFT Mils	Total DFT Mils (min)	Total Coats
Insulated Pipe										
Interior Exposed	Acrylic Emulsion	Clean and Dry	F-1,P-2	2-3	F-1	2-3			5	2
Exterior Exposed	Modified Epoxy	Clean and Dry	F-11	8-10						1
Interior Exposed - "Painted"	Epoxy	Clean and Dry ¹⁰	F-8	6-8	F-8	6-8			14	2
Immersion	Epoxy	Brush-Off Blast	FS-3	As needed	P-6	12-18	F-6	12-18	30	3
	Epoxy/Modified Polyurethane	SSPC-SP7	F-5 , P-7	4-6,3-5	F-12	50			55	2
Below Grade/Wet Wells	Coal Tar Epoxy	Clean and Dry	F-10	16-20					18	1
Interior/Immersion Severs	Vinyl Ester	Brush-Off Blast	FS-3	As Needed	P-6	12-18	F-6	12-18	30	3
	Novolac Epoxy	Abrasive Blast	P-6	3-5	F-7	40			48	2
Masonry										
Exterior Exposed – "Natural"	Water-Based Sealer	Clean and Dry	FS-5	125-175 ⁶ (ft ² /gal)						
Exterior Exposed – "Painted"	Modified Epoxy	Clean and Dry	F-11	8-10	F-11	8-10			18	2
Interior Exposed – "Natural"	Water-Based Sealer	Clean and Dry	FS-5	125-175 ⁶ (ft ² /gal)						
Interior Exposed – "Painted"	Epoxy	Clean and Dry ¹⁰	FS-2	75-100 ⁶ (ft ² -gal)	F-8	6-8	F-8	6-8	14	3
Concrete Floors										
Interior Exposed	Silicate Blend	Per product data sheet	F-19	300-350 (ft ² -gal)	F-19	300-350 (ft ² -gal)				2
	Epoxy/Polyurethane	SSPC-SP13	F-13	3-5	F-13	3-5	F-18	1-2	9	3
	Ceramic Filled Decorative Epoxy	SSPC-SP13	P-9	9-8	F-15	1/8" Double Broadcast	F-17	8-10	1/8"+	3
	Aggregate Filled Epoxy	SSPC-SP13	P-9	6-8	F-14	1/8" Double Broadcast	F-16	6-8	1/8"+	4
NOTES:										
1Field priming of shop-primed ferrous metal surfaces is required only where the shop primer has been removed because of damage or apparent corrosion										

- and the surface has been re-prepared in accordance with Part 3.2, Preparation of Surfaces, of this section.
- ²Where piping is to be striped, 2 full coats of the base color shall be applied prior to the application of the contrasting color of strip.
 - ³NSF approved for potable water service.
 - ⁴Provide additional cleaning per NAPF 500-03-01 "Solvent Cleaning" where required.
 - ⁵Exposures subject to aggressive chemical solutions such as inorganic and organic acids and high concentrations of hydrogen sulfide gas.
 - ⁶The spreading rate will depend of the porosity of the surface.
 - ⁷Depending on the method of application and color of the primer or intermediate coat, certain colors may require multiple coats for complete hiding.
 - ⁸Not required by Carboline.
 - ⁹Additional coat depends on operating conditions.
 - ¹⁰Stone rub to remove loose and small particles from surface.

Some film thickness ranges listed are only achievable by spray applications. Roller applications may require additional coats.

END OF SECTION

DIVISION 23

HVAC

SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Piping materials and fittings
 2. Joining materials
 3. Dielectric fittings
 4. Mechanical sleeve seals
 5. Piping Specialties
 6. Grout
 7. Piping Installation
 8. Equipment Installation
 9. Concrete Bases.
 10. Erection of Metal Supports
 11. Erection of Wood Supports
 12. Cutting and Patching
 13. Grouting

1.2 REFERENCES

- A. [The American Society of Mechanical Engineers \(ASME\)](#) Publications:
1. B1.20.1 "Pipe Threads, General Purpose, Inch"
 2. B16.21 "Nonmetallic Flat Gaskets for Pipes Flanges"
 3. B18.2.1 "Square and Hex Bolts and Screws, Inch Series"
- B. [ASTM International \(ASTM\)](#) Publications:
1. A47 "Standard Specification for Ferritic Malleable Iron Castings"
 2. A53 "Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless"
 3. A126 "Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings"
 4. A536 "Standard Specification for Ductile Iron Castings"
 5. B32 "Standard Specification for Solder Metal"
 6. C1107 "Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)"
 7. D2235 "Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings"
 8. D2564 "Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems"

9. D2657 "Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings"
 10. D2672 "Standard Specification for Joints for IPS PVC Pipe Using Solvent Cement"
 11. D2846 "Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems"
 12. D2855 "Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings"
 13. D3138 "Standard Specification for Solvent Cements for Transition Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Non-Pressure Piping Components"
 14. F402 "Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings"
 15. F477 "Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe"
 16. F493 "Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings"
 17. F656 "Standard Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings"
- C. [American Welding Society \(AWS\)](#) Publications:
1. "Soldering Manual"
 2. BRH "Brazing Handbook"
 3. A5.8 "Specification For Filler Metals For Brazing And Braze Welding"
 4. D1.1 "Structural Welding Code - Steel"
 5. D10.12 "Guide for Welding Mild Steel Pipe"
- D. [American Water Works Association \(AWWA\)](#) Publications:
1. C110/ANSI A21.10 " Standard for Ductile-Iron and Gray-Iron Fittings, 3 In.-48 In. (76 mm-1,219 mm), for Water "
 2. C111/ANSI A21.11 "Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings"
- E. [Copper Development Association \(CDA\)](#) Publications:
1. "Copper Tube Handbook"

1.3 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, crawl spaces, 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. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:
 - 1. Product Data: For dielectric fittings, flexible connectors, mechanical sleeve seals, and identification materials and devices.
 - 2. Coordination Drawings: Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:
 - a. Planned piping layout, including valve and specialty locations and valve-stem movement.
 - b. Clearances for installing and maintaining insulation.
 - c. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
 - d. Equipment and accessory service connections and support details.
 - e. Exterior wall and foundation penetrations.
 - f. Fire-rated wall and floor penetrations.
 - g. Sizes and location of required concrete pads and bases.
 - h. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.
 - i. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
 - j. Reflected ceiling plans to coordinate and integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers, and other ceiling-mounted items.

1.5 QUALITY ASSURANCE

- A. Equipment Selection: Equipment of higher electrical characteristics, physical dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. Additional costs shall be approved in advance by appropriate Contract Modification for these increases.
 - 1. If minimum energy ratings or efficiencies of equipment are specified, equipment must meet design requirements. See drawings for equipment schedules and requirements.

1.6 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 prevent entrance of dirt, debris, and moisture.
- B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.
- C. Protect flanges, fittings, and piping specialties from moisture and dirt.
- D. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 SEQUENCING AND SCHEDULING

- A. Coordinate mechanical equipment installation with other building components.
- B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.
- C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.
- D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.
- E. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- F. Coordinate requirements for access panels and doors if mechanical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Section 08 31 13 - "Access Doors and Frames."
- G. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

1.8 POSTED OPERATING INSTRUCTIONS

- A. Provide and post operating instructions for all mechanical systems.

PART 2 – PRODUCTS

2.1 HVAC PIPE AND PIPE FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe and fitting materials and joining methods.
- B. Pipe Threads: [ASME B1.20.1](#) for factory-threaded pipe and pipe fittings.

2.2 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](#), nonmetallic, flat, asbestos-free, 1/8-inch 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 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](#).
 - 1. Alloy Sn95 or Alloy Sn94: Approximately 95 percent tin and 5 percent silver, with 0.10 percent lead content.
 - 2. Alloy E: Approximately 95 percent tin and 5 percent copper, with 0.10 percent maximum lead content.
 - 3. Alloy HA: Tin-antimony-silver-copper zinc, with 0.10 percent maximum lead content.
 - 4. Alloy HB: Tin-antimony-silver-copper nickel, with 0.10 percent maximum lead content.
 - 5. Alloy Sb5: 95 percent tin and 5 percent antimony, with 0.20 percent maximum lead content.
- F. Brazing Filler Metals: [AWS A5.8](#).
 - 1. BCuP Series: Copper-phosphorus alloys.
 - 2. BAg1: Silver alloy.
 - 3. Welding Filler Metals: Comply with [AWS D10.12](#) for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- G. Solvent Cements: Manufacturer's standard solvent cements for the following:
 - 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](#).
- H. Plastic Pipe Seals: [ASTM F477](#), elastomeric gasket.
- I. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: [AWWA C110](#), rubber gasket, carbon-steel bolts and nuts.
- J. Couplings: Iron-body sleeve assembly, fabricated to match OD of plain-end, pressure pipes.
1. Sleeve: [ASTM A126](#), Class B, gray iron.
 2. Followers: [ASTM A47](#) malleable iron or [ASTM A536](#) ductile iron.
 3. Gaskets: Rubber.
 4. Bolts and Nuts: [AWWA C111](#).
 5. Finish: Enamel paint.

2.3 DIELECTRIC FITTINGS

- A. Approved Manufacturers:
1. [Anvil International, Inc.](#) (603-422-8000)
 2. [Central Plastics Co.](#) (800-654-3872)
 3. [Grinnell Mechanical Products](#), A Tyco International Company (800-500-4768)
 4. [Mueller Industries, Inc.](#) (800-348-8464)
 5. [Perfection Corporation](#) (800-544-6344)
 6. [Victaulic Co. of America](#) (800-742-5842)
- B. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.
- C. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.
- D. Insulating Material: Suitable for system fluid, pressure, and temperature.
- E. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- F. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150-psig minimum working pressure as required to suit system pressures.
- G. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
1. Provide separate companion flanges and steel bolts and nuts for 150-psig minimum working pressure as required to suit system pressures.
- H. Dielectric Couplings: Galvanized-steel coupling with inert and non-corrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

2.4 HVAC SLEEVES

- A. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:
1. Steel Sheet Metal: 0.0239-inch minimum thickness, galvanized, round tube closed with welded longitudinal joint.
 2. Steel Pipe: [ASTM A53](#), Type E, Grade A, Schedule 40, galvanized, plain ends.
 3. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral water stop, unless otherwise indicated.
 4. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - a. Underdeck Clamp: Clamping ring with set screws.

2.5 HVAC SLEEVE SEALS

- A. Approved Manufacturers:
1. [Metraflex Inc.](#) (800-621-4347)
 2. [PSI-Thunderline/Link-Seal](#) (800-423-2410)
- B. Description: Modular design, with interlocking rubber links shaped to continuously fill annular space between pipe and sleeve. Include connecting bolts and pressure plates.

2.6 HVAC SPECIALTIES

- A. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type if required to conceal protruding fittings and sleeves.
1. ID: Closely fit around pipe, tube, and insulation of insulated piping.
 2. OD: Completely cover opening.
 3. Cast Brass: Split casting, with concealed hinge and set screw.
 - a. Finish: Polished chrome-plate.
 4. Cast-Iron Floor Plate: One-piece casting.
- B. Grout:
1. Non-shrink, Nonmetallic Grout: [ASTM C1107](#), Grade B.
 - a. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, non-staining, non-corrosive, nongaseous, and recommended for interior and exterior applications.
 - b. Design Mix: 5000-psi, 28-day compressive strength.
 - c. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.1 HVAC PIPING SYSTEMS - COMMON REQUIREMENTS

- A. General: Install HVAC piping as described below, unless piping Sections specifies otherwise. Individual Division 22 and 23 Piping Sections specifies unique piping installation requirements.

- B. General Locations and Arrangements: 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 as required by Division 01 Sections and as outlined in Part 1 of this section.
- C. Install piping at indicated slope.
- D. Install components with pressure rating equal to or greater than system operating pressure.
- E. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.
- F. Install piping free of sags and bends.
- G. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.
- H. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.
- I. Install piping to allow application of insulation plus 1-inch clearance around insulation.
- J. Locate groups of pipes parallel to each other, spaced to permit valve operation and servicing.
- K. Install fittings for changes in direction and branch connections.
- L. Install couplings according to manufacturer's written instructions.
- M. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:
 - 1. Chrome-Plated Piping: Cast brass, one piece, with set screw, and polished chrome-plated finish.
 - 2. Uninsulated Piping Wall Escutcheons: Cast brass or stamped steel, with set screw, and chrome-plated finish.
 - 3. Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.
 - 4. Insulated Piping: Cast brass with concealed hinge, set screws, and chrome-plated finish.
 - 5. Piping in Utility Areas: Cast brass or stamped steel, with set-screw or spring clips.
- N. Install sleeves for pipes passing through concrete and masonry walls, and concrete floor and roof slabs.
 - 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 above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping rings where required.
 - 2. Build sleeves into walls and slabs as work progresses.

3. Install sleeves large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than 6-inch NPS (DN150).
 - b. Steel, Sheet-Metal Sleeves: For pipes 6-inch NPS (DN150) and larger, penetrating gypsum-board partitions.
 4. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Section 07 62 00 "Sheet Metal Flashing and Trim" for flashing.
 - a. Seal space outside of sleeve fittings with non-shrink, nonmetallic grout.
 5. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealant. Refer to Section 07 92 00 "Joint Sealants" for materials.
 6. Use Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant, unless otherwise indicated.
- O. Aboveground, Exterior-Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches in diameter and larger.
 3. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.
- P. Underground, Exterior-Wall, Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.
- Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire stopping materials. Refer to Section 07 84 00 - "Firestopping" for materials.
- R. Verify final equipment locations for roughing-in.
- S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- T. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping specification Sections:
1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 3. Soldered Joints: Construct joints according to [CDA's "Copper Tube Handbook."](#)

4. Brazed Joints: Construct joints according to [AWS's "Brazing Handbook,"](#) Chapter "Pipe and Tube."
5. 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:
 - a. Note internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 - b. Apply appropriate tape or thread compound to external pipe threads, unless dry seal threading is specified.
 - c. Align threads at point of assembly.
 - d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
 - e. 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.
6. Welded Joints: Construct joints according to [AWS D10.12](#), "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe," using qualified processes and welding operators according to "Quality Assurance" Article.
7. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
8. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following:
 - a. Comply with [ASTM F402](#) for safe-handling practice of cleaners, primers, and solvent cements.
 - b. CPVC Piping: [ASTM D2846](#) and [ASTM F493](#).
 - c. PVC Pressure Piping: [ASTM D2672](#).
 - d. PVC Non-pressure Piping: [ASTM D2855](#).
9. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to [ASTM D2657](#) procedures and manufacturer's written instructions.
 - a. Plain-End Pipe and Fittings: Use butt fusion.
 - b. Plain-End Pipe and Socket Fittings: Use socket fusion.
- U. Piping Connections: Make connections according to the following, unless otherwise indicated:
 1. Install unions, in piping 2-inch NPS (DN50) and smaller, adjacent to each valve and at final connection to each piece of equipment with 2-inch NPS (DN50) or smaller threaded pipe connection.

2. Install flanges, in piping 2-1/2-inch NPS (DN65) and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.
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.

3.2 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to provide maximum possible headroom, if mounting heights is not indicated.
- B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Owner's Representative.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- D. 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.
- E. Install equipment giving right of way to piping installed at required slope as specified in other Division 22 sections.
- F. Clearance from Electrical Equipment: Piping and ductwork are prohibited in electric rooms and closets, elevator machine rooms and installation over transformers, switchboards and motor control centers.

3.3 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000-psi 28-day compressive-strength concrete and reinforcement as specified in Section 03 30 00 - "Cast-in-Place Concrete."

3.4 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Field Welding: Comply with [AWS D1.1](#), "Structural Welding Code--Steel."
- C. Prime and paint all metal supports per Section 09 90 00 requirements similar to "Pipes and Mechanical Equipment".

3.5 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage to support and anchor HVAC 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.

3.6 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair cut surfaces to match adjacent surfaces.
- C. Refer to Division 01 Sections for additional requirements.

3.7 GROUTING

- A. Install nonmetallic, non-shrink, grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's written instructions.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placing of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases to provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout according to manufacturer's written instructions.

END OF SECTION

SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Hangers and Supports for HVAC Piping and Equipment.

1.2 REFERENCES

- A. [The American Society of Mechanical Engineers \(ASME\)](#) Publications:
 - 1. B31.9 "Building Services Piping"
- B. [ASTM International \(ASTM\)](#) Publications:
 - 1. A36 "Standard Specification for Carbon Structural Steel"
 - 2. A780 "Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings"
 - 3. C1107 "Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)"
- C. [American Welding Society \(AWS\)](#) Publications:
 - 1. D1.1 "Structural Welding Code - Steel"
- D. [Manufacturers Standardization Society of the Valve and Fittings Industry. \(MSS\)](#)
 - 1. SP-58 "Pipe Hangers and Supports - Materials, Design, and Manufacture"
 - 2. SP-69 "ANSI/MSS Edition Pipe Hangers and Supports - Selection and Application"
 - 3. SP-89 "Pipe Hangers and Supports -Fabrication and Installation Practices"
 - 4. SP-90 "Guidelines on Terminology for Pipe Hangers and Supports"

1.3 DEFINITIONS

- A. Terminology: As defined in [MSS SP-90](#), "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:
- B. Product Data:
 - 1. For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated. Indicate specified items selected for use in Project.

1.5 QUALITY ASSURANCE

- A. Engineering Responsibility: Where required by the local authority having jurisdiction 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.

PART 2 - PRODUCTS

2.1 HANGERS AND SUPPORTS

- A. Pipe Hangers, Supports, and Components:
 1. Approved Manufacturers:
 - a. [Cooper B-Line, Inc.](#) (618-654-2184)
 - b. [Grinnell Mechanical Products](#), A Tyco International Company (800-500-4768)
 - c. [National Pipe Hanger Corporation](#) (609-261-5353)
 2. 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.
 - a. Galvanized, Metallic Coatings: For piping and equipment that will not have field-applied finish.
 - b. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- B. Channel Support Systems:
 1. Approved Manufacturers:
 - a. [Cooper B-Line, Inc.](#) (618-654-2184)
 - b. [Grinnell Mechanical Products](#), A Tyco International Company (800-500-4768)
 - c. [National Pipe Hanger Corporation](#) (609-261-5353)
 2. MFMA-2, factory-fabricated components for field assembly.
 3. Coatings: Manufacturer's standard finish.
 4. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- C. Thermal-Hanger Shield Inserts:
 1. Approved Manufacturers:
 - a. [Carpenter & Patterson, Inc.](#) (301.333.4631)
 - b. [Erico \(Michigan Hanger\)](#) (440-248-0100)
 - c. [PHS Industries, Inc.](#) (800-626-2336)
 2. 100-psi minimum compressive-strength insulation, encased in sheet metal shield.
 3. Material for Cold Piping: [ASTM C552](#), Type I cellular glass.
 4. Material for Hot Piping: [ASTM C552](#), Type I cellular glass.

5. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
6. For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.
7. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.2 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.
 1. Approved Manufacturers:
 - a. [Gunnebo Fastening Corp.](#) (800-336-1640)
 - b. [Hilti, Inc.](#)(800-879-8000)
 - c. [ITW Ramset/Red Head](#) (800-899-7890)
- B. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
 1. Approved Manufacturers:
 - a. [Gunnebo Fastening Corp.](#) (800-336-1640)
 - b. [Hilti, Inc.](#)(800-879-8000)
 - c. [ITW Ramset/Red Head](#) (800-899-7890)
- C. Structural Steel: [ASTM](#) A36, 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: Nonstaining, noncorrosive, and nongaseous.
 3. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 – EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. General:
 1. Specific hanger requirements are specified in Sections specifying equipment and systems.
 2. Comply with [MSS](#) SP-69 for pipe hanger selections and applications that are not specified in piping system Specification Sections.
- B. 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 noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.

2. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24 if little or no insulation is required.
 3. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4 to allow off-center closure for hanger installation before pipe erection.
 4. Adjustable Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 5. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 6. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
 7. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
 8. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
- C. 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).
- D. 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 for heavy loads.
- E. Building Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction to attach to top flange of structural shape.
 2. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 3. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 4. C-Clamps (MSS Type 23): For structural shapes.
 5. 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.
 - b. Medium (MSS Type 32): 1500 lb.
- F. 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.

3.2 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. Install building attachments 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.
- D. 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.
- E. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- G. 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.
- H. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- I. 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.
- J. 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 long and 0.048 inch thick.
 - b. NPS 4 (DN100): 12 inches long and 0.06 inch thick.
5. Insert Material: Length at least as long as protective shield.

3.3 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.
- C. Prime and Paint Equipment Supports as specified in Section 09 90 00 "Painting".

3.4 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.

3.5 ADJUSTING

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments to level equipment and to achieve indicated slope of pipe.

3.6 PAINTING

- A. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 09 90 00 "Painting".
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with [ASTM A780](#).

END OF SECTION

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Identifying Devices and Labels for HVAC Piping and Equipment

1.2 REFERENCES

- A. [The American Society of Mechanical Engineers \(ASME\)](#) Publications:
 - 1. A13.1 “Scheme for the Identification of Piping Systems”
- B. [ASTM International \(ASTM\)](#) Publications:
 - 1. C1036 “Standard Specification for Flat Glass”

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:
 - 1. Product Data: For identification materials and devices.
 - 2. Samples: Of color, lettering style, and graphic representation required for each identification material and device.

1.4 QUALITY ASSURANCE

- A. Comply with [ASME A13.1](#), "Scheme for the Identification of Piping Systems" for lettering size, length of color field, colors, and viewing angles of identification devices.

1.5 SEQUENCING AND SCHEDULING

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 – PRODUCTS

2.1 GENERAL

- A. General: Products specified are for applications referenced in other Division 23 Sections. If more than single type is specified for listed applications, selection is Installer's option.
- B. Pipes Including Insulation: Full-band pipe markers, extending 360 degrees around pipe at each location.

2.2 IDENTIFYING DEVICES AND LABELS

- A. Lettering and Graphics:
- B. Utilize manufacturer's standard preprinted captions as selected by Owner's Representative.

- C. Coordinate names, abbreviations, and other designations used in mechanical identification with corresponding designations indicated. Use numbers, letters, and terms indicated for proper identification, operation, and maintenance of mechanical systems and equipment.
 - 1. Multiple Systems: Identify individual system number and service if multiple systems of same name are indicated.
- D. Use HVAC piping system terms indicated and abbreviate only as necessary for each application length.
 - 1. Arrows: Either integrally with HVAC piping system service lettering, to accommodate both directions, or as separate unit, on each pipe marker to indicate direction of flow.
- E. Plastic Duct Markers: Manufacturer's standard laminated plastic, in the following color codes:
 - 1. Green: Cold-air supply.
 - 2. Yellow: Hot-air supply.
 - 3. Blue: Exhaust, outside, return, and mixed air.
 - 4. Terminology: Include direction of airflow; duct service such as supply, return, and exhaust; duct origin, duct destination, and design flow.
- F. Plastic Tape: Manufacturer's standard color-coded, pressure-sensitive, self-adhesive, vinyl tape, at least 3 mils thick.
 - 1. Width: 1-1/2 inches on pipes with OD, including insulation, less than 6 inches; 2-1/2 inches for larger pipes.
 - 2. Color: Comply with [ASME](#) A13.1, unless otherwise indicated.
- G. Valve Tags: Stamped or engraved with 1/4-inch letters for HVAC piping system abbreviation and 1/2-inch sequenced numbers. Include 5/32-inch hole for fastener.
 - 1. Material: 0.032-inch thick, polished brass.
 - 2. Size: 1-1/2-inches diameter, unless otherwise indicated.
- H. Valve Tag Fasteners: Brass, wire-link chain and S-hooks.
- I. Access Panel and Equipment Markers: 1/16-inch thick, engraved plastic-laminate markers, with abbreviated terms and numbers corresponding to concealed valve and equipment (as scheduled). Provide 1/8-inch center hole for attachment.
- J. Valve Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include screws.
 - 1. Frame: Extruded aluminum.
 - 2. Glazing: [ASTM](#) C1036, Type I, Class 1, Glazing quality B, 2.5-mm, single-thickness glass.

PART 3 – EXECUTION

3.1 LABELING AND IDENTIFYING PIPING SYSTEMS

- A. Install pipe markers on each system as indicated below. Include arrows showing normal direction of flow.

1. Condensate.
 2. Refrigerent Piping (unit served).
- B. Marker Type: Plastic markers, with application systems.
- C. Fasten markers on pipes and insulated pipes by one of following methods:
1. Snap-on application of pretensioned, semirigid plastic pipe marker.
- D. Locate pipe markers where piping is exposed in machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations according to the following:
1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Mark each pipe at branch, where flow pattern is not obvious.
 3. Near penetrations through walls, floors, ceilings, or nonaccessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced at a maximum of 50-foot intervals along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

3.2 LABELING AND IDENTIFYING DUCT SYSTEMS.

- A. Duct Systems: Identify air supply, return, exhaust, intake, and relief ducts with duct markers; or provide stenciled signs and arrows showing service and direction of flow.
1. Location: Locate signs near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.3 LABELING AND IDENTIFYING HVAC EQUIPMENT

- A. Label all HVAC equipment including fan coil units, condensing units, fans, etc. Label shall correspond to equipment schedules on Drawings.

3.4 ADJUSTING AND CLEANING

- A. Relocate HVAC identification materials and devices that have become visually blocked by work of this or other Divisions.
- B. Clean faces of identification devices.

END OF SECTION 230553

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Balancing airflow within distribution systems, including submains, branches, and terminals, to indicated quantities according to specified tolerances.
2. Adjusting total HVAC systems to provide indicated quantities.
3. Measuring electrical performance of HVAC equipment.
4. Setting quantitative performance of HVAC equipment.
5. Verifying that automatic control devices are functioning properly.
6. Reporting results of the activities and procedures specified in this Section.
7. Verify performance of package terminal air conditioning units.

B. Related Sections:

1. Testing and adjusting requirements unique to particular systems and equipment are included in the Sections that specify those systems and equipment.
2. Field quality-control testing to verify that workmanship quality for system and equipment installation is specified in system and equipment Sections.

1.2 REFERENCES

A. [Associated Air Balance Council \(AABC\)](#)

1. "National Standards for Testing, Adjusting and Balancing"

B. [Air Movement & Control Association International, Inc. \(AMCA\)](#)

1. 201, "Fans and Systems"

C. [National Environmental Balancing Bureau \(NEBB\)](#)

1. "Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems"

D. [Sheet Metal and Air Conditioning Contractors' National Association \(SMACNA\)](#)

1. "HVAC Systems--Duct Design"

1.3 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.

- C. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- D. Report Forms: Test data sheets for recording test data in logical order.
- E. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- F. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- G. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- H. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- I. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- J. Test: A procedure to determine quantitative performance of a system or equipment.
- K. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:
 - 1. Quality-Assurance Submittals: Within 30 days from the Contractor's Notice to Proceed, submit 2 copies of evidence that the testing, adjusting, and balancing Agent and this Project's testing, adjusting, and balancing team members meet the qualifications specified in the "Quality Assurance" Article below.
 - 2. Contract Documents Examination Report: Within 45 days from the Contractor's Notice to Proceed, submit 2 copies of the Contract Documents Review Report as specified in Part 3 of this Section.
 - 3. Submittals Examination Report: Prior to the start of duct or piping fabrication, submit 2 copies of the Submitted Examination Report as specified in Part 3 of this Section.
 - 4. Certified Testing, Adjusting, and Balancing Reports: Submit 2 copies of reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting, and balancing Agent.

1.5 QUALITY ASSURANCE

- A. Agent Qualifications: Engage a testing, adjusting, and balancing agent certified by either AABC or NEBB.
- B. Certification of Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.
 2. Certify that the testing, adjusting, and balancing team complied with the approved testing, adjusting, and balancing plan and the procedures specified and referenced in this Specification.
- C. Testing, Adjusting, and Balancing Reports: Use testing, adjusting, and balancing standard forms from [AABC's](#) "National Standards for Testing, Adjusting and Balancing" or [NEBB's](#) "Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems".
- D. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.
- E. Testing, Adjusting, and Balancing Conference: Meet with the Owner's representatives on approval of the testing, adjusting, and balancing strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of testing, adjusting, and balancing team members, equipment manufacturers' authorized service representatives, HVAC controls Installer, and other support personnel. Provide 7 days advance notice of scheduled meeting time and location. As a minimum include the following agenda items:
1. Submittal distribution requirements.
 2. Contract Documents examination report.
 3. Testing, adjusting, and balancing plan.
 4. Work schedule and Project site access requirements.
 5. Coordination and cooperation of trades and subcontractors.

1.6 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 testing, adjusting, and balancing activities.
- B. Notice: Provide 7 days' advance notice for each test. Include scheduled test dates and times.
- C. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine Contract Documents to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment and submit "Contract Documents Examination Report."
 1. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
 2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and 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.

3. Examine Engineer's design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC systems and equipment controls.
- B. Examine approved submittal data of HVAC systems and equipment including sheet metal duct fabrication and piping shop drawings to ensure that the distribution system is reasonably complete and sufficiently designed to accurately balance the complete building. Submit "Submitting Examination Report".
1. Examine equipment performance data, including fan and pump 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 the 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 07 through 10; or in [SMACNA's](#) "HVAC Systems--Duct Design," Sections 05 and 06. Compare this data with the design data and installed conditions.
- C. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
1. Examine HVAC systems and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
 2. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
 3. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
 4. Examine terminal units to verify that they are accessible and their controls are connected and functioning.
 5. Examine plenum ceilings, utilized for return air, to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
 6. Examine heat-transfer coils for clean and straight fins.
 7. Examine equipment for installation and for properly operating safety interlocks and controls.
 8. Examine automatic temperature system components to verify the following:
 - a. Dampers, and other controlled devices operate by the intended controller.
 - b. Dampers are in the position indicated by the controller.

- c. Integrity dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in variable-air-volume terminals.
 - d. Thermostats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - e. Sensors are located to sense only the intended conditions.
 - f. Sequence of operation for control modes is according to the Contract Documents.
 - g. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
 - h. Interlocked systems are operating.
 - i. Changeover from heating to cooling mode occurs according to design values.
- D. Examine project record documents described in Division 01 Section - "Project Record Documents".
 - E. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

3.2 PREPARATION

- A. Prepare a testing, adjusting, and balancing 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 properly located, sized, and securely closed.
 - 4. Verify that smoke and fire dampers are open.
 - 5. Isolating and balancing valves are open and control valves are operational.
 - 6. Access to balancing devices is provided.
 - 7. Windows and doors can be closed so design conditions for system operations can be met.

3.3 GENERAL TESTING AND BALANCING PROCEDURES

- A. Perform testing and balancing procedures on each system according to the procedures contained in [AABC](#) national standards and this Section or in [NEBB's](#) "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.
- B. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, balancing, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

- C. 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 the insulation Specifications for this Project. Plastic plugs with retainers may be used to patch drilled holes in ductwork and housings.

3.4 FUNDAMENTAL AIR SYSTEMS' BALANCING PROCEDURES

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross check the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic single line diagrams of systems' "as-built" duct layouts and domestic hot water distribution.
- C. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- D. Check the 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.

3.5 CONSTANT-VOLUME AIR SYSTEMS' BALANCING PROCEDURES

- A. The procedures in this Article apply to constant-volume supply-, return-, and exhaust-air systems.
- B. Adjust fans to deliver total design airflows within the maximum allowable rpm listed by the 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 air-handling unit component.
 - 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. Adjust fan speed higher or lower than design with the approval of the Owner's Representative. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
 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 no overload will occur. Measure amperage in full cooling, full heating, and economizer modes to determine the maximum required brake horsepower.
- C. Adjust volume dampers for main duct, submain ducts, and major branch ducts to design 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 submains and branch ducts is unavailable for Pilot-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 submains and branch ducts to design airflows within specified tolerances.
- D. Measure terminal outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading hood or the outlet manufacturer's written instructions and calculating factors.
- E. Adjust terminal outlets and inlets for each space to design airflows within specified tolerances of design values. Make adjustments using volume dampers rather than extractors and the dampers at the air terminals.
1. Adjust each outlet in the same room or space to within specified tolerances of design quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 MOTORS

- A. Motors, ALL: 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 if high-efficiency motor.
 5. Nameplate and measured voltage, each phase.

6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

3.7 CONDENSING UNITS

- A. Verify proper rotation of fans and measure entering- and leaving-air temperatures. Record compressor data.

3.8 TEMPERATURE TESTING

- A. During testing, adjusting, and balancing, report need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor and outdoor wet- and dry-bulb temperatures every other hour for a period of 2 successive 8-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.

3.9 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. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Verify free travel and proper operation of control devices such as damper and valve operators.
- F. Confirm interaction of electrically operated switch transducers.
- G. Confirm interaction of interlock and lockout systems.
- H. Verify main control supply-air pressure and observe compressor and dryer operations.
- I. Record voltages of power supply and controller output. Determine if the system operates on a grounded or nongrounded power supply.
- J. Note operation of electric actuators using spring return for proper fail-safe operations.

3.10 TOLERANCES

- A. Set HVAC system airflow rates within the following tolerances:
 1. Supply, Return, and Exhaust Fans: Plus 5 to plus 10 percent.
 2. Air Outlets and Inlets: 0 to minus 10 percent.

3.11 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in 3-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 the instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to the certified field report data, include the following:
1. Pump curves.
 2. Fan curves.
 3. Manufacturers' test data.
 4. Field test reports prepared by system and equipment installers.
 5. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.
- D. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:
1. Title page.
 2. Name and address of testing, adjusting, and balancing Agent.
 3. Project name.
 4. Project location.
 5. Owner's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of testing, adjusting, and balancing Agent who certifies the report.
 10. Summary of contents, including the following:
 - a. Design versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 11. Nomenclature sheets for each item of equipment.
 12. Data for terminal units, including manufacturer, type size, and fittings.
 13. Notes to explain why certain final data in the body of reports vary from design values.
 14. Test conditions for fans and pump 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. Other system operating conditions that affect performance.
- E. System Diagrams: Include schematic layouts of air distribution systems and water distribution systems. Present with single-line diagrams and include the following:

1. Quantities of outside, supply, return, and exhaust airflows.
 2. Duct, outlet, and inlet sizes.
 3. Location of manual volume control dampers.
 4. Water flow meter.
 5. Balancing valve sizes/locations.
- F. Fan Test Reports: For supply, return, and exhaust fans, include the following:
1. Fan Data: Include the following:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches and bore.
 - h. Sheave dimensions, center-to-center and amount of adjustments in inches.
 2. Motor Data: Include the following:
 - a. Make and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches and bore.
 - f. Sheave dimensions, center-to-center and amount of adjustments in inches (mm).
 - g. Number of belts, make, and size.
 3. Test Data: Include design and actual values for the following:
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.
- G. Air Handling Test Reports.
- H. Electric Coil Test Reports; i.e., electric baseboards, electric wall heaters, electric unit heaters, electric cabinet heaters.
- I. Duct Traverse Reports.
- J. Air Terminal Device Reports; i.e., diffusers/registers/grilles.

- K. Pool Dehumidification Test Reports.
- L. Package Terminal Air Conditioning Test Reports; including equipment leveling to ensure condensate is pitched to building exterior.
- M. Pump Test Reports.
- N. Instrument Calibration Reports.

3.12 ADDITIONAL TESTS

- A. Within 90 days of completing testing, adjusting, and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial testing, adjusting, and balancing procedures were not performed during near-peak summer and winter conditions, perform additional inspections, testing, and adjusting during near-peak summer and winter conditions.

END OF SECTION

SECTION 23 07 00 - HVAC INSULATION

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Insulation Materials
 - 2. Jackets
 - 3. Accessories and Attachments
 - 4. Vapor Retarders

1.2 REFERENCES

- A. [ASTM International \(ASTM\)](#) Publications:
 - 1. A666 “Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar”
 - 2. C534 “Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tabular Form”
 - 3. C553 “Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications”
 - 4. C612 “Standard Specification for Mineral Fiber Block and Board Thermal Insulation”
 - 5. C921 “Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation”
 - 6. C1126 “Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation”
 - 7. E84 "Standard Test Method for Surface Burning Characteristics of Building Materials"

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:
 - 1. Product Data:
 - a. Identify thermal conductivity, thickness, and jackets (both factory and field applied) for each type of product indicated.
 - 2. Shop Drawings:
 - a. Submit manufacturer’s data for each type of insulation used.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or similar industry recognized craft training program.

- 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.

1.5 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.

1.6 COORDINATION

- A. Coordinate clearance requirements with duct Installer for insulation application.
- B. Coordinate clearance requirements with pipe installer for insulation application.

1.7 SCHEDULING

- A. Schedule insulation application after testing piping and duct systems. Insulation application may begin on segments of piping and ducts that have satisfactory test results.

PART 2 – PRODUCTS

2.1 INSULATION MATERIALS

- A. Mineral-Fiber Board Thermal Insulation:
 - 1. Approved Manufacturers:
 - a. [CertainTeed Corp.](#) (610-647-3011)
 - b. [Knauf Insulation.](#) (800-825-4434)
 - c. [Owens-Corning Fiberglas Corp.](#) (800-447-3759)
 - 2. 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.
- B. Mineral-Fiber Blanket Thermal Insulation:
 - 1. Approved Manufacturers:
 - a. [CertainTeed Corp.](#) (610-647-3011)
 - b. [Knauf Insulation.](#) (800-825-4434)
 - c. [Owens-Corning Fiberglas Corp.](#) (800-447-3759)
 - 2. 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.
- C. Closed-Cell Phenolic-Foam Insulation:
 - 1. Approved Manufacturers:
 - a. "Kooltherm Pipe Insulation"; [Kingspan Insulation Ltd.](#) (904-486-0553).

2. Block insulation of rigid, expanded, closed-cell structure. Comply with [ASTM C1126](#), Type II, Grade 1.
- D. Flexible Elastomeric Thermal Insulation:
1. Approved Manufacturers:
 - a. [Armstrong World Industries](#) (800-448-1405)
 - b. [Rubatex International LLC](#) (800-782-2839)
 2. Closed-cell, sponge or expanded-rubber materials.
 3. Comply with ASTM C534, Type I for tubular materials and Type II for sheet materials
 - a. Adhesive: As recommended by insulation manufacturer.
 - b. Ultraviolet Protective Coating: As recommended by insulation manufacturer.

2.2 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.

2.3 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, presized a minimum of 8 oz./sq. yd.
 1. Tape Width: 4 inches.
- B. Bands: 3/4 inch wide, in one of the following materials compatible with jacket:
 1. Stainless Steel: [ASTM A666](#), Type 304; 0.020 inch thick.
 2. Galvanized Steel: 0.005 inch thick.
 3. Aluminum: 0.007 inch thick.
 4. Brass: 0.010 inch thick.
 5. Nickel-Copper Alloy: 0.005 inch thick.
- C. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.
- D. Weld-Attached Anchor Pins and Washers: Copper-coated steel pin for capacitor-discharge welding and galvanized speed washer. Pin length sufficient for insulation thickness indicated.
 1. Welded Pin Holding Capacity: 100 lb for direct pull perpendicular to the attached surface.
- E. Adhesive-Attached 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.
 1. Adhesive: Recommended by the anchor pin manufacturer as appropriate for surface temperatures of ducts, plenums, and breechings; and to achieve a holding capacity of 100 lb for direct pull perpendicular to the adhered surface.

- F. 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.

2.4 VAPOR RETARDERS

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 – EXECUTION

3.1 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.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 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. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
1. Seal penetrations with vapor-retarder mastic.
 2. Apply insulation for exterior applications tightly joined to interior insulation ends.
 3. Seal insulation to roof flashing with vapor-retarder mastic.
- P. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.
- Q. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire/smoke damper sleeves for fire-rated wall and partition penetrations.
- R. 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.

3.4 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 and smaller, along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.

- b. On duct sides with dimensions larger than 18 inches. Space 16 inches o.c. each way, and 3 inches 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 overcompress 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 from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch staples, 1 inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
 7. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. Secure with steel band at end joints and spaced a maximum of 18 inches 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 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 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 and smaller, along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches. Space 16 inches o.c. each way, and 3 inches 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 overcompress 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 from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch staples, 1 inch 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 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 o.c.
8. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

3.5 CLOSED-CELL PHENOLIC-FOAM INSULATION APPLICATION

A. Apply insulation as follows:

1. Secure each layer of insulation to duct with stainless-steel bands at 12-inch intervals and tighten without deforming the insulation materials.
2. Apply two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch, soft-annealed, stainless-steel wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
3. On exposed applications, finish insulation with a skim coat of mineral-fiber, hydraulic-setting cement to surface of installed insulation. When dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin the finish coat to achieve smooth finish.

3.6 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 flanges as follows:

1. Apply pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of the same thickness as pipe insulation.

4. Secure insulation to flanges 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 fittings and elbows as follows:
1. Apply mitered sections of pipe insulation.
 2. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- D. 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.

3.7 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 overlap at seams and joints.
 2. Embed glass cloth between two 0.062-inch thick coats of jacket manufacturer's recommended adhesive.
 3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.

3.8 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.
- D. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
1. Indoor exposed metal ducts, unless noted otherwise.
 2. Metal ducts with duct liner, unless noted otherwise.
 3. Factory-insulated flexible ducts.
 4. Factory-insulated plenums, casings, terminal boxes, and filter boxes and sections, unless noted otherwise.

5. Flexible connectors.
6. Vibration-control devices.
7. Testing agency labels and stamps.
8. Nameplates and data plates.
9. Access panels and doors in air-distribution systems.

3.9 INDOOR DUCT AND PLENUM APPLICATION SCHEDULE

1. Follow Duct Insulation table shown on plans.

END OF SECTION

SECTION 23 11 23

FACILITY NATURAL-GAS PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipe, Fittings and Joining Materials
 - 2. Protective Coating
 - 3. Piping Specialties
 - 4. Valves

1.2 REFERENCES

- A. [American National Standards Institute \(ANSI\)](#) Publications:
 - 1. Z21.15 "Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves"
 - 2. Z21.21 "Automatic Valves for Gas Appliances (same as CSA 6.5)"
 - 3. Z21.24/CGA 6.10 "Connectors for Gas Appliances"
 - 4. Z21.41/CSA 6.9 "Quick Disconnect Devices for Use with Gas Fuel Appliances"
- B. [The American Society of Mechanical Engineers \(ASME\)](#) Publications:
 - 1. B1.20.1 "Pipe Threads, General Purpose, Inch"
 - 2. B16.1 "Cast Iron Pipe Flanges and Flanged Fittings"
 - 3. B16.11 "Forged Fittings, Socket-Welding and Threaded"
 - 4. B16.24 "Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 400, 600, 900, 1500 and 2500"
 - 5. B16.3 "Malleable Iron Threaded Fittings"
 - 6. B16.33 "Manually Operated Metallic Gas Valves for Use in Gas Piping Systems up to 125 psi (Sizes NPS ½ through NPS 2)"
 - 7. B16.38 "Large Metallic Valves For Gas Distribution (Manually Operated NPS-2 1/2 To 12,125 PSIG Max)"
 - 8. B16.39 "Malleable Iron Threaded Pipe Unions"
 - 9. B16.5 "Pipe Flanges and Flanged Fittings"
 - 10. B16.9 "Factory-Made Wrought Buttwelding Fittings"
- C. [ASTM International \(ASTM\)](#) Publications:
 - 1. A53 "Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless"

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:
 - 1. Submit Product Data for the following:
 - a. Corrugated, stainless-steel tubing systems. Include associated components.
 - b. Specialty valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
 - c. Pressure regulators. Include pressure rating, capacity, and settings of selected models.

1.4 QUALITY ASSURANCE

- A. [ANSI](#) Standard: Comply with [ANSI Z223.1](#), "National Fuel Gas Code."
- B. [IAS](#) Standard: Provide components listed in IAS's "Directory of A. G. A. and C. G. A Certified Appliances and Accessories" if specified to be IAS listed.
- C. [UL](#) Standard: Provide components listed in UL's "Gas and Oil Equipment Directory" if specified to be [UL](#) listed.

1.5 PROJECT CONDITIONS

- A. Gas System Pressure: As indicated on Drawings

- B. Design values of fuel gas supplied for these systems are as follows:
 - 1. Nominal Heating Value: As indicated on Drawings.
 - 2. Nominal Specific Gravity: As indicated on Drawings.

PART 2 PRODUCTS

2.1 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.2 PIPES, TUBES, FITTINGS, AND JOINING MATERIALS

- A. Steel Pipe: [ASTM A53](#); Type E or S; Grade B; Schedule 40; black.
 - 1. Malleable-Iron Threaded Fittings: [ASME B16.3](#), Class 150, standard pattern, with threaded ends according to [ASME B1.20.1](#).
 - 2. Unions: [ASME B16.39](#), Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends according to [ASME B1.20.1](#).
 - 3. Cast-Iron Flanges and Flanged Fittings: [ASME B16.1](#), Class 125.
 - 4. Steel Welding Fittings: [ASME B16.9](#), wrought steel or [ASME B16.11](#), forged steel.
 - 5. Steel Threaded Fittings: [ASME B16.11](#), forged steel with threaded ends according to [ASME B1.20.1](#).
 - 6. Joint Compound and Tape: Suitable for natural gas.
 - 7. Steel Flanges and Flanged Fittings: [ASME B16.5](#).
 - 8. Gasket Material: Thickness, material, and type suitable for natural gas.
- B. Transition Fittings: Type, material, and end connections to match piping being joined.

2.3 PROTECTIVE COATING

- A. Paint all exterior exposed gas piping with two coats of rust inhibitive paint.

2.4 PIPING SPECIALTIES

- A. Flexible Connectors: [ANSI Z21.24](#), copper alloy.
- B. Quick-Disconnect Devices: [ANSI Z21.41](#), convenience outlets and matching plug connector.

2.5 VALVES

- A. Valves, NPS 2 (DN 50) and Smaller: Threaded ends according to [ASME B1.20.1](#) for pipe threads.
- B. Appliance Connector Valves: [ANSI Z21.15](#) and IAS listed.
- C. Gas Stops: Bronze body with AGA stamp, plug type with bronze plug and flat or square head, ball type with chrome-plated brass ball and lever handle, or butterfly valve with stainless-steel disc and fluorocarbon elastomer seal and lever handle; 2-psig (13.8-kPa) minimum pressure rating.
- D. Gas Valves, NPS 2 (DN 50) and Smaller: [ASME B16.33](#) and IAS-listed bronze body and 125-psig pressure rating.
- E. Automatic Gas Valves: [ANSI Z21.21](#), with electrical or mechanical operator for actuation by appliance automatic shutoff device.
- F. Earthquake Valves: FM approved or listed in IAS Directory as complying with [ANSI Z21.70](#) and [UL](#) listed. Include mechanical operator.

PART 3 EXECUTION

3.1 PREPARATION

- A. Comply with [ANSI Z223.1](#), "Prevention of Accidental Ignition" Paragraph.

3.2 PIPING APPLICATIONS

- A. Flanges, unions, transition, and special fittings with pressure ratings same as or higher than system pressure rating may be used in applications below, unless otherwise indicated.

- B. Fuel Gas Piping, 2.0 psig or Less: Use the following:
 - 1. NPS 3/4 (DN 20) steel pipe, malleable-iron threaded fittings, and threaded joints.
 - 2. NPS 3/4 and NPS 1 (DN 20 and DN 25): Steel pipe, malleable-iron threaded fittings, and threaded joints.
 - a. Option: Soft copper tube, copper fittings, and brazed joints may be used for runouts at individual appliances.
 - 3. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): Steel pipe, malleable-iron threaded fittings, and threaded joints.

3.3 VALVE APPLICATIONS

- A. Appliance Shutoff Valves for Pressure 0.5 to 2 psig: Gas stop or gas valve.
- B. Piping Line Valves, NPS 2 (DN 50) and Smaller: Gas valve.

3.4 PIPING INSTALLATION

- A. Concealed Locations: Except as specified below, install concealed gas piping in airtight conduit constructed of Schedule 40, seamless, black steel pipe with welded joints. Vent conduit to outside and terminate with screened vent cap.
 - 1. Above-Ceiling Locations: Gas piping may be installed in accessible spaces, subject to approval of authorities having jurisdiction, regardless if such spaces are used as plenums. Do not locate valves above ceilings.
 - 2. In Partitions: Do not install concealed piping in solid partitions. Protect tubing from physical damage when installed inside partitions or hollow walls.
 - a. Exception: Tubing passing through partitions or walls.
 - 3. In Walls: Gas piping with welded joints and protective wrapping specified in "Protective Coating" Article in Part 2 may be installed in masonry walls, subject to approval of authorities having jurisdiction.
 - 4. Prohibited Locations: Do not install gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
 - a. Exception: Accessible above-ceiling space specified above.
- B. Drips and Sediment Traps: Install drips at points where condensate may collect. Include outlets of service meters. Locate where readily accessible for cleaning and emptying. Do not install where condensate would be subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use minimum-length nipple of 3 pipe diameters, but not less than 3 inches (75 mm) long, and same size as connected pipe. Install with space between bottom of drip and floor for removal of plug or cap.
- C. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels, unless indicated to be exposed to view.
- D. Install fuel gas piping at uniform grade of 0.1 percent slope upward toward risers.
- E. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- F. Connect branch piping from top or side of horizontal piping.
- G. Install unions in pipes NPS 2 (DN 50) and smaller, adjacent to each valve, at final connection to each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.
- H. Install corrugated, stainless-steel tubing system according to manufacturer's written instructions. Include striker plates to protect tubing from puncture where tubing is restrained and cannot move.
- I. Install strainer on inlet of each line pressure regulator and automatic and electrically operated valve.
- J. Install flanges on valves, specialties, and equipment having NPS 2-1/2 (DN 65) and larger connections.

- K. Install vent piping for gas pressure regulators and gas trains, extend outside building, and vent to atmosphere. Terminate vents with turned-down, reducing-elbow fittings with corrosion-resistant insect screens in large end.
- L. Install containment conduits for gas piping below slabs, within building, in gastight conduits extending minimum of 4 inches outside building, and vented to atmosphere. Terminate vents with turned-down, reducing-elbow fittings with corrosion-resistant insect screens in large end. Prepare and paint outside of conduits with coal-tar, epoxy-polyamide paint according to SSPC-Paint 16.

3.5 JOINT CONSTRUCTION

- A. Use materials suitable for fuel gas.
 - 1. Brazed Joints: Make with brazing alloy with melting point greater than 1000 deg F. Brazing alloys containing phosphorus are prohibited.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1 (DN 25) and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 2. NPS 1-1/4 (DN 32): Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): Maximum span, 108 inches; minimum rod size, 3/8 inch.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of fuel gas piping, fittings, and specialties.
- B. Install piping adjacent to appliances to allow service and maintenance.
- C. Connect piping to appliances using gas with shutoff valves and unions. Install valve upstream from and within 72 inches of each appliance. Install union downstream from valve.
- D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance using gas.

3.8 PAINTING

- A. Paint exterior service meters, pressure regulators, specialty valves, and piping.
 - 1. Color: Gray.

3.9 FIELD QUALITY CONTROL

- A. Inspect, test, and purge piping according to [ANSI Z223.1](#), Part 4 "Inspection, Testing, and Purging," and requirements of authorities having jurisdiction.
- B. Repair leaks and defects with new materials and retest system until satisfactory results are obtained.
- C. Report test results promptly and in writing to Owner's Representative and authorities having jurisdiction.
- D. Verify capacities and pressure ratings of service meters, pressure regulators, valves, and specialties.
- E. Verify correct pressure settings for pressure regulators.
- F. Verify that specified piping tests are complete.

3.10 ADJUSTING

- A. Adjust controls and safety devices. Replace damaged and malfunctioning controls and safety devices.

END OF SECTION

SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Tubes
 - 2. Fittings
 - 3. Joining Materials
 - 4. Specialties

1.2 REFERENCES

- A. [American Society of Heating, Refrigerating and Air-Conditioning Engineers \(ASHRAE\)](#) Publications:
 - 1. 15 "Safety Standard for Refrigeration Systems"
- B. [The American Society of Mechanical Engineers \(ASME\)](#) Publications:
 - 1. "(The 2004) ASME Boiler and Pressure Vessel Code"
 - 2. B16.22 "Wrought Copper and Copper Alloy Solder Joint Pressure Fittings"
 - 3. B31.5 "Refrigeration Piping and Heat Transfer Components"
- C. [ASTM International \(ASTM\)](#) Publications:
 - 1. B88 "Standard Specification for Seamless Copper Water Tube"
 - 2. B280 "Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service"
- D. [American Welding Society \(AWS\)](#) Publications:
 - 1. A5.8 "Specification For Filler Metals For Brazing And Braze Welding"
- E. [Underwriter's Laboratories, Inc. \(UL\)](#) Publications:
 - 1. 207 "Standard for Refrigerant-Containing Components and Accessories, Nonelectrical"
 - 2. 429 "Standard for Electrically Operated Valves"

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:
 - 1. Product Data for each valve type and refrigerant piping specialty specified.
 - 2. Refrigerant piping indicated is schematic only. Contractor shall size and design the piping configuration and install the piping, including oil traps, double risers, specialties, and pipe and tube sizes, to ensure proper operation and conformance with warranties of connected equipment.
 - 3. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience.

4. Maintenance data for refrigerant valves and piping specialties to include in the operation and maintenance manual specified in Division 01 Sections.

1.4 QUALITY ASSURANCE

- A. ASME Compliance: Qualify brazing and welding processes and operators according to [ASME](#) Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications."
- B. Regulatory Requirements: Comply with provisions of the following codes:
 1. [ASME](#) B31.5, "Refrigeration Piping."
 2. [ASHRAE](#) 15, "Safety Code for Mechanical Refrigeration."
- C. UL Standard: Provide products complying with [UL](#) 207, "Refrigerant-Containing Components and Accessories, Nonelectrical"; or [UL](#) 429, "Electrically Operated Valves."
- D. Listing and Labeling: Provide products specified in this Section that are [UL](#) listed and labeled.

PART 2 – PRODUCTS

2.1 TUBES

- A. Use pre-charged tubing where possible.
- B. Soft Copper Tube: [ASTM](#) B280, Type ACR, annealed temper.

2.2 TUBE FITTINGS

- A. Copper Fittings: [ASME](#) B16.22, wrought-copper streamlined pattern.

2.3 JOINING MATERIALS

- A. Brazing Filler Metals: [AWS](#) A5.8, Classification BAg-1 (Silver).

2.4 REFRIGERANT PIPING SPECIALTIES

- A. Moisture/Liquid Indicators: 500-psig operating pressure, 200 deg F operating temperature; forged-brass body, with replaceable, polished, optical viewing window with color-coded moisture indicator, and solder-end connections.
- B. Permanent Filter-Dryer: 350-psig maximum operating pressure, 225 deg F maximum operating temperature; steel shell, and wrought-copper fittings for solder-end connections; molded-felt core surrounded by desiccant.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for compliance with requirements for installation tolerances and other conditions affecting performance of refrigerant piping. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Above ground, within Building: Type ACR drawn-copper tubing.
- B. Below ground for 2-Inch NPS (DN50) and Smaller: Type L (Type B) annealed-copper tubing installed in schedule 40 PVC sleeve.

3.3 INSTALLATION

- A. Install refrigerant piping according to [ASHRAE 15](#).
- B. Basic piping installation requirements are specified in Section 23 05 00 - "Common Work Results for HVAC".
- C. Install piping in short and direct arrangement, with minimum number of joints, elbows, and fittings.
- D. Arrange piping to allow normal 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 floors, walls, or ceilings, sized to permit installation of full-thickness insulation. Maximum fill: 40%.
- F. Below ground, install copper tubing in schedule 40 PVC conduit. Vent conduit outdoors.
- G. Insulate suction lines.
 - 1. Do not install insulation until system testing has been completed and all leaks have been eliminated.
- H. Install branch lines to parallel compressors of equal length, and pipe identically and symmetrically.
- I. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.
- J. Slope refrigerant piping as follows:
 - 1. Install horizontal suction lines with a uniform slope of 0.4 percent downward to compressor.
 - 2. Install traps and double risers where indicated and where required to entrain oil in vertical runs.
 - 3. Liquid lines may be installed level.
- K. Use fittings for changes in direction and branch connections.
- L. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
- M. Reduce pipe sizes using eccentric reducer fittings installed with level side down.
- N. Provide bypass around moisture-liquid indicators in lines larger than 2-inch NPS (DN50).
- O. Install unions to allow removal of solenoid valves, pressure-regulating valves, expansion valves, and at connections to compressors and evaporators.
- P. Install refrigerant valves according to manufacturer's written instructions.
- Q. When brazing, remove solenoid-valve coils; remove sight glasses; and remove stems, seats, and packing of valves, and accessible internal parts of refrigerant specialties. Do not apply heat near bulb of expansion valve.

- R. Electrical wiring for solenoid valves is specified in Division 26 Sections. Coordinate electrical requirements and connections.
- S. Charge and purge systems, after testing, dispose of refrigerant following [ASHRAE 15](#) procedures.

3.4 HANGERS AND SUPPORTS

- A. General: Hangers, supports, and anchors are specified in Section 23 05 29 - "Hangers and Supports for HVAC Piping and Equipment." Provide according to [ASME B31.5](#) and MSS SP-69.
- B. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes. Tube sizes are nominal or standard tube sizes as expressed in [ASTM B 88](#).
 - 1. 1/2 Inch: Maximum span, 60 inches; minimum rod size, 1/4 inch.
 - 2. 5/8 Inch: Maximum span, 60 inches; minimum rod size, 1/4 inch.
 - 3. 1 Inch: Maximum span, 60 inches; minimum rod size, 1/4 inch.
 - 4. 1-1/4 Inches: Maximum span, 72 inches; minimum rod size, 1/4 inch.

3.5 PIPE INSULATION

- A. Piping insulation is specified in Section 23 07 00 "HVAC Insulation".

3.6 SPECIALTIES APPLICATION AND INSTALLATION

- A. Install permanent filter dryers in low-temperature systems using hermetic compressors, and before each solenoid valve.

3.7 PIPE JOINT CONSTRUCTION

- A. Basic pipe and tube joint construction is specified in Section 23 05 00 - "Common Work Results for HVAC."
- B. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide) during brazing to prevent formation of scale.

3.8 VALVE INSTALLATIONS

- A. Install refrigerant valves according to manufacturer's written instructions.

3.9 CONNECTIONS

- A. Electrical: Conform to applicable requirements of Division 16 Sections for electrical connections.

3.10 FIELD QUALITY CONTROL

- A. Inspect and test refrigerant piping according to [ASME B31.5](#), Chapter VI.
 - 1. Pressure test with nitrogen to 200 psig. Perform final tests at 27-psig vacuum and 200 psig using halide torch or electronic leak detector. Test to no leakage.
- B. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.
- C. Repair leaks using new materials; retest.

3.11 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat requirements.

3.12 CLEANING

- A. Before installation of copper tubing other than Type ACR, clean tubing and fittings with trichloroethylene.

3.13 COMMISSIONING

- A. Charge system using the following procedures:
 1. Install core in filter dryer after leak test, but before evacuation.
 2. Evacuate refrigerant system with vacuum pump until temperature of 35 deg is indicated on vacuum dehydration indicator.
 3. During evacuation, apply heat to pockets, elbows, and low spots in piping.
 4. Maintain vacuum on system for minimum of 5 hours after closing valve between vacuum pump and system.
 5. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
 6. Complete charging of system, using new filter-dryer core in charging line. Provide full-operating charge.

END OF SECTION 22 23 00

SECTION 233113 - METAL DUCTS

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Sheet Metal Materials
 2. Duct Liner
 3. Sealant Materials
 4. Hangers and Supports
 5. Duct Fabrication

1.2 REFERENCES

- A. [ASTM International \(ASTM\)](#) Publications:
1. A36 “Standard Specification for Carbon Structural Steel”
 2. A1008 “Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability”
 3. A480 “Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip”
 4. A653 “Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process”
 5. C168 “Standard Terminology Relating to Thermal Insulation”
 6. C411 “Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation”
 7. C916 “Standard Specification for Adhesives for Duct Thermal Insulation”
 8. C920 “Standard Specification for Elastomeric Joint Sealants”
 9. C1071 “Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)”
- B. [American Welding Society \(AWS\)](#) Publications:
1. D1.1 "Structural Welding Code - Steel"
 2. D1.2 “Structural Welding Code - Aluminum”
 3. D9.1 “Sheet Metal Welding Code “
- C. [National Fire Protection Association \(NFPA\)](#) Publications:
1. 90A “Standard for the Installation of Air Conditioning and Ventilating Systems”
 2. 90B “Standard for the Installation of Warm Air Heating and Air-Conditioning Systems”
 3. 96 “Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations”
- D. [Sheet Metal and Air Conditioning Contractors' National Association \(SMACNA\)](#) Publications:

1. "HVAC Air Duct Leakage Test Manual"
2. "HVAC Duct Construction Standards—Metal and Flexible"

1.3 DEFINITIONS

- A. Thermal Conductivity and Apparent Thermal Conductivity (k-Value): As defined in [ASTM C168](#).

1.4 SYSTEM DESCRIPTION

- A. Duct system design, as indicated, has been used to select and size air-moving and -distribution equipment and other components of air system. Changes to layout or configuration of duct system must be specifically approved in writing by the Engineer of Record. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

1.5 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:
 1. Product Data:
 - a. For duct liner and sealing materials.
 2. Welding Certificates: Copies of certificates indicating welding procedures and personnel comply with requirements in "Quality Assurance" Article.
 3. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
 4. Record Drawings: Indicate actual routing, fitting details, reinforcement, support, and installed accessories and devices.

1.6 QUALITY ASSURANCE

- A. Welding Standards: Qualify welding procedures and welding personnel to perform welding processes for this Project 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. Comply with [NFPA 90A](#), "Installation of Air Conditioning and Ventilating Systems," unless otherwise indicated.
- C. Comply with [NFPA 90B](#), "Installation of Warm Air Heating and Air Conditioning Systems," unless otherwise indicated.
- D. Comply with [NFPA 96](#), "Ventilation Control and Fire Protection of Commercial Cooking Operations," Chapter 3, "Duct System," for range hood ducts, unless otherwise indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store stainless-steel sheets with mill-applied adhesive protective paper maintained through fabrication and installation.

PART 2 – PRODUCTS

2.1 SHEET METAL MATERIALS

- A. Galvanized, Sheet Steel: Lock-forming quality; [ASTM A653](#), G90 coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.
- B. Carbon-Steel Sheets: [ASTM A1008](#), cold-rolled sheets; commercial quality; with oiled, exposed matte finish.
- C. Stainless Steel: [ASTM A480](#), Type 316, sheet form with No. 4 finish for surfaces of ducts exposed to view; and Type 304, sheet form with No. 1 finish for concealed ducts.
- D. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- E. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 DUCT LINER

- A. General: Comply with [NFPA 90A](#) or [NFPA 90B](#) and NAIMA's "Fibrous Glass Duct Liner Standard."
- B. Materials: [ASTM C1071](#) with coated surface exposed to airstream to prevent erosion of glass fibers.
 - 1. Thickness: 1 inch.
 - 2. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.
 - 3. Fire-Hazard Classification: Maximum flame-spread rating of 25 and smoke-developed rating of 50, when tested according to [ASTM C411](#).
 - 4. Liner Adhesive: Comply with [NFPA 90A](#) or [NFPA 90B](#) and [ASTM C916](#).
 - 5. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in duct.
 - a. Tensile Strength: Indefinitely sustain a 50-lb- tensile, dead-load test perpendicular to duct wall.
 - b. Fastener Pin Length: As required for thickness of insulation and without projecting more than 1/8 inch into airstream.
 - c. Adhesive for Attaching Mechanical Fasteners: Comply with fire-hazard classification of duct liner system.

2.3 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.
 - 1. Joint and Seam Tape: 2 inches wide; glass-fiber fabric reinforced.
 - 2. Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant, formulated with a minimum of 75 percent solids.

3. Flanged Joint Mastics: One-part, acid-curing, silicone, elastomeric joint sealants, complying with [ASTM C920](#), Type S, Grade NS, Class 25, Use O.

2.4 HANGERS AND SUPPORTS

- A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for building materials.
 1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- B. Hanger Materials: Galvanized, sheet steel or round, threaded steel rod.
 1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rod or galvanized rods with threads painted after installation.
 2. Straps and Rod Sizes: Comply with [SMACNA's](#) "HVAC Duct Construction Standards--Metal and Flexible" for sheet steel width and thickness and for steel rod diameters.
- 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](#).
 1. Supports for Galvanized-Steel Ducts: Galvanized steel shapes and plates.
 2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.

2.5 RECTANGULAR DUCT FABRICATION

- A. General: Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction with galvanized, sheet steel, according to [SMACNA's](#) "HVAC Duct Construction Standards--Metal and Flexible." Comply 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 classification.
 2. Materials: Free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.

2.6 SHOP APPLICATION OF LINER IN RECTANGULAR DUCTS

- A. Adhere a single layer of indicated thickness of duct liner with 90 percent coverage of adhesive at liner contact surface area. Multiple layers of insulation to achieve indicated thickness are prohibited.
- B. Apply adhesive to liner facing in direction of airflow not receiving metal nosing.
- C. Butt transverse joints without gaps and coat joint with adhesive.
- D. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
- E. Do not apply liners in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and standard liner product dimensions make longitudinal joints necessary.

- F. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely around perimeter; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
- G. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profile or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - 1. Fan discharge.
 - 2. Intervals of lined duct preceding unlined duct.
- H. Terminate liner with duct buildouts installed in ducts to attach dampers, turning vane assemblies, and other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct wall with bolts, screws, rivets, or welds. Terminate liner at fire dampers at connection to fire-damper sleeve.

2.7 ROUND DUCT FABRICATION

- A. Round Ducts: Fabricate supply ducts of galvanized steel according to [SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."](#)

2.8 ROUND SUPPLY AND EXHAUST FITTING FABRICATION

- A. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with [SMACNA's "HVAC Duct Construction Standards--Metal and Flexible,"](#) with metal thicknesses specified for longitudinal seam straight duct.
- B. Diverging-Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from body onto branch tap entrance.
- C. Elbows: Fabricate in die-formed, gored, pleated, or mitered construction. Fabricate bend radius of die-formed, gored, and pleated elbows one and one-half times elbow diameter. Unless elbow construction type is indicated, fabricate elbows as follows:
 - 1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with [SMACNA's "HVAC Duct Construction Standards--Metal and Flexible,"](#) unless otherwise indicated.
 - 2. 90-Degree, Two-Piece, Mitered Elbows: Use only for supply systems, or exhaust systems for material-handling classes A and B; and only where space restrictions do not permit using 1.5 bend radius elbows. Fabricate with single-thickness turning vanes.
 - 3. Round Elbows, 8 Inches and Smaller: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configuration or nonstandard diameter elbows with gored construction.
 - 4. Round Elbows, 9 through 14 Inches: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees, unless space restrictions require a mitered elbow. Fabricate nonstandard bend-angle configuration or nonstandard diameter elbows with gored construction.
 - 5. Round Elbows, Larger Than 14 Inches: Fabricate gored elbows, unless space restrictions require a mitered elbow.
 - 6. Die-Formed Elbows for Sizes through 8 Inches and All Pressures: 0.040 inch thick with two-piece welded construction.

PART 3 – EXECUTION

3.1 DUCT INSTALLATION, GENERAL

- A. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts, fittings, and accessories.
- B. Construct and install each duct system for the specific duct pressure classification indicated.
- C. Install round ducts in lengths not less than 12 feet, unless interrupted by fittings.
- D. Install ducts with fewest possible joints.
- E. Install fabricated fittings for changes in directions, changes in size and shape, and connections.
- F. Install couplings tight to duct wall surface with a minimum of projections into duct.
- G. Install ducts, unless otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs.
- H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- I. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- J. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions, unless specifically indicated.
- K. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
- L. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults, electrical equipment spaces and enclosures, and through elevator equipment rooms.
- M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same metal thickness as duct. Overlap opening on four sides by at least 1-1/2 inches.
- N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire damper, sleeve, 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 Section 07 84 00 "Firestopping."
- O. Cover open ends of ductwork during construction to keep clean and free of debris.

3.2 SEAM AND JOINT SEALING

- A. General: Seal duct seams and joints according to the duct pressure class indicated and as described in [SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."](#)
- B. Pressure Classification Less Than 2-Inch wg: Transverse and longitudinal joints.
- C. Seal externally insulated ducts before insulation installation.
- D. Materials: 3M Brand No. 800.

3.3 HANGING AND SUPPORTING

- A. Install rigid round, rectangular, and flat-oval metal duct with support systems indicated in [SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."](#)
- B. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.
- C. Support vertical ducts at a maximum interval of 16 feet and at each floor.
- D. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

3.4 CONNECTIONS

- A. Connect equipment with flexible connectors according to Section 23 33 00 "Air Duct Accessories."
- B. For branch, outlet and inlet, and terminal unit connections, comply with [SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."](#)
- C. Leakage Test: Perform tests according to [SMACNA's "HVAC Air Duct Leakage Test Manual."](#)

3.5 ADJUSTING

- A. Refer to Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for detailed procedures.

3.6 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect the system. Vacuum interior as well as exterior of ducts before final acceptance to remove dust and debris.

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Manual-Volume Dampers
 - 2. Fire Dampers
 - 3. Turning Vanes
 - 4. Duct-Mounted Access Doors
 - 5. Flexible Connectors
 - 6. Flexible Ducts
 - 7. Accessories

1.2 REFERENCES

- A. [National Fire Protection Association \(NFPA\)](#) Publications:
 - 1. 90A "Installation of Air Conditioning and Ventilating Systems"
 - 2. 90B "Installation of Warm Air Heating and Air Conditioning Systems"
- B. [Sheet Metal and Air Conditioning Contractors' National Association \(SMACNA\)](#) Publications:
 - 1. "HVAC Duct Construction Standards-Metal and Flexible."
- C. [Underwriter's Laboratories, Inc. \(UL\)](#) Publications:
 - 1. "Fire Resistance Directory"
 - 2. 181 "Standard for Factory-Made Air Ducts and Air Connectors"
 - 3. 181B "Closure Systems for Use with Flexible Air Ducts and Air Connectors"
 - 4. 555 "Fire Dampers"
 - 5. 555C "Standard for Safety for Ceiling Dampers"

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:
 - 1. Product Data: For the following:
 - a. Manual-volume dampers.
 - b. Fire dampers.
 - c. Duct-mounted access doors.
 - d. Flexible ducts.
 - 2. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, location, and size of each field connection. Detail the following:

- a. Special fittings and manual- and automatic-volume-damper installations.
- b. Fire damper installations, including sleeves and duct-mounted access doors and panels.
3. Product Certificates: Submit certified test data on dynamic insertion loss; self-noise power levels; and airflow performance data, static-pressure loss, dimensions, and weights.

1.4 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."
- B. Sheet Metal and Air Conditioning Contractors National Association, Inc. manuals (**SMACNA**) except where details or notes on drawings indicate otherwise.
 1. HVAC Construction Standards Metal and Flexible.
 2. Fire Damper and Heat Stop Guide for Air Handling Systems.
- C. Underwriters Laboratories (**UL**) Standard for Safety **UL** 181, **UL** 555.

PART 2 – PRODUCTS

2.1 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.
- B. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
 1. Steel Frames: Hat-shaped, galvanized, sheet steel channels, minimum of 0.064 inch 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- thick, galvanized, sheet steel.
 3. Blade Axles: Nonferrous.
 4. Tie Bars and Brackets: Galvanized steel.
- C. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.2 FIRE DAMPERS

- A. General: Labeled to **UL** 555.
- B. Fire Rating: One and one-half hour unless noted otherwise.
- C. Frame: **SMACNA** Type B with blades out of airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.

- D. Mounting Sleeve: Factory- or field-installed galvanized, sheet steel.
 - 1. Minimum Thickness: 0.052 inch or 0.138 inch thick 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.
- E. Mounting Orientation: Vertical or horizontal as indicated.
- F. Blades: Roll-formed, interlocking, 0.034 inch thick, galvanized, sheet steel. In place of interlocking blades, use full-length, 0.034-inch thick, galvanized steel blade connectors.
- G. Horizontal Dampers: Include a blade lock and stainless-steel negator closure spring.
- H. Fusible Link: Replaceable, 165 F rated as indicated.
- I. Provide access door in duct adjacent to each fire damper.

2.3 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 wide, curved blades set 3/4 inch o.c.; support with bars perpendicular to blades set 2 inches o.c.; and set into side strips suitable for mounting in ducts.

2.4 DUCT-MOUNTED ACCESS DOORS

- A. General: Fabricate doors 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 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 thick, fibrous-glass.

2.5 FLEXIBLE CONNECTORS

- A. Approved Manufacturers:
 - 1. [Ventfabrics, Inc.](#) (800-621-1207)
 - 2. [Ward Industries, Inc.](#) (630-595-7320)
 - 3. [Vent Products Co.](#) (800-368-8368)
 - 4. [Ductmate Industries, Inc.](#) (800-990-8459)
- B. General: Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with [UL 181](#), Class 1.
- C. Standard Metal-Edged Connectors: Factory fabricated with a strip of fabric 3-1/2 inches wide attached to two strips of 2-3/4 inch wide, 0.028 inch thick, galvanized, sheet steel. Select metal compatible with connected ducts.

- D. Transverse Metal-Edged Connectors: Factory fabricated with a strip of fabric 3-1/2 inches wide attached to two strips of 4-3/8 inch wide, 0.028 inch thick, galvanized, sheet steel. Select metal compatible with connected ducts.
- E. Conventional, Indoor System Flexible Connector Fabric: Glass fabric double coated with polychloroprene.
 - 1. Minimum Weight: 26 oz./sq. yd.
 - 2. Tensile Strength: 470 lbf/inch in the warp, and 360 lbf/inch in the filling.
 - 3. Minimum Movement: 2 inches.

2.6 FLEXIBLE DUCTS

- A. Approved Manufacturers:
 - 1. [Clevaflex. Ltd.](#) (216-941-6505)
 - 2. Approved Substitution
- B. General: Comply with [UL 181](#), Class 1.
- C. Flexible Ducts, Uninsulated: Corrugated aluminum. For use on dryer vents only.
- D. Flexible Ducts, Insulated: Factory-fabricated, insulated, round duct, with an outer jacket enclosing 1-1/2-inch 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 positive, 1/2-inch wg negative.

2.7 ACCESSORIES

- A. Duct sleeves: Minimum 20 gauge USSG galvanized sheet steel unless otherwise indicated.
 - 1. Clearances:
 - a. Non-insulated duct: 1 inch between duct and sleeve on all sides.
 - b. Insulated duct: 1 inch between insulation and sleeve on all sides.
 - c. Grilles, registers and diffusers: Zero clearance.
 - 2. Provide closure collars for exposed ducts on each side of wall or floor opening. Collars shall be galvanized sheet metal, minimum 4 inch wide, and fit tight against surface and around duct or insulation. Install with nails 6 inch on center.
 - 3. Framed openings: Provide clearances and closure collars the same as for duct sleeves.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details shown in [SMACNA's "HVAC Duct Construction Standards--Metal and Flexible"](#) for metal ducts and [NAIMA's "Fibrous Glass Duct Construction Standards"](#) for fibrous-glass ducts.
- B. Install volume dampers in lined duct; avoid damage to and erosion of duct liner.
- C. Provide test holes at fan inlet and outlet and elsewhere as indicated.
- D. Install fire dampers according to manufacturer's [UL](#)-approved written instructions.
 - 1. Install fusible links in fire dampers.
- E. Install duct access panels for access to both sides of duct coils. Install duct access panels downstream from volume dampers, fire dampers, turning vanes, automatic dampers, smoke detectors, outside and exhaust air plenums equipment, and other locations as indicated.
 - 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.
- F. Label access doors according to Section 23 05 53 "Identification for HVAC Piping and Equipment."
- G. Provide flexible connections at fan and building joints.
- H. Install automatic dampers supplied by the automatic temperature control system manufacturer. Notch end of rod and label duct/casing to indicate open and closed blade position.
- I. Provide volume dampers at following locations:
 - 1. In all duct splits and branch connections of supply, return, and exhaust systems.
 - 2. Ducts connecting to common plenums.
 - 3. Ducts serving single outlet.
 - 4. At open return duct in hung ceiling.
 - 5. Other locations as indicated on drawings.
- J. Provide access doors in following locations and as indicated on the drawings.
 - 1. Fire dampers.
- K. Flexible duct installation.
 - 1. Installation shall be in accordance with [SMACNA](#) and local building code standards.
 - 2. Flexible duct runs shall be a maximum of 5 feet, straight lengths, no bends.
 - 3. Connections to beaded sheet metal fittings shall be with 3 wraps of approved tape and stainless steel draw band for tight seal. Seal the outer jacket with 3 wraps of approved [UL 181B](#) tape.
 - 4. A 1 ½" minimum strap shall be used to support the flexible duct at a distance not greater than 5'-0". Maximum permissible sag is ½" per foot of duct length.

3.2 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Adjust fire dampers for proper action.
- C. Final positioning of manual-volume dampers is specified in Section 230593 "Testing, Adjusting, and Balancing for HVAC".

END OF SECTION 233300

SECTION 233700 - AIR OUTLETS AND INLETS

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Diffusers
 - 2. Registers
 - 3. Grilles

1.2 REFERENCES

- A. [Air Movement & Control Association International, Inc. \(AMCA\)](#) Publications:
 - 1. 511 "Certified Ratings Program for Air Control Devices"
- B. [American Society of Heating, Refrigerating and Air-Conditioning Engineers \(ASHRAE\)](#) Publications:
 - 1. 70 "Method of Testing for Rating the Performance of Air Outlets and Inlets"
- C. [National Fire Protection Association \(NFPA\)](#) Publications:
 - 1. 90A "Standard for the Installation of Air Conditioning and Ventilating Systems"

1.3 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.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:
 - 1. Product Data: For each model indicated, include the following:
 - a. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.
 - b. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
 - c. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size, finish, and accessories furnished.
 - d. Assembly Drawing: For each type of air outlet and inlet: indicate materials and methods of assembly of components.

1.5 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.
- B. [NFPA](#) Compliance: Install diffusers, registers, and grilles according to [NFPA 90A](#), "Standard for the Installation of air-conditioning and Ventilating Systems."

PART 2 – PRODUCTS

2.1 MANUFACTURED UNITS

- A. Diffusers, registers, and grilles (As scheduled on Drawings):
 - 1. Approved Manufacturers:
 - a. Price
 - b. [Titus](#)
 - c. Metalaire

2.2 SOURCE QUALITY CONTROL

- A. Testing: Test performance according to [ASHRAE 70](#), "Method of Testing for Rating the Performance of Air Outlets and Inlets."
- B. Noise Criteria: Diffusers, registers, and grilles shall not exceed a noise level of NC-30.

PART 3 – EXECUTION

3.1 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.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb, according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.
- B. Ceiling-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. For units installed in lay-in ceiling panels, locate units in the center of the panel. Where architectural features or other item conflict with installation notify Owner's Representative for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connection to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

3.4 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 233700

SECTION 23 81 26 - SPLIT SYSTEM GAS FURNACE AIR CONDITIONING UNITS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Split-System Air-Conditioning and Gas Furnace Units

1.02 REFERENCE STANDARDS

- A. National Fire Protection Association (NFPA) Publications:
 - 1. 70 "National Electric Code"
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Publications:
 - 1. 90.1 "Energy Code for Commercial and High-Rise Residential Buildings"

1.03 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:
 - 1. Product Data:
 - a. Include the following:
 - 1) Rated capacities
 - 2) Furnished specialties, and accessories for each type of product indicated.
 - 3) Performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
 - 2. Shop Drawings: Diagram power, signal, and control wiring.
 - 3. Field quality-control test reports.
 - 4. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.04 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of split-system units and are based on the specific system indicated.
- 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. Energy-Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- D. Indoor Section will be designed, tested and constructed to the current ANSI Z 21.47/CSA 2.3 design standard for gas-fired central furnaces. Unit will be third party certified by CSA to the current ANSI Z 21.47/CSA 2.3 design standard for gas-fired central furnaces. Unit will carry the CSA Blue StarR and Blue FlameR labels. Unit efficiency testing will be performed per the current DOE test procedure as listed in the Federal Register. Unit will be certified for capacity and efficiency and listed in the latest AHRI Consumer's Directory of Certified Efficiency Ratings. Unit will carry the current Federal Trade Commission Energy

- E. Outdoor Section will be rated in accordance with the latest edition of AHRI Standard 210. Unit will be certified for capacity and efficiency, and listed in the latest AHRI directory. Unit construction will comply with latest edition of ANSI/ ASHRAE and with NEC. Unit will be constructed in accordance with UL standards and will carry the UL label of approval. Unit will have c--UL--us approval. Unit cabinet will be capable of withstanding Federal Test Method Standard No. 141 (Method 6061) 500—hr salt spray test. Air--cooled condenser coils will be leak tested at 150 psig and pressure tested at 450 psig. Unit constructed in ISO9001 approved facility.

1.05 COORDINATION

- A. Coordinate size and location of concrete bases for units. Coordinate the location of cast anchor-bolt inserts into bases.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Each unit will be shipped as a single package only and is to be stored and handled per unit manufacturer's recommendations.

1.07 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: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Approved Manufacturers:
 - 1. Trane, A Business of American Standard Companies
 - 2. Carrier Corp.; Carrier Air Conditioning Division, United Technologies Corporation
 - 3. Lennox International Inc.
 - 4. York, A Johnson Controls Company

2.02 INDOOR UNIT SYSTEM DESCRIPTION: Indoor furnace with gas-fired condensing furnace for use with natural gas. Furnish cold air return plenum, external media cabinet for use with accessory media filter or standard filter.

- A. Blower Wheel and Blower Motor: Galvanized blower wheel shall be centrifugal type, statically and dynamically balanced. Blower motor shall be permanently lubricated with sealed ball bearings, and have multiple speeds. Blower motor shall be direct drive and soft mounted to the blower scroll to reduce vibration transmission.
- B. Filters: Furnace shall have reusable--type filters.
- C. Casing: Casing shall be of .030 in. thickness minimum, pre--painted galvanized steel.
- D. Draft Inducer Motor: Draft inducer motor shall be single--speed design.
- E. Primary Heat Exchangers: Primary heat exchangers shall be corrosion--resistant aluminized steel of fold--and--crimp sectional design and applied operating under negative pressure.

- F. Controls: Controls shall include a micro--processor--based integrated electronic control board with at least 16 service troubleshooting codes displayed via diagnostic flashing LED light on the control, a self--test feature that checks all major functions of the furnace, and a replaceable automotive--type circuit protection fuse. Multiple operational settings available, including blower speeds for high heat, low cooling, high cooling and continuous fan. Continuous fan speed may be adjusted from the thermostat. Cooling airflow will be selectable between 325 and 400 CFM per ton of air conditioning. Features will also include temporary reduced airflow in the cooling mode for improved dehumidification.

2.03 OUTDOOR UNIT SYSTEM DESCRIPTION: Outdoor-mounted, air-cooled, split-system air conditioner unit suitable for ground installation. Unit consists of a hermetic compressor, an air-cooled coil, propeller-type condenser fans, and a control box. Unit will discharge supply air upward as shown on contract drawings. Unit will be used in a refrigeration circuit to match up to a packaged fan coil or coil unit. Contained within the unit enclosure is all factory wiring, piping, controls, compressor, and refrigerant charge of R-410.

- A. Unit Cabinet: Unit cabinet will be constructed of galvanized steel, bonderized, and coated with a powder coat paint.
- B. Fans: Condenser fan will be direct--drive propeller type, discharging air upward. Condenser fan motors will be totally enclosed, 1--phase type with class B insulation and permanently lubricated bearings. Shafts will be corrosion resistant. Fan blades will be statically and dynamically balanced. Condenser fan openings will be equipped with coated steel wire safety guards.
- C. Compressor: Compressor will be hermetically sealed. Compressor will be mounted on rubber vibration isolators.
- D. Condenser Coil: Condenser coil will be air cooled. Coil will be constructed of aluminum fins mechanically bonded to copper tubes which are then cleaned, dehydrated, and sealed.
- E. Refrigeration Components: Refrigeration circuit components will include liquid--line shutoff valve with sweat connections, vapor--line shutoff valve with sweat connections, system charge of R--410A refrigerant, and compressor oil. Unit will be equipped with high--pressure switch, low pressure switch and filter drier for Puron refrigerant.

PART 3 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. Install ground-mounting, compressor-condenser components on 6-inch- thick, reinforced concrete base; 6 inches larger on each side than unit. Coordinate anchor installation with concrete base.
- D. Install seismic restraints where required.
- E. Install floor mounted evaporator-fan unit and compressor-condenser components on restrained, rubber isolator mounts. Install suspended evaporator-fan units with restrained, spring isolators with a minimum static deflection of 1-inch.

- F. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.02 CONNECTIONS

- A. Install piping adjacent to unit to allow service and maintenance.
- B. Duct Connections: Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors.

3.03 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 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.
- C. Remove and replace malfunctioning units and retest as specified above.

3.04 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.

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

SECTION 238239 - UNIT HEATERS – NATURAL GAS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Gas-fired unit heaters.

PART 2 - EXECUTION

2.1 INSTALLATION

- A. Install unit heaters to comply with NFPA 90A.
- B. Install and connect gas-fired unit heaters and associated fuel and vent features and systems according to NFPA 54.
- C. Suspended Units: Suspend unit heaters from structure with all-thread hanger rods and seismic restraint. Adjust hangers so unit is level and plumb. Hanger rods and attachments to structure are specified in Section 23 0529 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.
- E. Gas Piping: Comply with Section 23 1123, Facility Natural-Gas Piping. Connect gas piping to gas train inlet; provide union with enough clearance for burner removal and service.
- F. Install piping adjacent to machine to allow service and maintenance.
- G. Ground equipment according to Section 26 0526, Grounding and Bonding for Electrical Systems.
- H. Connect wiring according to Section 26 0519, Low-Voltage Electrical Power Conductors and Cables.
- I. Adjust initial temperature set points.
- J. Adjust burner and other unit components for optimum heating performance and efficiency.

2.2 FIELD QUALITY CONTROL

- A. Perform the following field tests and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

DIVISION 26

ELECTRICAL

SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

PART I - GENERAL

1.01 DEFINITIONS

Whenever occurring in Division 260000 the following words shall have the meanings given below:

- A. "Provide" shall mean to furnish, install and connect complete.
- B. "Wiring" shall mean wire or cable, installed in conduit, cable tray, or wireways with all required boxes, fittings, connectors, and accessories completely installed.
- C. "Work" shall be understood to mean the materials completely installed including the labor involved.
- D. "Plans and Specifications/Contract Documents" shall be understood to mean the complete documents, including all trades, divisions, sections, addenda, etc.
- E. "Review of Shop Drawings" - see Division 1.
- F. "Conduit" shall mean either rigid steel conduit, intermediate metal conduit (IMC), electrical metallic tubing (EMT), or plastic conduit (PVC).

1.02 The Contractor AGREES that upon the submittal of a bid, he will have read and studied ALL of the Contract Documents, and that all of the requirements and coordination resulting from these documents are included in his bid. The intent is to obtain a complete installation of electrical work to which end the Contractor shall provide ALL labor, equipment, material, freight, rigging, etc., specified, shown or scheduled on plans. He also agrees that any other accessory items which may not be specified, shown, or scheduled on the plans, but which normally are furnished or can be reasonably implied from the specifications and/or plans to be required shall be provided.

1.03 No exclusion from, or limitations in the drawings, specifications, or other contract documents for the electrical work shall be reason for the omitting of the appurtenances or accessories necessary to complete any required system or item of equipment in this project.

1.04 Should the Contractor find any discrepancies and/or omissions in the contract documents, or be in doubt as to the intent of said documents, he shall obtain clarification or correction from the Architect and the Engineer BEFORE submitting a bid for work under this division. The Contractor will not be granted monetary allowances for discrepancies between his bid and the intent of the work after the contract is let, due to failure to follow this instruction.

1.05 The contractor shall not use any material or equipment that contains asbestos, PCB's, or any other substance which is known to endanger the public health.

1.06 SCOPE OF WORK

- A. The Contractor shall refer to Architectural, Mechanical, and Structural drawings and specifications for related work.

- B. The work of this division shall include the furnishing of all labor, supplies, materials, sales tax, permits, inspection fees, costs of testing, shop drawings, as built drawings, operation and maintenance manuals, and the performing of all operations including installation, cutting and chasing, trenching and backfilling, compaction, coordination with other trades on the job, etc., to the end of obtaining a complete installation of electrical work as shown on the drawings and called for in the written specifications.
- C. The work to be performed under the electrical contract shall include, but not be limited to:
 - 1. Service entrance conduit and wire.
 - 2. Service entrance equipment including disconnects, switchboards, panelboards, etc.
 - 3. Feeder conduit and wire.
 - 4. Distribution, lighting, and miscellaneous panelboards.
 - 5. Branch circuit conduit and wire.
 - 6. Lighting Fixtures.
 - 7. Wiring devices including receptacles, light switches, etc.
 - 8. Telecommunications service entrance conduit, and interior conduit and outlet boxes.
 - 9. Fire Alarm System complete, if called for on the drawings
 - 10. Disconnects
 - 11. Control system conduit for mechanical contract.
 - 12. Provision of temporary power at 120/240, single phase for construction.
- D. Work not included under the electrical contract:
 - 1. All motor starters and their associated control devices, heaters, etc. will be furnished with the motors under Division 230000 of these specifications.
 - 2. Control and interlock wiring for mechanical contract supplied systems.
 - 3. Telecommunications head end equipment, connectors, faceplates or any cabling
 - 4. Cable television head end equipment, connectors, faceplates or any cabling
- E. The owner will not make any consideration to the contractor for any alleged misunderstanding of the amount of work to be performed. Submittal of a bid for work shall convey full agreement by the Contractor to all items and conditions specified, indicated on the drawings, and/or required by the nature of the job site.
- F. The Contractor shall be responsible for ensuring that all equipment and materials are installed in a neat and workmanlike manner and are aligned, leveled and adjusted for satisfactory operation. He shall install all equipment so that all parts are easily accessible for inspection, operation, maintenance and repair. He shall insure that all equipment is solidly supported from building structures.
- G. The contractor is responsible for hand marking the covers of any junction boxes with the identification of any circuits contained. Sharpie mark the exterior of the boxes except in cases where the ceilings are painted out or otherwise coated, mark the interior of the box covers in that case.

1.08 CODES, LAWS AND ORDINANCES

- A. Comply with all laws, codes, ordinances, and etc., having jurisdiction over the work to be performed under the contract for this project, EXCEPT where the requirements of the drawings and/or specifications are in excess of those called for in said laws, codes, ordinances, etc.
- B. Perform work in accordance with the locally adopted editions of the standards listed below; EXCEPT where federal, state and/or local codes are more stringent, in which case, follow them instead:

1. National Fire Protection Association	NFPA
2. Underwriters Laboratories	UL
3. American Society of Testing Materials	ASTM
4. National Electrical Code	NEC
5. National Electrical Manufacturing Association	NEMA
6. Occupational Safety & Health Act	OSHA
- C. The Contractor shall be responsible for installation of the work called for in the contract documents in accordance with all codes, laws, and ordinances, which govern such work. Should he encounter anything contained within the contract documents during preparation for bid which would prohibit the successful compliance of his responsibility under this item, he shall notify the Architect prior to execution of the contract for work so that adjustments can be made to the contract.
- D. The Contractor shall be responsible for obtaining all permits, inspection certificates, etc., required by local, state and/or federal authorities for this project, at his expense. Any and all additional work, expense, etc., incurred as the result of failure to request timely inspections, and or permits, shall be charged against the Contractor.
- E. Approval of the Architect, Engineer, and the appropriate inspection authorities must be secured for the complete electrical installation prior to contract closeout. Upon completion of the electrical work, the Contractor will furnish the Architect with two (2) copies of all certificates of inspection, permits, etc. Final payment to the Contractor will not be made until the requirements of this paragraph have been met.

1.09 LOCAL CONDITIONS

- A. Existing site utilities, underground services, structures, etc., are shown on the drawings accurately in scope only. No expressed or implied guarantee is given as to exact location of the above items. The Contractor is required to verify exact locations and subsequent effects of such on the job.
- B. The Contractor shall contact the local utility companies (power, telephone, etc.) to confirm the scheme of service called for on the drawings. Should the Contractor discover the need for any change to these service schemes per the utility involved, he shall notify the Architect prior to any work being performed so that a solution can be provided. Also, if the contractor becomes aware of any aid to construction cost that will be incurred to the project for any of the utility companies to provide their services, the Contractor shall advise the Architect as soon as possible in the process so that arrangements can be made for the owner to pay these aid to construction utility fees directly to the utility. Note that this does not include any meter fees, permits, pad

preparation or leveling, primary duct bank work, or other items identified elsewhere in any of the documents which the contractor is otherwise responsible for.

- C. Contractor shall verify with the Local Power Company the value of fault current in amperes which will be available at the secondary terminals of the Power Company transformer. If this value is in excess of the AIC ratings of the various panels, circuit breakers, etc., as shown on the drawings, the Contractor shall supply such equipment with AIC ratings which will accommodate the available fault current. Any increase in cost due to this item shall be included in the bid.
- D. Contractors desiring to bid on work under this division are required to visit the job site before bid submittal. During said visit the Contractor shall become familiar with all site conditions which will affect his work and the cost of the work. He shall also verify exact location of the equipment of the various utility companies from whom services will be required. The Contractor shall submit a letter with his bid stating that he has complied with this requirement.

1.10 PLANS AND SPECIFICATIONS

- A. While drawings are to scale, they are diagrammatic. **DO NOT SCALE DRAWINGS HAVING 1/4" OR SMALLER SCALE.** Equipment, conduit, outlets, etc., are not exactly positioned; therefore, the Contractor shall refer to architectural drawings for actual building dimensions, ceiling layouts, light fixture locations, work by other trades, etc.
- B. Should any conflict exist between the drawings and the written specifications, the specifications shall generally govern. Contact Engineer for clarifications.
- C. The drawings and written specifications for all divisions are part of the contract. Any work and material shown in the one and omitted in the other, or which may be reasonably implied by both or either, shall be fully furnished and performed by the Contractor, as required for a complete electrical system installation.
- D. No deviation from the drawings and specifications shall be made without the full knowledge and consent of the Architect. Should the Contractor find, at any time during the progress of the work, that, in his judgment, existing conditions make desirable a modification in requirements covering any particular item or items, he shall report such item promptly to the Architect for his decision and instructions.
- E. The right is reserved by the Architect to move any equipment, outlet, conduit, etc.; as much as ten (10) feet at no increase in cost, provided the Contractor is notified of the change before work on the detail in question is started.
- F. It shall be the responsibility of the Contractor to ensure that the equipment he provides will fit into the available space, leaving reasonable space for maintenance and servicing of the equipment. If, after the installation of any equipment, it is determined that the space requirements have not been met, the Contractor shall rearrange the work at no additional cost.

1.11 COORDINATION OF WORK

- A. It is the responsibility of the Contractor to plan all work so that it proceeds with a minimum of interference with all other trades. He is to inform all parties concerned of openings in the building construction for equipment or conduit required for the electrical work. He is to coordinate the electrical work with the mechanical and plumbing installation.
- B. The contractor shall review and coordinate the locations of all electrical equipment (meters, instrument transformer cabinets, panels, disconnect switches, lighting contactors, etc.) mounted on the outside walls of buildings with the drawings for the mechanical, plumbing, and architectural disciplines to avoid any conflicts in locations with sprinkler risers, plumbing risers, rain downspouts, doors, etc. Generally, meter center risers are shown on the drawings for the purposes of information only; they are not dimensioned. In addition, the locations of the meter centers on the site plans are diagrammatic only. They are not dimensioned. The contractor must coordinate these installations. If there are any questions as to locations of equipment, notify the engineer for clarification prior to installation of equipment.
- C. The Contractor shall provide all required frames, sleeves, inserts, supports, anchor bolts, etc., as required for completion of the work.
- D. The Contractor shall lay out and coordinate all work well enough in advance so as to avoid conflicts or interference with other work in progress. If there is any interference, the electrical layout may be altered to suit the conditions, prior to the installation of any work and at no additional cost to the Owner. Consult the Architect for instructions.
- E. The contractor shall verify the location of all disconnect switches required by the project, prior to their installation. The installed location of any disconnect shall not impede the access to, or working space around, any piece of equipment. Neither shall the location cause any loss of equipment performance due to impeded air flow, etc. This requirement applies regardless of the location shown for the disconnects on the plans. If there is any question as to disconnect location, the contractor shall ask the engineer for clarification prior to installation. If any disconnect is found to be installed in such a way that it causes any problems as mentioned above, it shall be relocated at the expense of the contractor.
- F. Work lines and established heights shall be in strict accordance with architectural drawings and specifications, insofar as these drawings and specifications extend. It is the Contractor's responsibility to verify all elevations and detailed dimensions not indicated.
- G. The Contractor shall coordinate all outlets, fixtures, equipment, etc., with floor, wall and ceiling patterns. Any lines which must pitch shall have right-of-way over lines whose elevations can be changed.

1.12 EQUIPMENT DATA

- A. Deliver all printed tags, instructions, certified drawings, parts lists, certificates, etc., supplied with equipment items, to the Architect at completion of the project.
- B. Assemble all such printed materials into a stiff-back binder identified on its face.

1.13 SHOP DRAWINGS

- A. Shop drawings for switchboards, panelboards, transformers, generators, bus duct, cable tray, fire alarm systems, security systems, lighting fixtures, and other items as might be requested, shall be submitted to the Architect's Engineer for his approval, by the Contractor promptly upon receipt of the contract for work.
- B. The engineer will review the shop drawings for errors in the contractor's interpretation of the contract documents only, and to assist the contractor in compliance with the documents. Correction comments or approval made on shop drawings during the review do not relieve the contractor from compliance with requirements of the contract documents, plans, and specifications. Review or approval of the shop drawings shall not relieve the contractor from responsibility for confirming and correlating all quantities and dimensions, coordination of his work with the other trades, and performance of his work in a safe and satisfactory manner. Review of shop drawings shall not permit any deviations from plans and specifications by the contractor, nor shall it permit changes to the plans and specifications by the engineer. Changes to, or deviations from, the contract documents may only be made by a Change Order issued by the architect and executed properly.
- C. The contractor shall review the information prepared by his suppliers and note any changes required prior to submitting the information to the engineer.
- D. Equipment subject to shop drawing approval shall not be ordered until approved by the Engineer. Material ordered or installed without such approval, if rejected by the Engineer, shall be removed and replaced with approved items at the Contractor's expense.
- E. In order to procure approval for such equipment, the Contractor shall submit electronic copies of shop drawings and/or brochures describing each piece of equipment. Description shall include rated capacities, dimensions, manufacturer's catalog number, performance data with operating characteristics, optional features, modifications, etc.
- F. Note that if the contractor fails to submit all required shop drawings in a timely fashion which allows for resubmittal as required per comments he is solely for resulting project delays, liquidated damages, or having to provide temporary fixtures(if allowed by the architect) while awaiting the arrival of the shop drawing approved fixtures or devices for installation.
- G. See individual specification sections or drawings for additional shop drawing requirements.
- F. If equipment is substituted and approved in the shop drawing process; its use may affect electrical, mechanical, structural, and other systems which were designed based on the original equipment specifications. Any changes, and their cost, in any of the divisions of work affected by the substitution of equipment, shall be the sole responsibility of the contractor making the substitution.

PART II - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. All materials and equipment shall be new and the best grade. They shall conform to all standards and requirements governing the work. Any and all equipment and materials damaged during installation or shipment shall be immediately replaced at NO cost to the Owner.
- B. Reference shall be made to drawing schedules and details and/or specifications for manufacturer, model, catalog number, size, capacity, performance, installation, etc., of equipment and material. Such information is used to denote design, workmanship, and quality desired.
- C. The Contractor shall offer his bid for work based on the electrical equipment (including light fixtures) which is described in these specifications and described in the respective schedules on the drawings. Pre-bid approvals for substitute equipment will not be given.
- D. PRODUCT SELECTION PROCEDURES:

Product selection shall be governed by the Contract Documents, and not by previous project experience which the Contractor or his suppliers may possess. Procedures governing product selection include the following:
 - 1. PROPRIETARY SPECIFICATION REQUIREMENTS: See drawings for cases in which no substitutions shall be permitted.
 - 2. NON-PROPRIETARY SPECIFICATONS: When the specification lists products or manufacturers that are available for incorporation into the work, but do not restrict the Contractor to use of these products only, the Contractor may propose any available product which complies with the contract requirements. Such products are still subject to the shop drawings submittal process.
- E. In the submission of substitute equipment and materials, the Contractor shall note the following: (1) capacities are absolute minimum and must be equaled, (2) physical size limitations for space allotted, (3) structural properties, (4) noise levels, (5) interchangeability, (6) compatibility with other materials, (7) similar items shall be same manufacturer and style wherever possible.
- F. All materials and equipment, for which a UL or NEMA standard is established, shall be so approved and labeled or stamped.
- G. NEMA standards shall be taken as minimum requirements for electrical equipment.
- H. Electrical equipment shall operate properly under a 10 percent plus or minus voltage variation.
- I. Adhesives are not acceptable as mounting, supporting or assembling media.

PART III - EXECUTION

- 3.01** All materials required for the project shall be ordered by the Contractor in a timely manner which allows the material to be received at the job site for installation in agreement with the job schedule, so that work of the other divisions is not held up in any way.
- 3.02** All materials and equipment received at the job site by the Contractor shall be stored and protected from damage while they wait to be installed.
- 3.03** All work shall be carried out in a neat and orderly manner by experienced electricians, under the constant supervision of a competent electrician, trained and licensed in this field, who shall represent the Contractor at all times in connection with the work.
- 3.04** Materials or work installed, rejected by the Architect's Engineer upon inspection shall be completely removed by the Contractor, and the work redone in a manner acceptable to the Engineer by the Contractor at no charge.
- 3.05** When rejected work is removed, should other material, equipment, etc., be damaged in the process, the Contractor shall make all necessary repairs, so that the damaged equipment is equal in quality, strength and appearance to its original state.

3.06 SPACE REQUIREMENTS

- A. The Contractor is fully responsible for determining in advance of purchase that all equipment and materials proposed for installation will fit into the space indicated while allowing sufficient clearance about the equipment and materials to allow proper maintenance and servicing of all components requiring such, including equipment and materials of other divisions located in the vicinity. Shop drawing approval does not alleviate the contractor of this responsibility.
- B. Clearances in front of panelboards, switchboards, motor starters, busway taps, and other electrical equipment requiring servicing while energized, shall be provided in accordance with the NEC, table 110-16a, as required by the code text. Shop drawing approval does not alleviate the contractor of this responsibility.

3.07 FIRESTOPPING

- A. Firestop all penetrations of building fire rated surfaces made by this division.
- B. Each penetration shall be protected by a firestop system with a rating equal to or greater than the original assembly in which the penetration occurs.
- C. All firestop material shall be installed in accordance with manufacturer's standard details and the UL Building Materials Directory for each type of fire rated assembly penetrated.
- D. Telecommunications sleeves shall be firestopped with materials that will permit re-entry and use of the sleeves.

3.08 WIRING ELECTRICALLY OPERATED EQUIPMENT

- A. The Contractor shall provide all conduit, conductors, wiring, etc., required to connect

power to all electrically operated equipment installed on the project, whether provided by this division or other divisions, or by the owner.

- B. The Contractor shall install, support, and electrically connect motor starters, disconnects, etc., and shall complete all power wiring circuits so that each is left in satisfactory condition.
- C. All control equipment associated with any equipment furnished under any other division, or by the owner, shall be furnished by that provider.
- D. This division shall provide all conduit required for control wiring as needed for Division 230000. Refer to that division and its associated drawings for specifics.
- E. This division is responsible for the provision of, and fire alarm system wiring of, duct smoke detectors for all HVAC equipment requiring them. If there is a fire alarm system provided for the project, the detectors shall be tied to that system. If there is no fire alarm system, the Contractor shall provide remote visual and audible alarm indicators and remote test stations per the requirements of NFPA 72 or 90A, latest edition.

3.09 RECORD AND AS-BUILT DOCUMENTS

- A. The Contractor shall maintain at the job site a complete set of Contract Documents. These documents shall be kept current with all changes, substitutions, etc., to the original documents as reflected by the actual work being installed.
- B. At closeout, the Contractor shall provide the Owner with one complete set of as-built reproducible drawings. These documents shall show installed locations, sizes, etc., of all work and material as required by the contract documents and actually installed on the project. If for some reason CAD or Rivet versions of the as-builts are required at project conclusion by the owner or architect, the contractor is responsible for making these changes or paying the engineer to make the changes per the firms standard hourly rates.
- C. For each piece of equipment installed or provided, the Contractor shall provide the number of OEM hardcopies or electronic files as required by the architect to include:
 - 1. Manufacturer's printed catalog pages
 - 2. Manufacturer's operating and maintenance instructions
 - 3. Manufacturer's wiring and connection diagrams, etc.,
 - 4. Motor interlock and control diagrams showing operating instructions for, and normal positions of, each motor and controller
 - 5. Warranty information

All of this information shall be provided in bound 8-1/2" by 11" hardback booklets, or electronic if allowed by the architect.

3.10 CLEANING

- A. The Contractor shall insure that all interior and exterior surfaces of panelboards, transformers, switchboards, motor starters, cabinets, etc., are cleaned so as to be free

of dust, dirt, grease, plaster, debris, etc. Lighting fixtures shall be cleaned according to manufacturer's recommendations. Interior of can lights to be wiped clean of fingerprints.

- B. Any electrical equipment having sustained damage to any factory painted surfaces shall have that damage repaired and restored to original factory condition.
- C. Any and all ferrous metal surfaces exposed on the electrical system shall be painted.

3.11 TEMPORARY LIGHTING AND POWER

- A. As soon as is possible, the Contractor shall install temporary electrical wiring and lighting for the project in accordance with NEC Article 305.
- B. Wiring shall consist of non-metallic sheathed cable with ground wire.

3.12 EXCAVATION, SHORING, AND BACKFILL

- A. The Contractor shall perform all necessary excavation required for installation of his work. Each utility shall be installed in a separate trench.
- B. Excavation shall be below that required for general construction and final grade. It is expected that the Contractor shall process normally difficulties encountered in excavation related to rocks, debris, etc. However, should the Contractor encounter "solid" rock impediments to his excavation, he shall contact the Architect for directions.
- C. Any and all trenching shall be performed strictly in accordance with OSHA, and other authorities having jurisdiction, rules and regulations regarding "cave in" safety shoring. All shoring material used shall be completely removed prior to backfilling the trench.
- D. The Contractor shall not backfill trenches until the conduit banks have been inspected by the proper authorities.
- E. Backfill shall be done simultaneously on both sides of the equipment, raceways, etc. Backfill shall be clean soil, free of rocks, cinders, wood, debris, etc.
- F. Backfill shall be installed in 12-inch layers. It shall be compacted to 85% per ASTM D-1557 in areas under sidewalks and grass; and to 95% under any paved areas.
- G. Should concrete encasement of raceways be required, the sides and floor of the trench shall be used as formwork for the concrete. This shall not apply unless the excavation is clean, free of debris, and of the proper size.

3.13 CUTTING AND PATCHING

- A. The Contractor shall be responsible for the location and size of all openings required for his work.
- B. The Contractor shall not cut into structural members or architectural finish surfaces without expressed written approval of the Architect.

- C. Any patching of surfaces required by the Contractor's work shall be made so that they are equal in quality and appearance to the original surface.

3.14 FLASHING

- A. Raceways which pass through walls or roof surfaces to the outside shall be flashed in accordance with architectural standards and with the requirements of the roofing manufacturer.
- B. Any raceways penetrating the roof shall maintain a clearance of 18 inches minimum from all parapets.
- C. Whenever raceways pass through floor structures which contain a water proofing membrane, the Contractor shall provide a watertight floor sleeve for each raceway. The lowest floor shall be exempt.

3.15 MOISTURE - DAMP PROTECTION

- A. Whenever any electrical component such as panels, raceways, etc., will be in contact with surfaces which may become damp or wet, that component shall be mounted on standoff devices so that it is a minimum of ¼" away from the surface.

3.16 GUARANTEE AND WARRANTY

- A. The Contractor and the General Contractor shall, and hereby does, guarantee that all work executed, and all electrical equipment installed, under this division will be free of all defects in materials, manufacture, and workmanship for a period of one (1) year from the date of final acceptance of the building. The above parties agree that they will, at their expense, repair and/or replace all such defective work and equipment, and any and all other work damaged thereby, which becomes defective during the term of this guarantee.

END OF SECTION

SECTION 26 05 02 – TESTING FOR ELECTRICAL SYSTEMS

PART I - GENERAL

1.01 SUMMARY

- A. The entire electrical system shall be tested to insure proper operation and safety for building occupants and operating personnel.
- B. Testing shall insure conformity to code requirements and conformity to contract documents.

1.02 REGULATORY REQUIREMENTS

- A. Testing shall be in conformance local codes, utility company requirements, and standard industry practices.
- B. Testing shall accomplish the requirements of the NEC, Article 110.

PART II – PRODUCTS

- 2.01** Testing shall be performed with instruments and materials required and approved for the purpose.

PART III - EXECUTION

- 3.01** Perform appropriate tests on the entire electrical system before it is energized. Testing shall be performed to insure that it is free of unintended grounds, short circuits, and open circuits.
- 3.02** Provide safeguards to protect all personnel involved in the testing as well as for protection of equipment being tested.
- 3.03** Testing shall be performed in a timely manner. Reports of results shall be filed with the Architect in written form.
- 3.04** Testing shall include the following:
 - 1. Prior to connections to equipment, all service entrance conductors and feeder conductors shall be tested for unintended grounds and for insulation integrity with a megohm meter. Any conductor found to be defective in the testing shall be replaced.
 - 2. Ground fault protection systems on service entrance equipment shall be tested according to the NEC, Article 230-95.
 - 3. The grounding system network shall be tested to insure a resistance value of not more than ten (10) ohms to ground. Should the system test results be higher than 10 ohms, additional ground rods shall be driven, or alterations made to the system, to produce the 10-ohm or less value required.
 - 4. Full load currents of each feeder shall be measured to test for phase load balance. If the phases are not load balanced, circuit rearrangement shall be made to achieve

balanced load conditions.

5. The proper operation of all alarm and control systems installed under this division shall be verified by system operational testing.
6. All circuits having parallel conductors shall be tested for proper phasing using hot phasing or other compatible techniques.

3.05 The Contractor shall provide additional testing as deemed necessary by the Architect to insure that all equipment functions properly and meets the requirements of the specifications and drawings.

END OF SECTION

SECTION 26 05 19 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART I - GENERAL

1.01 SUMMARY

- A. This section includes building wires and cables, metal clad cable, connectors, and terminations for systems rated below 600 volts.

1.02 RELATED DOCUMENTS

- A. All drawings and Division 01 of the specifications and the general conditions of the Contract apply to this section.
- B. Section 260553 – Identification for Electrical Systems

1.03 REGULATORY REQUIREMENTS

- A. All products required and furnished under this section shall be listed and labeled per the NEC by UL or other testing agency acceptable to the authority having jurisdiction, and marked for intended use.
- B. All products furnished under this section, as installed, shall meet all requirements of the NEC.

1.04 WIRE AND CABLE

- A. All wire and cable routing shown on the drawings is approximate. Field verify dimensions and routing lengths of all conductors and cables required prior to installation.
- B. All wire and cable furnished on this project shall be copper and drawings reflect conductor sizes, conduit sizes, etc. based on copper conductors.

1.05 SUBMITTAL FOR INFORMATION:

- A. Provide written data for aluminum conductor substitution to the engineer indicating the voltage drop and ampacity calculations for the aluminum conductor substitute to match the copper conductor involved.

PART II - PRODUCTS

2.01 CONDUCTORS

- A. Specified gauge sizes refer to American Wire Gauge, copper conductors.
- B. All wire and cable shall be of soft drawn, annealed, copper having a conductivity of not less than 98% of that of pure copper; each wire continuous without weld, splice, or joint throughout its length; uniform in cross section and free from flaws, scales and other imperfections.

- C. Sizes specified are AWG through No. 4/0 and circular mils above No. 4/0. Conductor No. 10 and smaller shall be solid; No. 8 and larger stranded. Note that the manufacturers recommendations for certain pieces of equipment may require stranded wire in smaller sizes than noted above; always follow manufacturers recommendations.
- D. Conductors No. 4 and smaller shall be Type "THHN/THWN"; larger conductors shall be type "THW". Other types allowed with approval of the engineer.
- E. All conductors shall be of the same name brand and shall be in the original wrapping.

2.02 BRANCH CIRCUIT CONDUCTORS

- A. Minimum wire size for lighting and power circuits shall be #12. #10 shall be used where the run to the first outlet exceeds 75' for 120V circuit and 150' for 277V circuit.
- B. Branch circuit wiring shall be rated for 75 degrees C minimum. Note that 90 degree wire can be used for derating but not to increase the overall ampacity of a circuit, since connections at most manufacturers equipment is rated for 75 degree C max, as a limiting factor.
- C. All installations to be based on wire in conduit except for cases where the use of MC cable or NM cable is specifically noted as being allowed on the drawings in certain applications or instances. In these cases, follow the appropriate NEC section for installation guidelines or obtain the approval of the local AHJ in regards to any specifics he has for that area as relates to MC or NM cable installation.

2.04 SPLICES & TERMINATIONS

- A. Splices for #10 AWG and smaller wire used on Branch circuits and fixtures shall be of the "Live Spring" pressure type, Ideal Co. wing nut and/or wire nut type connectors or approved equal. Splices shall be rated 600 volts or 1000 volts when enclosed in a fixture or sign.
- B. Solderless, mechanical type lugs shall be used for terminal connections for copper conductors of #8 AWG or larger.

PART III - EXECUTION

3.01 WIRE AND CABLE

- A. Conductors shall be continuous from outlet to outlet and from outlet to junction box or pull box. All splices and joints shall be carefully and securely made to be mechanically and electrically solid with "Live Spring" pressure type connectors, by "IDEAL CO." or approved equal. Tape shall be "Scotch" No. 33 for indoor and NO. 88 for outdoor or approved equal. Where connection is made to any material, copper terminal lugs shall be bolted or compression fitted to the conductors. Where multiple

connections are made to the same terminal, individual lugs for each conductor shall be used.

- B. Wire shall not be drawn into a conduit until all work on the conduit system, which might cause damage to the wiring, is complete.
- C. Where two or more circuits run to a single outlet box, tag each circuit with linen tags as a guide to the fixture hanger in making fixture connections.
- D. All stranded conductors shall be furnished with copper connecting lugs drilled or reamed the full diameter of the bare conductors.
- E. Mains and feeders shall be run their entire length in continuous pieces without joints or splices. If the runs are too long for a single conductor piece, then joint and/or splices installed per these specifications shall be used.
- F. All splices, taps, terminations, etc. in the conductors shall be kept where they are fully accessible for inspection and maintenance.
- G. All wiring in cabinets, boxes, gutters, etc., shall be neatly tied and held in place by nylon cable ties and mounting brackets.
- H. At each fixture outlet a loop or end of wire not less than 8" long shall be left for connection to fixtures.
- I. The number of crosses hatches, where indicated, designates the number of conductors to be installed when the number exceeds minimum of two (2). Where crosshatches are not indicated, the number of conductors shall be as determined by switching, homeruns, etc. This does not apply to conduit provided for telephone or other special systems.
- J. Branch circuits shall contain the necessary number of conductors to afford the switch control indicated.
- K. Splices, etc. in signal and/or communication conductors shall be made with crimp-on or soldered connections, which are properly insulated.
- L. The Contractor shall not permit conductor bends to a radius less than 10 diameters or thickness on circuits of 600 volts or less.
- M. Conductors, when installed, shall not have dents, cuts, and scars, pressure indentation, abraded areas, etc. The Contractor will be responsible for replacement of conductors so damaged, at his expense.
- N. Lubricants used to ease conductor-pulling operations shall be specifically manufactured for that purpose. TALC only shall be used on isolated branch circuit wiring.
- O. An UL approved non-oxidation compound or grease is to be applied at all Aluminum terminations of panel feeders, secondary service conductors, and primary (high voltage) service conductors prior to connection.

END OF SECTION

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART I - GENERAL

1.01 SUMMARY

- A. This section includes the electrical grounding of all electrical systems and equipment provided on this project.

1.02 RELATED DOCUMENTS

- A. All drawings and Division 01 of the specifications and the general conditions of the Contract apply to this section.
- B. Specification section 260519 – Low Voltage Electric Power Conductors and Cables

1.03 REGULATORY REQUIREMENTS

- A. All components, equipment, fittings, accessories, etc. required and furnished under this section shall be listed and labeled per the NEC by UL or other testing agency acceptable to the authority having jurisdiction, and marked for intended use.
- B. All components, equipment, fittings, accessories, etc. required and furnished under this section shall comply with the NEC, particularly Article 250.

1.04 GROUNDING SYSTEM

- A. Components of the grounding system shall include (but not limited to):
 1. Building water supply pipe
 2. Building structural steel
 3. Driven ground rod(s)

PART II - PRODUCTS

2.01 MANUFACTURERS

- A. All grounding equipment shall be manufactured by ERICO International Corporation or equal.
- B. Grounding conductor manufacturers shall be per Section 260519 of these specifications.

2.02 CONDUCTORS

- A. All grounding conductors shall be copper. Conductors smaller than No. 8 AWG shall be solid; all other conductors shall be stranded. Ground conductors shall be bare or have type THHN insulation, green in color.
- B. Aluminum grounding conductors shall not be used.

2.03 GROUND RODS

- A. Ground rods shall be copper clad, sectional, solid steel, 8-ft. long, ¾ in. diameter.
- B. Rods shall be threaded on both ends.
- C. All couplings shall be bronze and made by the rod manufacturer.

2.04 CONNECTIONS

- A. Grounding connections made to ground rods, building re-steel, counterpoise systems, etc. shall be made via exothermic welding means.
- B. Grounding connections to pipes shall be made with bolted pressure type or compression type clamps manufactured for grounding purposes.
- C. Grounding connections to boxes, fixtures, etc. shall be made at the factory provided grounding terminal.

PART III - EXECUTION

3.01 SERVICE GROUND

- A. Provide driven ground rods in 3 separate locations arranged in a triangle, separated from each other by a minimum of 10 ft. Set rods so that top of final rod driven is 2 inches below grade at each of the 3 locations. The number of rods are allowed to be reduced if ground test provided to the engineer demonstrate a resistance of 25 ohms or less.
- B. Connect ground rods together with grounding conductor via exothermic welding process or compression type installed with the use of a high pressure crimping tool. Provide connection to main service entrance disconnect ground bus connection point and to system neutral at this location with grounding conductor.
- C. Provide grounding conductor from main service entrance disconnect ground bus to main building water service piping. Provide grounding conductor shunts around all valves and water meter in water service piping. Shunts shall be braided type.

3.02 BUILDING CONNECTIONS

- A. Provide grounding conductors from main service entrance disconnect ground bus connection point to building foundation reinforcement steel and to building frame steel.
- B. Provide bonding connections to all above ground sections of gas piping upstream from the equipment shutoff valve that the pipe feeds.

3.03 COMMUNICATIONS SYSTEMS

- A. Provide a #4 AWG grounding conductor from the grounding electrode system to the communications system (fire alarm, security, telephone, data, cable television, etc.) utility service cabinet.

- B. Provide connection to service and/or central equipment locations on a ¼" by 2" by 12" grounding bus.

3.04 EQUIPMENT CONNECTIONS

- A. Provide grounds to all equipment requiring them, including, but not limited to:
 - 1. Electric service
 - 2. Secondary of transformers (except the isolating type).
 - 3. Conduit and enclosures.
 - 4. All neutral conductors.
 - 5. Panelboards, switchboards, etc.
 - 6. Ground terminals on receptacles, appliances, equipment, etc.
 - B. Make all connections with galvanically compatible materials.
 - B. Clean all connections points so that new bare metal surfaces are involved in connections.
 - C. Tighten all bolts, screws, etc. on grounding connections to torque ratings of manufacturer, or per UL 486A if there are no manufacturer's instructions on torque settings.
 - D. Seal all grounding connections of dissimilar metals with inert product intended for this purpose to exclude moisture infiltration into connection joints.
 - E. Provide grounding connection for all step down transformer neutrals to nearest building steel member.
- 3.05** Route all grounding conductors via shortest physical path possible without obstructing access to other systems or placing the conductors in locations where they will be subjected to any type of damage.
- 3.06** All bonding conductors (straps, jumpers, etc.) shall be installed so that their connections are isolated from equipment vibrations, etc.
- 3.07** In all raceway systems provide an equipment grounding conductor in addition to the circuit neutral inside the raceway with the phase conductors. Equipment grounding conductor shall be "Green" in color.

END OF SECTION

SECTION 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART I - GENERAL

1.01 RELATED DOCUMENTS

- A. The General and Supplementary Conditions, and General Requirements Division, apply to the work specified in this Section.

1.02 LOCATION OF OUTLETS

- A. Unless specifically indicated, all outlets are located diagrammatically on the drawings. Reference shall be made to the architectural and mechanical plans for the exact location of all outlets.
- B. Outlets shall be located so that they will be symmetrical with architectural details and power outlets shall be so located as to properly serve the equipment.

1.03 JUNCTION BOXES AND PULL BOXES

- A. Furnish and install junction and pull boxes as required to facilitate installation of the various conduit systems and as required by the NEC.
- B. The contractor is responsible for hand marking the covers of any junction boxes with the identification of any circuits contained. Sharpie mark the exterior of the boxes except in cases where the ceilings are painted out or otherwise coated, mark the interior of the box covers in that case.
- C. The contractor is responsible for providing blank covers for any boxes which he installs which are not utilized at the time of turnover to the owner. This includes boxes which were originally intended for use by others with low voltage systems but that don't get utilized for whatever reason. Note that stainless blank cover plates are required in cases where that is the coverplate material used for other devices on the project.

PART II - PRODUCTS

2.01 SECONDARY SERVICE CONDUIT

- A. Secondary service duct shall be galvanized rigid steel conduit, IMC or schedule 40 PVC.

2.02 TELECOMMUNICATIONS SERVICE ENTRANCE DUCT

- A. Telephone service duct shall be schedule 40 PVC conduit. Where penetrations through slabs occur, use long sweep rigid steel conduit elbows.

2.03 FEEDERS & BRANCH CIRCUITS

- A. Rigid conduit or IMC shall be used for all feeders and sub-feeders and branch circuits,

where exposed to possible physical damage. EMT shall be permitted in protected areas.

2.04 RIGID CONDUIT

- A. All rigid conduit shall be of the best quality steel of standard dimensions, hot dip galvanized, threads included, clean and smooth inside. Conduit shall be manufactured as Electrical Conduit with the manufacturer's trademark or stamp on each length of conduit.
- B. Fittings for all rigid conduits shall be steel or malleable iron as manufactured by Thomas and Betts or equal. DIE CAST FITTINGS OF ANY MATERIAL SHALL NOT BE USED.

2.05 ELECTRIC METALLIC TUBING (EMT)

- A. EMT conduit shall be of the best quality steel of standard dimensions, hot dip galvanized, clean and smooth inside. Conduit shall be manufactured as Electrical Conduit with the manufacturer's trademark or stamp on each length of conduit.
- B. Fittings for all EMT conduit shall be compression type, made of steel, with case hardened locknuts, and nylon insulated throats; or steel setscrew fillings with case hardened locknuts, and nylon insulated throats. DIE CAST FITTINGS OF ANY MATERIAL SHALL NOT BE USED. Fittings shall be manufactured by Thomas and Betts or equal.

2.06 RIGID NONMETALLIC CONDUIT (PVC)

- A. All PVC conduit shall be produced by the same manufacturer, be schedule 40, and manufactured as Electrical Conduit with the manufacturer's trade mark or stamp on each length of conduit.
- B. All PVC conduit fittings and cement shall be secured from the conduit manufacturer.
- C. All PVC conduit shall meet the following standards:
 - 1. Rated for 90 degrees centigrade.
 - 2. Shall have a tensile strength of 7,000 psi @ 73 degrees F.
 - 3. Shall have a flexural strength of 11,000 psi.
 - 4. Shall have a compressive strength of 8,600 psi.
- D. PVC not allowed above grade except for use with ground wires(only).

2.07 FLEXIBLE CONDUIT

- A. Flexible Steel Conduit (No Cover) shall be constructed of reduced wall galvanized steel, and shall be manufactured as Electrical Conduit with the manufacturer's trademark or stamp.
- B. PVC Extruded Cover Flexible Conduit shall be used in all outdoor applications. It shall be UL listed for outdoor use.

- C. Connectors and fittings for flexible conduit shall be steel type with nylon insulated throats. Connectors shall "bite" into the conduit under pressure of the connector bolt. All connectors and fittings shall be manufactured by Thomas and Betts or equal.

2.08 BELOW GRADE CONDUIT AND CABLE SEAL

- A. Seals for either conduit or cable below grade shall form a reliable lasting seal between building and the outside and shall be able to withstand pressures to a minimum head of 50 feet of water. The below grade seals shall be as manufactured by O.Z./Gedney and sized for the particular application.

2.09 THREADED JOINT COMPOUND

- A. Threaded joint compound shall be a corrosive inhibiting compound that is electrically conductive under pipe joint pressure. The compound shall be Thomas and Betts "KOPR-HIELD" or approved equal.

2.10 CONDUIT IDENTIFICATION TAPE

- A. Conduit identification tape for use in marking underground conduit runs shall be inert polyethylene, resistant to acids, alkalis, etc., which might be in the soil. The tape shall be a minimum of 4 mils thick, 6 inches wide, and yellow in color. It shall have the words "CAUTION – ELECTRIC LINE BURIED BELOW" imprinted along its entire length with a contrasting color permanent ink. The tape shall be "Terra Tape" as manufactured by Reef Industries, Inc., Houston, Texas; or equal.

2.11 PULL BOXES

- A. All pull boxes shall be constructed of code gauge galvanized steel of the dimensions required by Article 370 of the NEC, according to the number, size, and position of conduits entering the box.
- B. Pull boxes installed in vertical runs of conductors shall be provided with Red Seal type VVC or approved equal cable supports as required by Table 300-19 of the NEC.
- C. Pull boxes for horizontal runs of feeder conductors which contain more than one feeder shall be provided with reinforced flange and removable 12 gauge 1-1/2" by 1-1/2" galvanized channel for support of conductors. Wood supports shall not be used.
- D. Pull boxes installed in finished spaces shall be flush mounted and shall be provided with trim, hinged door, and flush latch with lock to match trims for flush mounted panelboards.
- E. Where exterior pull boxes are required in the ground, provide drive over rated covers in appropriate areas.

2.12 OUTLET BOXES

- A. All outlet boxes shall be constructed of code gauge galvanized steel.

- B. Outlet boxes specified herein are minimum size boxes. Larger boxes of the same type shall be provided if required by the NEC in consideration of the number and size of conductors installed.
- C. Outlet boxes for surface mounted and pendant mounted lighting fixtures shall be four inch octagon boxes, 1-1/2 inches deep. Fixtures studs shall be provided for support of fixtures if required.
- D. Outlet boxes for flush mounted lighting fixtures shall be four inch square boxes, 1-1/2 inches deep with blank cover.
- E. Outlet boxes for switches, receptacles, and wall mounted junction boxes shall be four inch square boxes, 1-1/2 inches deep. Where only one conduit enters box, 3-1/2 inch deep single gang switch boxes may be used. Outlet boxes for GFCI receptacles shall be 2-3/4 inches deep.
- F. Outlet boxes recessed in concrete lock walls and partitions shall be designed especially for installation in concrete block and tile walls and partitions. Single gang or multi-gang square cornered masonry boxes shall be used for one or more devices at the termination of a conduit run. Conventional four inch octagonal or 4-11/16 inch square boxes fitted with square tile covers of proper depth for concrete block shall be used where two or more conduits enter a box.
- G. Where specialty equipment such as fire alarm components, security components, etc., are installed provide outlet boxes suitable in size for these devices.
- H. Outlet boxes to be used in exposed conduit run shall be cast ferrous alloy type. Outlet boxes for vapor-tight lighting fixtures shall be cast corrosion resistant type.

2.13 FLOOR BOXES

- A. Floor outlet boxes shall be adjustable, sheet steel, designed for use in concrete slabs, and water tight if noted on drawings.
- B. Boxes for use in a floor to be carpeted shall be supplied with an adjustable brass carpet flange.
- C. Provide shallow boxes where required due to slab thickness.
- D. Watertight boxes or boxes on grade shall be cast metal and adjustable. Provide rubber gasket and bronze disk.
- E. Covers for all floor boxes shall be supplied in accordance with the use of the box.

PART III - EXECUTION

3.01 INSTALLATION

- A. Unless otherwise specifically noted on the drawings, ALL CONDUCTORS installed on this project shall be installed in conduit as specified herein.

- B. Any conduit installed on this project shall be no smaller than $\frac{3}{4}$ " , except as otherwise noted on the drawings. Where desirable for ease of installation, larger sizes than those called out on the drawings may be used. The contractor is responsible for resolution of any conflicts arising from the use of larger sizes.
- C. Conduit shall be continuous from outlet to outlet, from outlet to panelboard cabinet, junction box, and/or pull box. Conduit shall enter and be secured to all boxes, etc., in such a manner that each raceway system will be electrically continuous from the service entrance to all outlets. All conduit from panelboard cabinets and junction boxes shall terminate in approved outlet boxes or conduit fittings. Conduit connection to any box, which has no threaded hub for its reception, shall be installed with two locknuts.
- D. In general, the conduit installation shall follow the layout shown. However, this layout is diagrammatic only; and where changes are necessary due to structural conditions, other apparatus, or other causes, such changes shall be made without any additional cost to the Owner. Offsets in conduit are not indicated, and must be provided as required.
- E. Junction boxes and pull boxes shall be provided and installed as required to facilitate the systems shown on the drawings. "AX" expansion fittings shall be installed in all conduit runs wherever they cross building expansion joints.
- F. At couplings, conduit ends shall be threaded so they meet in the coupling. Right and left couplings shall not be used; conduit couplings of the Erickson type or approved equal shall be used at locations requiring such joints.
- G. Connections in conduit installed in outdoor or indoor locations where exposed to continuous or intermittent moisture, shall provide a liquid-tight seal. The sealing hub fittings shall be of steel or malleable iron, with recessed sealing "O" ring and a nylon insulated throat, Thomas and Betts Series 370. All conduit and cable, telephone or otherwise, which extend from the interior to the exterior below grade shall be sealed with a fitting designed for that particular use so as to be watertight.
- H. No bends will be permitted with a radius less than size (6) times the diameter of the conduit nor more than 90 degrees.
- I. All conduits shall be concealed in the wall, in or below floors or above ceilings unless otherwise directed or indicated. Concealed conduit shall be supported from the building construction at intervals not exceeding 8'-0". Concealed conduit above the ceiling shall be supported independent of ceiling construction. Where ceilings of the lay-in type are used, conduit must be installed high enough to permit removal of ceiling panels and lighting fixtures.
- J. Where conduit is expressly shown to be run exposed, the conduit shall be supported at intervals not exceeding 8'-0" with straps and wood screws for wood construction, machine screws for metal construction, and expansion bolts for masonry construction. Exposed conduit in finished spaces that pass through walls or ceilings shall be provided with chrome plated escutcheons. Run exposed conduit, where permitted by this specification, parallel or at right angles to the building with approved galvanized iron clamps or hangers. Devices attached to masonry or slabs shall be secured with inserts and bolts or lead expansion sleeves. Provided a support at each outlet box, at each conduit elbow, and at each junction

- box. Wooden plugs inserted in drilled holes are not acceptable as support bases.
- K. Where two (2) or more conduits are run parallel and adjacent, they shall be installed on gang hangers.
 - L. Where connections are made to motors more than 2'-0" away from walls or columns, a vertical conduit, minimum size 3/4", securely attached to floor and ceiling shall be installed and the wiring carried into and out of this conduit by means of condulets and flexible conduit.
 - M. Conduit embedded in concrete, which is in contact with the earth, and conduit installed outside the building below grade shall be rigid steel conduit, IMC or PVC.
 - N. Conduit shall be located 6" minimum from surfaces with temperature ranges above 140 degree F.
 - O. Conduit shall not be installed in any manner, which will result in the accumulation of condensation in the pipe.
 - P. In masonry construction, wooden plugs inserted in drilled holes are NOT acceptable as bases for supports for conduit. The Contractor shall use approved types of galvanized wall brackets, beam clamps, strap hangers, or pipe straps secured by means of toggle bolts in hollow masonry units, expansion bolts in concrete or brick, machine screws or bolts and nuts in metal surfaces, and wood screws in wood surfaces.
 - Q. Conduit runs left for future use shall be checked for unblocked passage by the use of a ball mandrel. Contractor shall leave a non-mildewing polyolefin pull line in each such conduit. The line shall have an average tensile strength of 200 lbs. for 1" or smaller conduit and 500-lbs. for conduit larger than 1". Pull lines shall be based on the standard set by Ideal Co. product #31-343 for 200-lb. line and 32-244 for 500-lb. line.

3.02 CONDUIT PROTECTION

- A. Conduit shall not be installed in any manner that will result in the accumulation of water inside the pipe.
- B. Conduit shall be located a minimum of 6 inches away from any surfaces which will reach surface temperatures of 140°F. or above.
- C. All conduit installed in the ground outside of the building shall be buried a minimum of 36 inches below finished grade, but in no case shall it be buried more than 48 inches deep without the written consent of the Engineer.
- D. Conduit run inside the building below floor slabs shall be included within the concrete pour of the slab, located between the reinforcing steel vertically.
- E. For all conduit installed in the ground outside of the building, provide identifying marker tape over the entire length of the conduit run. Place tape below finished grade between 12 inches and 18 inches absolute.
- F. All conduit shall be secured in place and protected to prevent damage to work during

construction. The ends of all conduit and conduit fittings shall be plugged to avoid filling with dirt, plaster, gypsum, etc. Plugs shall be Thomas and Betts series 1470.

- G. All conduit shall be blown out and swabbed clear of water and trash prior to the installation of any conductors in the conduit.

3.03 GROUNDING AND TERMINATIONS

- A. Connections to all panelboards, cabinets, pull boxes, etc., shall be installed with a grounding wedge lug between the bushings and the box; or with locknuts designed to “bite” into the metal of the box.
- B. To insure continuity of electrical ground and to improve conductivity, use Kopr-Shiel compound, series CP-8 as manufactured by Thomas and Betts on all rigid conduit threaded joints.
- C. In ALL conduit runs, rigid or otherwise provide a green colored insulated grounding conductor inside the conduit with the phase conductors.

3.04 PENETRATIONS

- A. Where any electrical item such as conduit, cable, telephone cable, busway, etc., penetrates a wall, floor, or ceiling, the original integrity for the respective wall, floor, or ceiling shall be restored. The opening around the item making the penetration shall be sealed airtight. If the surface penetrated is fire rated, the sealant shall have a fire rating equal to the original surface. In no case shall the penetration result in a lessening of the fire rating of the surface penetrated.
- B. Any openings in surfaces left for future routing of electrical work shall be left sealed as noted in Item A above.
- C. Provide sleeves for conduit, cables, busway, etc., accurately before concrete floors are poured; or set boxes in the forms so as to leave openings in the floors so the required sleeves can be subsequently located.
- D. Sleeves shall be rigid conduit with bushings installed on each end. Sleeves shall extend 6 inches beyond the surface they penetrate.

3.05 FLEXIBLE CONDUIT

- A. Non-covered flexible steel conduit shall be used in making short connections from outlet boxes to recessed lighting fixtures. Such conduit runs shall be no longer than 72-inches.
- B. Flexible conduit runs to other equipment shall be kept as short as possible, but shall have a minimum length of 12 inches.
- C. Flexible conduit connections to dry type transformers, rotating or vibrating machinery, kitchen equipment, or any other equipment, which may result in the conduit being exposed to moisture, shall be PVC covered.

3.06 PVC CONDUIT

- A. PVC conduit shall not be used above grade under any circumstances.
- B. All PVC conduit joints of any type shall be solvent welded in accordance with the manufacturer's recommendations.

3.07 PULL BOXES

- A. Pull boxes shall be provided where indicated on the drawings and/or where required to facilitate the installation of all required conductors or as required by NEC.
- B. Pull boxes shall be installed exposed only in unfinished spaces. They shall be accessible.
- C. Feeders within pull boxes shall be individually laced with nylon tie straps of the type with enlarged tab to permit identification of each feeder.
- D. Conductors shall not be spliced inside pull boxes except with the approval in writing of the Architect. Where splices are permitted they shall be made with splicing sleeves attached to the conductors with hydraulic crimping tools or with tap blocks. Split bolt connectors shall not be permitted.

3.08 OUTLET LOCATIONS

- A. Furnish and install outlet, junction, and pull boxes as required to facilitate the installation of the electrical systems as required.
- B. All outlet, junction, and pull boxes shall be accessible with covers designed for quick removal. Where boxes are located above non-accessible ceilings, in walls, etc., in finished areas, the removable cover shall be flush with the finished surface. Cover finish and the exact location of the boxes shall be approved by the Architect .
- C. The drawings are intended to show the locations of outlets, devices, fixtures and arrangement and control of circuits only. Exact locations shall be determined by actual measurement at the building and/or reference to the architectural drawings.
- D. The location of any outlet may be moved ten feet with the prior approval of the Architect and before it is installed without any additional expense to the Owner.
- E. Contractor shall check the location of all wall outlets including light fixtures, receptacles and switches, to verify that the outlets will clear any wall fixture, shelving, work tables, sinks or similar equipment that will be installed.
- F. Outlets occurring in architectural features shall be accurately centered in same. Install wall switch outlets on the STRIKE SIDE of doors with cover plate clearing door trim.
- G. Outlet boxes in non fire rated partitions shall NOT be set back to back. Boxes set side by side facing separate rooms or spaces, shall be connected together by offset nipple; after conductors are pulled, the nipples shall be tightly packed with mineral wool to prevent sound transmission.
- H. Outlet boxes in fire-rated partitions shown to be mounted on the opposite side of the

partition at the same height, shall be separated horizontally by a minimum of 24 inches.

- I. The mounting height of all wall outlets is indicated on the architectural or electrical drawings. The height is from the finished floor to the center line of the device or outlet. The Contractor may with the Architect's approval vary the mounting heights to correspond to masonry joints.
- J. Where outlets are shown as being adjacent and different mounting heights are indicated for each, they shall be mounted one directly over the other at the heights specified.

3.09 OUTLET BOXES

- A. All outlet boxes shall be flush mounted within the wall regardless of wall construction, unless they are specifically shown as being used with exposed conduit. Cuts for outlet boxes in masonry walls shall be made so that the cover plate will completely cover the cut. The edge of all boxes shall be flush with the surface in which they are installed.
- B. The devices that are to be installed in the boxes shall be screwed tight before cover plates are installed. Plates shall not be used as a means for tightening the devices or holding them in place.
- C. Provide extension rings for all boxes when required by wall finish.
- D. Junction boxes shall be provided with blank covers. Covers on ceiling outlets shall be round, and shall be painted to match ceilings. Covers on wall junction boxes shall be of size and finish as used on switch and receptacle outlets.
- E. Where outlets are shown as being adjacent and different mounting heights are specified for each, they shall be mounted ONE DIRECTLY over the other, on the center line of the group or on the center line of the room or wall.
- F. The mount height of all wall outlets is indicated on the architectural or electrical plans. The mounting height is from finished floor to the centerline of the device or outlet. The Contractor may, with the Architect's approval on the job, slightly vary the mounting height of wall outlet so that the outlet box, top or bottom, will occur at a masonry joint.
- G. Outlet boxes shall be provided with 3/8" fixture stud to support light fixture. Outlet boxes shall be firmly anchored to structural member of the building, using wood screws for wood construction, bolts for steel construction, and expansion bolts secured in place with cement mortar for masonry construction. Ceiling outlet flush in furred acoustical tile ceiling construction for surface or pendant mounted lighting fixtures shall be in 4" square or octagonal pressed steel boxes supported from stud and rod, bars or hangers supported from the building structure independent of the ceiling construction. For outlet boxes located between steel studs, provide Caddy No. BHA; and adjacent to studs, provide Caddy No. MSC.
- H. Where drawings indicate ganged installation of switches controlling 277 volt lighting circuits of opposite phase, switches shall be separated by one full gang width, or separated with a permanently installed barrier between phase and/or different voltages.

- I. Outlet boxes shall not be used as support for lighting fixtures

END OF SECTION

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART I - GENERAL

1.01 SECTION INCLUDES

- A. This section includes equipment marking, wire and cable marking, and conduit marking.

1.02 RELATED SECTIONS

- A. All conditions and requirements of Division 01 shall apply to the work specified in this section.
- B. Section 099100 - Painting

1.03 REGULATORY REQUIREMENTS

- A. Furnish products that are manufactured and rated for labeling and marking electrical equipment.

PART II - PRODUCTS

2.01 EQUIPMENT NAMEPLATES

- A. Nameplates shall be engraved three layer laminated plastic. In all cases, inner layer shall be white in color.
- B. Nameplates shall be provided on all electrical enclosures and/or cabinets.
- C. Engraved letters shall be 3/8 inches high.
- D. Nameplate outer layer color shall be:
 - 1. 480/277 volt equipment – Red
 - 2. 208/120 volt equipment – Black
 - 3. 240/120 volt equipment – Blue

2.02 WIRE AND CABLE MARKERS

- A. Markers shall be colored plastic tape for service entrance and feeder conductors and PVC sleeve type markers for branch circuit conductors.
- B. PVC sleeve type markers shall be equal to Thomas & Betts E-Z-Code, white with black writing.
- C. Service entrance and feeder conductor marking shall consist of phase identification follows:

208Y/120 Volt System	480y/277 Volt System
Phase A - Black	Phase A - Brown
Phase B - Red	Phase B - Purple
Phase C - Blue	Phase C - Yellow
Neutral - White	Neutral - White with Black Stripe
Ground - Green	Ground - Green

- D. Branch circuit conductor marking shall consist of the source panel name and the branch circuit number as listed in the panel schedules on the drawings.

2.03 CONDUIT MARKERS

- A. Conduit and raceway labeling shall be stenciled painted letters of height of 2 conduit diameters, or 2 inches, which ever is smaller. Voltage and function shall be stated in label.
- B. Label paint shall be enamel meeting requirements of Section 099100 – Painting. Color per voltage system:
1. 480/277 volt raceway – Red
 2. 208/120 volt raceway – Black
 3. 240/120 volt raceway – Blue

2.04 UNDERGROUND RACEWAY MARKERS

- A. Raceway route markers shall be 4” by 4” by 18” long concrete stakes.
- B. Raceway route warning tape shall be inert polyethylene, resistant to acids, alkalis, etc., which might be in the soil. The tape shall be a minimum of 4 mils thick, 6 inches wide, and yellow in color. It shall have the words “CAUTION – ELECTRIC LINE BURIED BELOW” imprinted along its entire length with a contrasting color permanent ink. The tape shall be “Terra Tape” as manufactured by Reef Industries, Inc., Houston, Texas; or equal.

2.05 PANELBOARD CIRCUIT DIRECTORIES

- A. Circuit directory cards shall be white heavy cardboard manufactured for the purpose, with machine written black ink circuit number legends.
- B. Circuit identification shall be in agreement with the actual connections installed and clearly labeled as to the areas served by that circuit.

2.06 SWITCHBOARD AND DOORLESS PANELBOARD CIRCUIT BREAKER MARKERS

- A. Circuit breakers markers shall be as per paragraph 2.01 above.
- B. Circuit identification shall be in agreement with the actual connections as guided by the panel schedules on the drawings.

PART III - EXECUTION

- 3.01** Clean and remove grease, etc. from all equipment surfaces that will receive nameplates.
- 3.02** Provide labels for all electrical panels, switchboards, disconnects, cabinets, feeder and service raceways, motors, and major pieces of electrical equipment installed under this division
- 3.03** Provide panelboards that have doors with a directory card of all circuits in the panel.
- 3.04** Provide circuit breakers in switchboards and in panelboards that do not have doors with labels stating the circuit number and what the breaker is supplying.
- 3.05** Label all feeder conduits and all single equipment branch circuit conduits in excess of 6 ft. in length with painted labels located at 20 ft. on center along the entire length of the conduit run.
- 3.06** Mark all underground conduit runs installed outside the building with stakes set with tops flush in the ground directly over the source, end, and bends locations in the conduit run.
- 3.07** Provide marker tape over the entire length of all underground conduit runs installed outside the building. Tape shall be installed at a depth between 12 and 18 inches below the surface of the ground directly over the conduit.
- 3.08** Mark all service entrance phase conductors and the neutrals with colored plastic tape to identify phase assignments on each end of the conductor and in all pull and/or junction boxes.
- 3.09** Branch circuit conductors shall be color-coded via insulation color as follows:

208Y/120 Volt System	480y/277 Volt System
Phase A - Black	Phase A - Brown
Phase B - Red	Phase B - Purple
Phase C - Blue	Phase C - Yellow
Neutral - White	Neutral - White with Black Stripe
Ground - Green	Ground - Green

END OF SECTION

SECTION 26 24 16 - PANELBOARDS

PART I - GENERAL

1.01 SECTION INCLUDES

- A. Lighting and appliance panelboards

1.02 RELATED SECTIONS

- A. Overcurrent Protective Devices

1.03 REFERENCES

The panelboards and protection devices in this specification are designed and manufactured according to latest revision of the following standards (unless otherwise noted).

- A. ANSI 61
- B. ANSI/NEMA KS 1, Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts)
- C. ANSI/NEMA PB 1, Panelboards
- D. ANSI/NFPA 70, National Electrical Code
- E. ASTM - American Society of Testing Materials
- F. CSA C22.2 No. 29, Panelboards and Enclosed Panelboards
- G. CSA C22.2 No. 5.1, Molded Case Circuit Breakers
- H. Federal Specification W-C-375, Rev. B, Amend. 1, Circuit Breakers, Molded Case; Branch Circuit and Service
- I. Federal Specification W-P 115, Rev. C, Panel, Power Distribution
- J. NEMA AB 1, Molded Case Circuit Breakers and Molded Case Switches
- K. NEMA PB 1.1, General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less
- L. UL 489, Molded-Case Circuit Breakers and Circuit-Breaker Enclosures
- M. UL 50, Enclosures for Electrical Equipment
- N. UL 67, Panelboards
- O. UL 943, Ground-Fault Circuit-Interrupters

1.04 DEFINITIONS

- A. Overcurrent Protective Device -- a circuit breaker pole or single fuse. Example: a 2-pole device is considered 2 protective devices.

1.05 SYSTEM DESCRIPTION

- A. Short circuit rating of panelboards shall be the interrupting rating of lowest rated device in the panel or applicable UL series rating for proper main and branch device combinations.
- B. Panelboards shall have a maximum of 42 protective devices per panel, including sub-feeders and excluding main overcurrent protective devices. For more than 42 devices, 2 or more panelboards are required.
- C. With 2 or more panelboards, sub-feed lug or thru-feed lugs shall be used in all but 1 section of each panelboard. Lugs shall have same capacity as incoming mains. Cable inter-connections shall be field installed.
- D. Protective devices shall be molded case circuit breakers.

1.06 SUBMITTALS

- A. Manufacturer shall provide copies of following documents to owner for review and evaluation in accordance with general requirements of Division 1 and Division 16:
 - 1. Product Data on specified product;
 - 2. Shop Drawings on specified product;
 - 3. Certified trip curves for each specified product;

1.07 PROJECT RECORD DOCUMENTS

- A. Maintain an up-to-date set of Contract documents. Note any and all revisions and deviations that are made during the course of the project.

1.08 OPERATION AND MAINTENANCE DATA

- A. Manufacturer shall provide copies of installation, operation and maintenance procedures to owner in accordance with general requirements of Division 1 and Division 16.
- B. Submit operation and maintenance data based on factory and field testing, operation and maintenance of specified product.

1.09 QUALIFICATIONS

- A. Manufacturer shall have specialized in the manufacture and assembly of lighting and appliance panelboards for 25 years.

- B. Lighting and appliance panelboards shall be listed and/or classified by Underwriters Laboratories in accordance with standards listed in Article 1.03 of this specification.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products in accordance with recommended practices in manufacturer's Installation and Maintenance Manuals.
- B. Deliver each lighting panelboard in individual shipping cases for ease of handling. Each panelboard shall be wrapped for protection.
- C. Inspect and report concealed damage to carrier within specified time.
- D. Store in a clean, dry space. Maintain factory protection or cover with heavy canvas or plastic to keep out dirt, water, construction debris, and traffic. (Heat enclosures to prevent condensation.)
- E. Handle in accordance with NEMA and manufacturer's written instructions to avoid damaging equipment, installed devices, and finish.

1.11 PROJECT CONDITIONS (SITE ENVIRONMENTAL CONDITIONS)

- A. Follow (standards) service conditions before, during and after panelboard installation.
- B. Lighting and appliance panelboards shall be located in well-ventilated areas, free from excess humidity, dust and dirt and away from hazardous materials. Ambient temperature of area will be between minus [30] and plus [40] degrees C. Indoor locations shall be protected to prevent moisture from entering enclosure.

1.12 SEQUENCING AND SCHEDULING

1.13 WARRANTY

- A. Manufacturer warrants equipment to be free from defects in materials and workmanship for 1 year from date of installation or 18 months from date of purchase, whichever occurs first.

1.14 MAINTENANCE SERVICE

- A. Furnish complete service and maintenance of lighting and appliance panelboards for 1 year from date of substantial completion.
- B. Include parts and labor.

1.15 EXTRA MATERIALS

- A. Provide spares as indicated in drawings.

1.16 FIELD MEASUREMENTS

- A. Make all necessary field measurements to verify that equipment shall fit in allocated space in full compliance with minimum required clearances specified in National Electrical Code.

PART II - PRODUCTS

2.02 EQUIPMENT

- A. Furnish Lighting Panelboards, as indicated in drawings.

2.03 COMPONENTS

Refer to Drawings for: actual layout and location of equipment and components; current ratings of devices, bus bars, and components; voltage ratings of devices, components and assemblies; and other required details.

A. RATINGS

1. Lighting and appliance panelboards shall be rated as indicated in drawings.
2. Maximum current ratings for mains, sub-feeds and branches, respectively, shall be specified in drawings.

B. ENCLOSURE

1. Boxes shall be a nominal 20 inches wide and 5.75 inches deep with wire bending space per National Electric Code. Electrical Contractor to Coordinate with Architect to insure that any walls which have recessed panels are located and a minimum of 6" deep prior to work.
2. Fronts shall be reinforced steel with concealed hinges and concealed trim adjusting screws. Trim clamps are unacceptable.
3. All door locks shall be metallic corbin latch bolt type or equivalent. All door locks shall be keyed for a single key.
4. Clear Lexan (or equal) directory card holders shall be permanently mounted on front door.
5. All panelboard series ratings shall be prominently displayed on dead front shield.
6. Interiors shall permit top or bottom incoming cables.

C. BUS BARS

1. Bus bars shall be phase sequenced, fully insulated and supported by high impact Noryl (or equal) interior base assemblies. Note that certain building

owners require the use of copper bussing in lieu of aluminum. Verify prior to bid and submit RFI to engineer if this appears to be an concern.

2. Bus bars shall be mechanically supported by zinc finished galvanized steel frames to prevent vibration and damage from short circuits.
3. Terminations shall be UL tested and listed and suitable for UL copper wire.
4. Provide [1] continuous bus bar per phase. Each bus bar shall have sequentially phased branch circuit connectors bolt-on branch circuit breakers. Bus bars shall be rated as indicated in drawings.
5. Split solid neutral bus shall be plated and located in main compartment for all incoming neutral cables to be same length.
6. Lugs shall be rated for 75 degree C terminations.
7. Main lugs for copper conductors shall be bolted lugs. Lugs for aluminum conductors shall be compression lugs.
8. Lug bodies shall bolt in place.

D. CIRCUIT BREAKERS

1. Molded case circuit breakers shall be bolt-on devices for 120/240V panels and shall be bolt-on for 277/480V panels.
2. All circuit breakers shall have thermal and magnetic trip elements in each pole.
3. Multi-pole breakers shall have internal common trip crossbars for simultaneous tripping of each pole.
4. Circuit breakers shall not be restricted to any mounting location due to physical size.
5. All branch breakers 15 to 100 amperes shall be able to be mounted in any panel position for twin or double mounting without space penalty. Sum of ratings for 2 such twin mounted devices shall not exceed 180 amperes.
6. Main and sub-feed circuit breakers may be vertically or horizontally mounted.
7. Branch breaker panelboard connections shall be copper to copper.
8. All panelboard terminations shall be rated as indicated in drawings.
9. All breakers shall have an over center mechanism and be quick make and quick break.
10. All breakers shall have handle trip indication and a trip indicator in window of circuit breaker housing.

11. Breaker handle and faceplate shall indicate rated ampacity.
 12. Circuit breaker escutcheon shall have standard ON/OFF markings.
 13. Main breakers shall be UL listed for use with: Shunt, Under Voltage, and Ground Fault Shunt Trips; Auxiliary and Alarm Switches; and Mechanical Lug Kits.
 14. Branch breakers shall be UL listed for use with: Shunt Trips, Auxiliary and Alarm Switches.
- E. Contactors shall be electronically held.

2.04 ACCESSORIES

- A. Contactor control relays
- B. Furnish nameplates for each device as indicated in drawings. Color schemes shall be as indicated on drawings.
- C. Provide Transient Voltage Surge Suppression system as specified in the TVSS section and on prints.

2.06 FINISH

- A. Boxes shall be corrosion resistant, zinc finish galvanized.
- B. Fronts shall be powder finish painted ANSI 61 gray.

PART III - EXECUTION

3.01 EXAMINATION

- A. Verify that panelboards are ready to install as shipped.
- B. Verify field measurements are as shown on Drawings.
- C. Verify that required utilities are available, in proper location and ready for use.
- D. Beginning of installation means installer accepts conditions.

3.02 LOCATION

3.03 INSTALLATION

Additional provisions and editing may be required for this part.

- A. Install per manufacturer's instructions.
- B. Install required safety labels.

3.04 FIELD QUALITY CONTROL

- A. Inspect installed panelboards for anchoring, alignment, grounding and physical damage.
- B. Check tightness of all accessible mechanical and electrical connections with calibrated torque wrench>. Minimum acceptable values are specified in manufacturer's instructions.
- C. Test each key interlock system for proper functioning.

3.05 ADJUSTING

- A. Adjust all circuit breakers, access doors, operating handles for free operation as described in manufacturer's instructions.

3.06 CLEANING

- A. Clean interiors of panels to remove construction debris, dirt, shipping materials.
- B. Repaint scratched or marred exterior surfaces to match original finish.

END OF SECTION

SECTION 26 27 26 - WIRING DEVICES

PART I - GENERAL

1.01 RELATED DOCUMENTS

- A. The General Supplementary Conditions, and General Requirements (Divisions 1), apply to the work specified in the Section.

1.02 SWITCHES, RECEPTACLES & COVERPLATES

- A. Provide switches, receptacles, and coverplates as indicated on the plans and as specified herein.
- B. All devices used by the contractor shall be UL approved and certified as meeting federal specifications as well as NEMA performance standards.

PART II - PRODUCTS

2.01 MATERIALS

- A. Materials provided under this Section shall be manufactured and tested under the following standards:
 - 1. NEMA WD-1 and WD-6 General Wiring Devices
 - 2. ANSI/UL 498 Electrical Attachment Plugs and Receptacles
 - 3. ANSI/UL 20 General Use Snap Switches
 - 4. NEC-adopted edition
- B. All devices provided shall be UL listed and labeled.
- C. All devices provided for use with plain steel coverplates shall be grey in color. Verify which projects require stainless covers prior to bid and submit RFI to the engineer if a discrepancy is noted. Non stainless cover plates to be of a standard color selected by the architect if not indicated on the drawings. Provide blank covers for all open boxes not utilized by contractor or owner by end of project.

2.01 SWITCHES

- A. Control switches for general lighting shall be quiet action, flush mounted, toggle handle type. Terminals shall be wire-wrap screw type. Switches shall be rated for 120-277 volt service, 20 amperes.
- B. Pilot light switches, where called for on the drawings, shall be the same as in "A" above complete with an internally lighted toggle. Toggle light shall be "LINE VOLTAGE".
- C. Switches shall be commercial specification grade, color as indicated on the drawings or as selected by the architect, and manufactured by P&S, Hubbell, or Leviton.

- D. Wall box dimmer switches shall be rated for the load served (if not indicated on the drawings) and fully compatible with the lamps or light fixtures provided.

2.02 RECEPTACLES

- A. Convenience receptacles, either single or duplex type, for general-purpose use shall be rated 125 volts, 20 ampere. They shall have wire-wrap screw type terminals, straight non-locking blade slots, and U-ground as by NEMA 5-20R configuration. They shall be constructed of two-piece molded housing with a wrap around type mounting strap and shall have double-wiping bronze contacts. Devices are to have finder grooves.
- B. Receptacles shall be of the color selected by the architect unless otherwise specifically noted in these specifications or on the drawings.
- C. Receptacles shall be commercial specification grade as manufactured by a major manufacturer and as follows:
 - 1. Duplex rated at 20 amps with finder grooves, back and side wired.
 - 2. Ground fault interrupter duplex rated at 20 amps with LED indicator of trip
- D. Receptacles for special purposes or of special construction shall be so stated and specifications given on the drawings.
- E. Provide tamper resistant devices in lieu of the above where required by NEC Article 406.12.

2.03 FLOOR OUTLETS

- A. Floor outlet receptacles shall include duplex outlets as installed in floor boxes as specified on the drawings unless otherwise noted. Finishes and surface activations by the architect.

2.04 COVERPLATES

- A. Coverplates shall be commercial specification grade. Plates shall match the device or combination of devices in question. See drawings for any notes on specialty plates.
- B. Telecommunications outlet coverplates provided by others unless indicated by contractor on drawings. The exception is blank covers which are to be provided by the contractor if not used by project conclusion.
- C. Covers for weatherproof outlets shall be gasketed and have flip covers for protected areas. Exposed devices to have extra heavy duty in-use covers per NEC 406.9(B).

PART III - EXECUTION

3.01 INSTALLATION

- A. Where more than one device is indicated at a location, the devices shall be mounted in combined sectional gang boxes and covered jointly by a common plate.
- B. Light switches shall be installed on the strike side of doors as actually installed; advise Architects where drawings contradict.
- C. The Architect reserves the right to relocate any wiring device up to a distance of ten feet from the location shown, before rough in, without additional cost.
- D. All junction boxes, outlet boxes, sectional switch boxes, utility boxes, etc. shall be covered with a finished coverplate unless specifically noted otherwise.
- E. Device plates shall be securely fastened using all required screws. All four (4) edges shall be in continuous contact with finished wall surfaces.
- F. Coverplates shall be mounted with vertical orientation, unless otherwise noted or shown on drawings.

END OF SECTION

SECTION 26 28 13 - FUSES

PART I - GENERAL

- 1.01** This section covers over current devices used for switchboard main sections, disconnect switches, etc.
- 1.02** The equipment furnished under this section shall be designed, manufactured, and tested according to the following standards:
- A. UL 977 Fused Power Circuit Devices
 - B. UL Requirements for Class L Current Limiting and High Interrupting Fuses.

PART II - PRODUCTS

2.01 FUSES

- A. Fuses protecting panelboards and transformers shall be current limiting type, Class J, 600 volt, with interrupting capacity of 200,000 amps RMS.
- B. Fuses protecting motor branch circuits shall be dual element type, 250 or 600 volt, with interrupting capacity of 200,000 amps RMS. They shall be sized for motor nameplate data per manufacturer's recommendations.
- C. Clips for fuses rated above 10,000 AIC shall be rejection types. Clips shall be provided in accordance with NEC 240-60 (B).

PART III - EXECUTION

- 3.01** Contractor shall insure that overcurrent devices are installed securely, properly and in accordance with standard industry practice. All bolt connections which secure the device to its supports shall be tight and secure. All terminal screws on lugs, etc. shall be tight and securely hold the conductor in place. Covers on enclosed devices shall be installed and left closed and secured by screws, clamp closures, or locks, as required.
- 3.02** All over-current protective devices shall be sized for the protected device, regardless of other considerations, such as the maximum size protective device that will physically fit in the subject unit.
- 3.04** The contractor shall provide the owner with a spare fuse cabinet complete with 1 set (minimum or 3) of spare fuses for each fuse size rating on the project. No more than 3 fuses of the same size rating are required.

END OF SECTION

SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART I - GENERAL

- 1.01** The term enclosed switch shall refer to fused switches, motor switches, twist-lock receptacles, and any other mechanical device designed to physically interrupt a circuit other than overcurrent protective devices.
- 1.02** Equipment furnished under this section shall be designed, manufactured, and tested in accordance with the following standards:
- A. NEMA KS1 Air Break Switches
 - B. ANSI-C33.64 Safety Standard for Enclosed Switches
 - C. UL-98 Safety Standards for Enclosed Switches
 - D. NEMA AB-1 Molded Case Circuit Breakers
 - E. UL 489 Branch Circuit and Service Circuit Breakers

PART II - PRODUCTS

- 2.01** Switches for use on circuits of voltages at 600 and below, shall be safety switches which:
- A. Are UL listed, E-4669
 - B. Are equipped with full cover interlocks so that they can not be opened with switch in the "ON" position, without manually overcoming the interlock as per the manufacturer's instructions.
 - C. Are equipped with quick-make, quick-break mechanisms
 - D. Are suitable for use as service entrance equipment when installed in accordance with the NEC
 - E. Housed in NEMA 1 enclosures on indoor dry applications and NEMA 3R enclosures on outdoor or damp applications
 - F. Have covers with handles, which can be padlocked, to secure the operating handle in the "OFF" position.
 - G. All disconnects to be heavy duty unless otherwise allowed to be general duty as noted on the drawings.
- 2.02** Switches shall be fusible types unless otherwise noted on the drawings.
- 2.01 CIRCUIT BREAKERS**
- A. Circuit breakers shall be molded case type, equipped with a quick-make, quick-break mechanism. Breakers shall be thermal-magnetic type and have automatic release by means of thermal elements in each phase.

- B. Breakers shall be rated for the application and be ambient temperature compensated.
- C. Breakers shall have silver alloy contacts, be equipped with heat-absorbing arc-chutes, and have straight in wiring UL listed lugs of the same rating as the breaker frame.
- D. Breaker ampacity shall be marked on the breaker case and be visible from the front when the breaker is installed.
- E. When tripped, the breaker handle or toggle shall be in a position between "ON" and "OFF" and shall not be capable of re-closing until the handle or toggle is moved to the "OFF" position first.
- F. Breakers with two or three poles shall have handles, which are factory made to trip all poles together. Field-made "tie" handles will not be permitted.
- G. Breakers shall match and be manufactured by the same company that manufactures the panelboard in which they are installed.
- H. Breakers shall have an interrupting capacity not less than the available fault current at the breaker. Unless otherwise specified or scheduled on the drawings, all breakers are to be series rated by the manufacturer for the available fault current indicated at the main on the drawings.
- I. All circuit breakers shall be bolt in type. Plug in breakers shall not be permitted.

2.02 GROUND FAULT CIRCUIT INTERRUPTER BREAKERS

Ground fault protective devices shall be constructed so as to have a sensor, which encircles all conductors, including the neutral. This sensor shall react to an unbalance of current in the conductors so as to trip the circuit-interrupting device and open the circuit. The device shall detect leaks of 5 milliamperes and open the circuit within 1-1/2 to 3 cycles of current.

PART III - EXECUTION

- 3.01** Disconnect switches are appurtenances to the project. Their locations, while required to meet the NEC, shall not cause any impediment to the project. Therefore, the contractor shall verify the location of all disconnect switches required by the project, prior to their installation. The installed location of any disconnect shall not impede the access to, or the working space around, any piece of equipment. Neither shall the location cause any loss of equipment performance or maintainability due to impeded air flows, blocked access panels or doors, etc. As disconnect switches are generally shown diagrammatically without dimensions, this requirement applies regardless of the location shown on the drawings. If there is any question as to the location of any disconnect, the contractor shall ask the engineer for clarification prior to installation. (While it may appear that a chosen location is appropriate, coordination with other trades must be made by the contractor to insure that other equipment to be installed at a later date will not cause the disconnect location to be problematic.) If any disconnect is found to be installed in a location which causes problems for the equipment as implied above, the disconnect shall be relocated at the sole expense of the contractor.

- 3.02** Switches shall be installed so as to be readily accessible with proper spacing in front per the NEC.
- 3.03** Switches shall be securely mounted on brackets, unistrut type rails, etc. Do not mount directly to masonry, sheetrock, etc., without proper support from structure or proper standoff brackets.
- 3.04** Bolts, terminal screws, etc., for switches shall be tightened to securely hold the devices, conductors, or pads to the points of termination or support. Loose connections shall not be permitted. Multiple hole pads or termination plates shall be installed with ALL bolts required so that there are no bolt holes unused.
- 3.05** All switches shall be identified per the corresponding sections of this specification.

END OF SECTION

SECTION 26 43 13 - TRANSIENT VOLTAGE SUPPRESSION FOR LOW VOLTAGE ELECTRICAL POWER SYSTEMS

PART I - GENERAL

1.01 SECTION INCLUDES

This section describes the materials and installation requirements for transient voltage surge suppressors (TVSS), including integrated TVSS in switchboards, distribution and branch panelboards and motor control centers for the protection of all AC electrical circuits.

1.02 STANDARDS

Most Recent Editions of:

- A. ANSI/IEEE C62.41, C62.45 & C62.48
- B. National Electric Code
- C. Underwriters Laboratories: UL1449 & UL1283

PART II – PRODUCT

2.01 TRANSIENT VOLTAGE SURGE SUPPRESSORS

- A. Surge Suppressor
 1. TVSS shall be Listed in accordance with UL 1283 and 1449 Second Edition.
 2. TVSS shall be marked with a short circuit current rating and shall not be installed at a point on the system where the available fault current is in excess of that rating. (This is Article 285.6 of the 2002 NEC and is the Engineer's requirement, regardless of whether or not the Authority Having Jurisdiction adopts the 2002 Code.)
 3. Integral TVSS shall be installed by, UL Listed by and shipped from the electrical distribution equipment manufacturer's factory. Field or aftermarket conversions are disallowed.
 4. TVSS shall provide surge current diversion paths for all modes of protection; L-N, L-G, N-G in WYE systems, and L-L, L-G in DELTA systems.
 5. TVSS shall be modular in design. Each module shall be fused with a surge rated fuse and incorporate a thermal cutout device. (Note: thermal cutouts protect against sustained overvoltages.)
 6. At Service Entrance, a UL approved disconnect switch shall be provided as a means of disconnect if a 60A breaker is not available.

7. TVSS shall meet or exceed the following criteria:
 - a. Maximum surge current capability (single pulse rated) per phase or per mode as indicated on the drawings.
 - b. UL 1449 Listed and Recognized Component Suppression Voltage Ratings shall not exceed the following:

<u>VOLTAGE</u>	<u>L-N</u>	<u>L-G</u>	<u>N-G</u>
208Y/120	400V	400V	400V

8. TVSS shall have a minimum EMI/RFI filtering of -50dB at 100kHz.
9. TVSS shall be provided with 1 set of NO/NC dry contacts.
10. Service entrance TVSS shall be provided with a surge counter.
11. TVSS shall have a five-year warranty. Warranty shall be the responsibility of the electrical distribution equipment manufacturer and shall be supported by their respective field service division.
12. If not shown on the drawings, surge suppression is to be provided on all service entrance gear but not at downstream panelboards. In all cases the drawings shall over ride this spec section in cases where TVSS is indicated on the drawings.
13. If not indicated on the drawings, surge suppression is to be located integral to the equipment and provided by the gear manufacturer internally mounted. Drawings shall override if TVSS is noted there.

2.02 MANUFACTURERS

Approved Vendors: as noted on drawings.

END OF SECTION

SECTION 26 50 00 LIGHTING FIXTURES

PART 1 - GENERAL

1.01 SCOPE

- A. The General Conditions and Supplementary Conditions and General Requirements (Division 1), apply to the work specified in this Section.
- B. All lighting fixtures together with required mounting hardware, lamps, and fixture supports shall be provided under this Section.

1.02 WORK INCLUDED

- A. Provide and install fixtures as shown on the drawings and in the schedules complete with all associated hardware, completely wired, controlled, and securely attached to building structure.
- B. Coordinate installation and connection of all lighting fixtures with the installation of the ceiling and with the work of all other trades. Provide a total system that is complete and finished in appearance.
- C. If any fixture type is shown on the plans but is not described in the Lighting Fixture Schedule, request a clarification from the Architect prior to bid. Provide a suitable fixture as directed. The absence of the description of a fixture, which is shown on the plans, does not relieve the contractor from the responsibility of supplying a fixture.
- D. Verify fixture numbers before placing an order. Furnish all fixtures with proper frames, fittings, and devices as required for installation in the ceiling systems being installed.
- E. All fixtures of the same type are to be supplied from the same manufacturer, identical in finish and appearance.

1.03 QUALITY ASSURANCE

- A. All fixtures supplied for this project shall be new, of good quality, and be approved by, and bear the label of, the applicable regulatory agency. All fixtures shall bear the UL label.
- B. All blemished, damaged, or unsatisfactory fixtures shall be replaced in a satisfactory manner as directed by the Architect.
- C. All fixtures shall meet all applicable local codes and regulations.
- D. The lighting designated for this project is based on design using the fixtures scheduled by manufacturer and catalog number. Alternate equals are generally accepted unless otherwise noted on the drawings. Equality shall be the sole determination of the Engineer. Note that the contractor is responsible for turning in shop drawings for review in a timely fashion which allows for review, rejection and resubmittal as needed. Delivery and lead times for fixtures are a contractor issue, with the contractor paying any liquidated damages for the project related to delayed fixture delivery due to rejected submittals, or if allowed by the architect providing temporary fixtures at his cost while waiting on delivery of the approved fixtures.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver lighting fixtures individually wrapped in factory-fabricated containers, unless noted otherwise.
- B. Any fixtures damaged are not to be installed. Return damaged fixtures to manufacturer, and replace them for installation.
- C. Fixtures shall be stored in clean, dry spaces, in their original shipping containers until ready for installation. They are to be protected while stored to prevent damage from all causes.

1.05 SUBMITTALS

- A. Refer to the appropriate sections in Division 1 for submittal format, and provide additionally as follows:
 - 1. Submit standard drawings or cut sheets for each fixture type noted in the Lighting Fixture Schedule.
 - 2. Drawings shall indicate name of project, fixture type, complete details of fixture, including manufacturer's name and complete catalog number including all aspects of fixture intended to be provided.

PART 2 - PRODUCTS

2.01 INTERIOR LUMINAIRES AND ACCESSORIES

- A. All LED light engines (combination of diodes, driver, heat sink, housing and optics), whether screw-in or hardwired, shall meet all of the following:
 - 1. The rated driver input wattage and total number of LEDs shall be published by the manufacturer for each fixture unit.
 - 2. The LED fixture manufacturer shall have been in business and producing LED fixtures for a minimum of 10 years.
 - 3. All LED fixtures shall be dimmable either by CAT 5 communications, or 0 to 10 volt controls.
 - 4. All LED fixtures shall be DLC listed.
 - 5. All LED fixtures shall be Energy Star listed.
 - 6. All LED fixtures shall be UL listed
- B. Housings shall be formed of cold rolled steel. Housings shall be painted after fabrication.
- C. LED units shall be manufactured for 50 to 100 thousand hours of operation. LEDs shall exhibit 99% lumen maintenance at 60,000 hours of operation.
- D. All drivers and internal components of all fixtures shall be accessible from the floor side of the installed fixture.

2.02 EXTERIOR LUMINAIRES AND ACCESSORIES

- A. Enclosures: Complete with gaskets to form weatherproof assembly.
- B. Exterior LED fixtures shall be manufactured and rated for outdoor installation.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install fixtures complete and ready to operate.
- B. Provide all required mounting hardware and accessories for the ceiling construction encountered. Fixture catalog numbers shown in the fixture schedule do not necessarily denote specific mounting accessories
- C. Luminaire Pole Bases: Size and constructed as indicated on Drawings. Project anchor bolts 2" minimum above base. Install poles on bases plumb; provide double nuts for adjustment. Grout around pole base.
- D. Use belt slings or non-chafing ropes to raise and set pre-finished luminaire poles.

3.02 REPLACEMENT

- A. Replace failed fixture components as required up to complete fixture for any fixture that is not operating properly at building construction completion prior to turn over to owner.

3.03 ADJUSTING AND CLEANING

- A. Align luminaires and clean lenses and diffusers at completion of Work. Clean paint splatters, dirt, and debris from installed luminaires. The interior of all recessed can lights to be wiped

clean of fingerprints prior to the final engineering punch list.

- B. For parking lot light poles, touch up luminaire and pole finishes as directed by the engineer in the punch list.

END OF SECTION

SECTION 27 05 00 - COMMON WORK RESULTS FOR COMMUNICATIONS

PART I - GENERAL

- 1.01** The Contractor shall furnish all material and equipment as specified below or on the drawings to provide a complete communications raceway system, left in readiness for installation of wiring by others.

PART II - PRODUCTS

2.01 BACKBOARDS

- A. Communications equipment backboards shall be provided where indicated on the drawings. Backboards shall be $\frac{3}{4}$ " thick plywood, grade B-C, fire-retardant, securely fastened to the wall. Boards shall be sized as shown on the drawings, but will generally be in units of 4 ft. by 8-ft. sheets.

2.02 CONDUITS

- A. Unless otherwise specified, conduits to outlet boxes will run from the outlet box up to nearest ceiling space and be stubbed and bushed at this location. Conduits shall be $\frac{3}{4}$ " unless otherwise noted on the drawings.
- B. Pull strings shall be provide in all conduits to be left empty.
- C. Service entrance conduits shall be PVC sized as shown on the drawings. Where conduits are to penetrate the slab, steel conduit long sweep elbows shall be used. No PVC slab penetrations will be allowed.
- D. Where required, or shown on the drawings, steel conduit sleeves shall be provided to allow access between floors, through walls, etc. All sleeves shall have reamed and bushed ends.

2.03 TELEPHONE GROUND CONDUCTOR

- A. Provide a $\frac{3}{4}$ " conduit at the service entrance backboard to the outside and a #6 insulated copper wire to serve as a ground for the telephone system. Leave wire with 6-ft. tail at backboard for use by the Communications Utility Company or the data installer. Terminate wire at either service ground or nearest building ground.

PART III - EXECUTION

3.01 SERVICE ENTRANCE CONDUITS

- A. Provide service entrance conduits per the drawings. Install conduits per the requirements of the local communications utility. Install conduit a minimum of 24 inches below finished grade. Provide pull lines in all conduits.

3.02 BACKBOARDS

- A. Install backboards flush with floor.
- B. Paint backboard to match walls of room in which it is installed.
- C. Provide a duplex receptacle outlet at backboard with circuit.

3.03 Provide all sleeves, floor or wall, with appropriate fire stopping if they penetrate a fire barrier.

END OF SECTION

DIVISION 31

EARTHWORK

SECTION 31 20 00

EARTHWORK

PART 1 - GENERAL

1.1 SCOPE

- A. This section includes earthwork and related operations, including but not limited to clearing and grubbing the construction site; dewatering; excavating all classes of material encountered; pumping, draining, and handling of water encountered in the excavations; handling, storage, transportation, and disposal of all excavated and unsuitable material; construction of fills and embankments; backfilling around structures and pipe; backfilling all trenches and pits; compacting; all sheeting, shoring, and bracing; preparation of subgrades; surfacing and grading; and any other similar, incidental, or appurtenant earthwork operation which may be necessary to properly complete the work.
- B. Provide all services, labor, materials, and equipment required for all earthwork and related operations necessary or convenient to the Contractor for furnishing a complete work as shown on the Drawings or specified in these Contract Documents.

1.2 GENERAL

- A. The elevations shown on the Drawings as existing are taken from the best available data and are intended to give reasonable, accurate information about the existing elevations. They are not precise, and the Contractor should satisfy himself as to the exact quantities of excavation and fill required.
- B. Perform earthwork operations in a safe and proper manner taking appropriate precautions against all hazards.
- C. Maintain in good condition at all times all excavated and fill areas for structures, trenches, fills, topsoil areas, embankments, and channels until final acceptance by the Owner. Repair all damage caused by erosion or other construction operations using material of the same type as the damaged materials.
- D. If soil borings are available for the area of this work, they will be on file at the Owner's address where they will be made available for review. This information is made available for such use as Contractor may choose to make of it in the preparation of his bid, but the Owner gives no guarantee, either expressed or implied, that it represents a true or complete cross section of all of the material to be encountered in performing the excavation and earthwork on this project.
- E. Earthwork operations within the rights-of-way of the State Department of Transportation, the County Road Department, and the respective cities shall be conducted in accordance with the requirements and provisions of the permits issued by those agencies for the construction within their respective rights-of-way. Such requirements and provisions, where applicable, shall take precedence over and supersede the provisions of these Specifications.

- F. Control grading to prevent water running into excavations. Obstruction of surface drainage shall be avoided and a means shall be provided whereby storm water can be uninterrupted in existing gutters, other surface drains, or temporary drains. Material for backfill or for protection of excavation in public roads from surface drainage shall be neatly placed and kept shaped so as to cause the least possible interference with public travel. Free access must be provided to all fire hydrants, valves, meters, and private drives.
- G. No classification of excavated materials will be made. Excavation and trenching work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the contract work, regardless of the type, character, composition, or condition thereof.
- H. Tests for compaction and density shall be conducted by the Engineer or by an independent testing laboratory selected by him. Costs of compaction tests performed by an independent testing laboratory shall be paid for directly by the Owner and not as a part of this contract. Make all necessary excavations and supply any samples of materials necessary for conducting compaction and density tests. Pay the cost of all retests made necessary by the failure of materials to conform to the requirements of these Contract Documents.
- I. All earthwork operations shall comply with the requirements of OSHA Construction Standards, Part 1926, Subpart P, "Excavations, Trenching, and Shoring," and Subpart O, "Motor Vehicles, Mechanized Equipment, and Marine Operations," and shall be conducted in a manner acceptable to the Engineer.
- J. It is understood and agreed that a thorough investigation by the Contractor has been made of the surface and subsurface conditions of the site and any special construction problems which might arise as a result of nearby watercourses and floodplains, particularly in areas where construction activities may encounter water-bearing sands and gravels or limestone solution channels. Provide all services, labor, equipment, and materials necessary or convenient for completing the work.

PART 2 - EXECUTION

2.1 INITIAL SITE PREPARATION

- A. Preparatory to beginning construction operations, remove from the site all vegetative growth, trees, brush, stumps, roots, debris, and any other objectionable matter, including fences, buildings, and other structures shown on the Drawings in the construction areas which are designated for removal or which, if left in place, would interfere with the proper performance or completion of the contemplated work, would impair its subsequent use, or would form obstructions therein.
- B. Grub and remove stumps and roots to a depth not less than 5 feet below grade. Fill all holes or cavities which extend below the subgrade elevation of the proposed work with compacted layers of crushed rock or earth backfill conforming to the requirements specified here for backfill. Do not incorporate organic material from clearing operations in excavation backfill or embankment material.
- C. Exercise special precautions for the protection and preservation of trees, cultivated shrubs, sod, fences, buildings, and other structures located in the construction area but

not within designated clearing limits as shown on the Drawings or within the limits of embankments, excavations, or proposed structures. Repair or replace any of the aforementioned items damaged by Contractor's operation or construction activities.

- D. Remove and dispose of any excess material resulting from clearing or site preparation operations. Dispose of such materials in a manner acceptable to the Engineer and at an approved location where such materials can be lawfully placed.

2.2 DEWATERING

- A. Provide and maintain at all times during construction ample means and devices with which to promptly remove and properly dispose of all water from any source entering the excavations or other parts of the work. Dewatering shall be accomplished by methods which will ensure a dry excavation and preservation of the final lines and grades of the bottoms of excavations. Methods of dewatering may include sump pumps, well points, deep wells, or other suitable methods which do not damage or weaken structures, foundations, or subgrades. Shallow excavations may be dewatered using open ditches, provided such ditches are kept open and free-draining at all times. The actual dewatering methods used shall be acceptable to the Engineer.
- B. Do not place concrete or mortar in water nor allow water to rise over newly placed concrete or mortar for at least 24 hours after placement, unless specifically authorized by the Engineer. No concrete structure shall be exposed to unequal hydrostatic forces until the concrete has reached its specified 28-day strength. Do not allow water to rise above bedding during pipe-laying operations. Exercise care to prevent damage to pipelines or structures resulting from flotation, undermining, or scour. Dewatering operations shall commence when ground or surface water is first encountered and shall be continuous until water can safely be allowed to rise in accordance with the provisions of this section. Protect excavations from the entrance of surface water to the extent possible by the use of dikes and/or covers.
- C. Standby pumping equipment shall be on the jobsite. A minimum of 1 standby unit (a minimum of 1 for each 10 in the event well points are used) shall be available for immediate installation should any pumping unit fail. The design and installation of well points or deep wells shall be suitable for the accomplishment of the work. Submit drawings or diagrams on proposed well point or deep well dewatering systems to the Engineer for review.
- D. If foundation soils are disturbed or loosened by the upward seepage of water or an uncontrolled flow of water, excavate and replace the affected areas with crushed rock at no cost to the Owner.
- E. Dispose of the water from the work in a suitable manner without damage to adjacent property. Conveyance of the water shall not interfere with traffic flow or treatment facilities operation. Do not drain water into work built or under construction without prior consent of the Engineer. The Contractor will be held responsible for the condition of any pipe or conduit which he may use for drainage purposes, and all such pipes or conduits shall be left clean and free of sediment.
- F. Provide sedimentation and desilting basins as necessary or when directed by the Engineer to prevent the entrance of excessive or injurious amounts of sand and silt from surface runoff or dewatering operations into storm drains or receiving waters. The system used for desanding or desilting the water shall be a baffled structure and

shall provide not less than 5 minutes detention time and shall be designed to have a "flow-through" velocity not exceeding 0.2 foot per second at the anticipated peak flow. The method of desanding or desilting and the point of disposal shall be subject to the approval of the Engineer.

- G. Dispose of water safely and in accordance with applicable Environmental Protection Agency, U.S. Army Corps of Engineers, and State Water Quality Control Division standards and permits.

2.3 SHEETING, SHORING, AND BRACING

- A. The sides of all excavations shall be sufficiently sheeted, shored, and braced as necessary to prevent slides, cave-ins, settlement, or movement of the banks; to maintain the excavation clear of all obstructions; and to provide safe working conditions. Wood or steel sheeting shall be used in wet, saturated, or flowing ground. All sheeting, shoring, and bracing shall have sufficient strength and rigidity to withstand the pressure exerted and to maintain shape and position under all circumstances.
- B. Correctly assessing the need for sheeting, analyzing the stresses induced, and maintaining regulatory compliances shall be totally the responsibility of the Contractor. Since the Engineer does not dictate or determine the Contractor's sequence or limits of excavation, the Engineer assumes no responsibility for sheeting and shoring. The Contractor must employ or otherwise provide for adequate professional structural and geotechnical engineering supervision to assess the need for sheeting and shoring and design same. Results of sheeting and shoring analysis and design shall be submitted to the Engineer on request.
- C. Excavations adjacent to existing or proposed buildings and structures, or in paved streets or alleys, shall be sheeted, shored, and braced adequately to prevent undermining beneath or subsequent settlement of such structures or pavements. Underpinning of adjacent structures shall be done when necessary to maintain structures in safe condition. Any damage to structures or pavements occurring through settlements, water or earth pressures, slides, caves, or other causes due to failure or lack of sheeting or bracing, or improper bracing or occurring through negligence or fault of the Contractor in any other manner shall be repaired by the Contractor at his own expense.
- D. Sheeting, shoring, or bracing materials shall not be left in place unless otherwise specified or shown on the Drawings or ordered by the Engineer in writing. Such materials shall be removed in such manner that no danger or damage will occur to new or existing structures or property, public or private, and so that cave-ins or slides will not take place. Trench sheeting shall be left in place until backfill has been brought to a level 12 inches above the top of the pipe. It shall then be cut off and the upper portion removed. Sheeting for structures shall be left in place until backfill has been brought to a level 12 inches above the top of the bottom footing. It shall then be cut off and the upper portion removed.
- E. All holes and voids left in the work by the removal of sheeting, shoring, or bracing shall be filled and thoroughly compacted.

2.4 EXCAVATION

A. General

1. Excavation shall include the removal of all material from an area necessary for the construction of a pipeline or structure. Excavations shall provide adequate working space and clearances for the work to be performed therein.
2. All material excavated below the bottom of concrete walls, footings, and foundations shall be replaced, by and at the expense of the Contractor, with Class B concrete to the lines and grades shown on the Drawings, except where otherwise shown on the Drawings, specified herein, or authorized by the Engineer.
3. Where quicksand, soft clay, spongy or swampy earth, or other materials unsuitable for subgrade or foundation purposes are encountered below the excavation limits, they shall be removed and disposed of to the level of suitable material. Areas so excavated shall be backfilled with Class B concrete or with compacted layers of crushed rock, sand, or other approved material conforming to the requirements specified herein for backfill to the lines and grades shown on the Drawings.
4. Place barriers at each end of all excavation and at such places as may be necessary along excavations to warn all pedestrian and vehicular traffic of such excavations. Place lights along excavations from sunset each day to sunrise of the next day until the excavations are backfilled. Barricade all excavations in such a manner as to prevent persons from falling or walking into any excavation.

B. Rock Excavation

1. Rock encountered in the process of excavation for structures shall be uncovered and stripped of all loose materials over the entire limits of excavation. Rock encountered for removal in a trench section shall be uncovered for a distance of not less than 50 feet.
2. Excavate rock and large boulders in trenches over the horizontal limits of excavation and to depths as shown on the Drawings.
3. Backfill the space below grade for pipelines to the proper grade with compacted layers of crushed rock or sand conforming to the requirements specified herein for backfill. Where pipe sewers are constructed on concrete cradles, excavate rock to the bottom of the cradle as shown on the Drawings.
4. Excavate rock under structures to lines and grades shown on the Drawings. Unless specified otherwise, where rock excavation has been carried below grade, the Contractor shall backfill to grade with Class B concrete at his own expense.
5. Where rock foundation is obtained at grade for over 50 percent of the area of any one structure, the portion of the foundation that is not rock shall be excavated below grade to reach a satisfactory foundation of rock. The portion below grade shall be backfilled with Class B concrete.
6. Where rock foundation is obtained at grade for less than 50 percent of any one structure and satisfactory rock cannot be found over the remaining area by

reasonable additional excavation, the rock shall be removed for a depth of 12 inches below grade and the space below grade shall be backfilled to the proper grade with compacted layers of crushed rock conforming to the requirements specified herein for backfill.

7. Drilling and blasting operations shall be conducted with due regard for the safety of persons and property in the vicinity and in strict conformity with requirements of all ordinances, laws, and regulations governing blasting and the use of explosives. Conduct rock excavation near existing pipelines or other structures with the utmost care to avoid damage. Promptly repair injury or damage to other structures and properties to the satisfaction of the Owner by the Contractor at his own expense. The Contractor is advised to hire qualified consultants to perform a "preblast survey" in area where damage could occur due to blasting; all expenses for such survey must be borne by the Contractor, and no separate payment for same will be made.
8. Complete rock excavation for all structures and adjacent trenches under this Contract and any other rock excavation directed by the Engineer before construction of any structure is started in the vicinity.

C. Borrow Excavation

1. Wherever the backfill of excavated areas or the placement of embankments or other fills requires specified material not available at the site or material in excess of suitable material available from the authorized excavations, such materials shall be obtained from other sources. This may require the opening of borrow pits at points not immediately accessible from the work. In such cases make suitable arrangements with the property owner and pay all costs incident to the borrowed material including royalties, if any, for the use of the material. Before a borrow pit is opened, the quality and suitability of the material to be obtained therefrom shall be approved by the Engineer.
2. Borrow pits shall be cleared, grubbed, and finish-graded in accordance with the requirements specified herein.

- D. Roadway Excavation. Roadway excavation shall consist of excavation for roadways and parking areas in conformity with lines, grades, cross sections, and dimensions shown on the Drawings. After shaping to line, grade, and cross section, the subgrade shall be rolled until compacted to a depth of at least 6 inches to 100 percent of the maximum density at optimum water content as determined by AASHTO T99, Method A. This operation shall include any reshaping and wetting required to obtain proper compaction. All soft or otherwise unsuitable material shall be removed and replaced with suitable material.

E. Trench Excavation

1. Trench excavation shall consist of the removal of materials necessary for the construction of water, sewer, and other pipelines and all appurtenant facilities including manholes, inlets, outlets, headwalls, collars, concrete saddles, piers, and pipe protection called for on the Drawings.
2. Excavation for pipelines shall be made in open cut unless shown otherwise on the Drawings. Trenches shall be cut true to the lines and grades shown on the

Drawings or established by the Engineer on the ground. The banks of trenches shall be cut in vertical, parallel planes equidistant from the pipe centerline. From an elevation 12 inches above the top of the pipe to the bottom of the trench, the horizontal distances between vertical planes for different sizes of pipe shall not exceed those shown on the Drawings. When sheeting is used, the width of the trench shall be considered as the distance between the inside faces of the sheeting. The bottom of the trench shall be cut carefully to the required grade of the pipe except where bedding materials or cradles are shown, in which case the excavation shall extend to the bottom of the bedding or cradles as shown on the Drawings. Minimum pipe cover shall be as shown on the Drawings or specified in these Contract Documents.

3. The use of a motor-powered trenching machine will be permitted, but full responsibility for the preservation, replacement, and/or repair of damage to any existing utility services and private property shall rest with the Contractor.
4. Bell holes for bell and spigot pipe and/or mechanical joint pipe shall be excavated at proper intervals so the barrel of the pipe will rest for its entire length upon the bottom of the trench. Bell holes shall be large enough to permit proper installation of all joints in the pipe. Bell holes shall not be excavated more than 10 joints ahead of pipe laying. No part of any bell or coupling shall be in contact with the trench bottom, trench walls, or granular embedment when the pipe is jointed.
5. Excavation for manholes, outlets, collars, saddles, piers, and other pipeline structures shall conform to the additional requirements specified herein for structural excavation.
6. Pipe trenches shall not be excavated more than 400 feet in advance of pipe laying and all work shall be performed to cause the least possible inconvenience to the public. Adequate temporary bridges or crossings shall be constructed and maintained where required to permit uninterrupted vehicular and pedestrian traffic.
7. Wherever pipe trenches are excavated below the elevation shown on the Drawings, the Contractor, at his own expense, shall fill the void thus made at the proper grade with Class B concrete or with compacted layers of crushed rock or sand conforming to the requirements specified herein for backfill, unless otherwise specified herein or shown on the Drawings.
8. In all cases where materials are deposited along open trenches, they shall be placed so that no damage will result to the work and/or adjacent property in case of rain or other surface wash.

F. Structural Excavation

1. Structural excavation shall consist of the removal of all materials necessary for the construction of structures, including tanks, foundations, footings, wet wells, dry wells, box culverts, flumes, channels, buildings, and other miscellaneous structures.
2. The bottoms of structural excavations shall be true to the lines and grades shown on the Drawings. Faces of excavations shall not be undercut for extended footings. Except as provided herein for excavation of unsuitable material or rock, where the excavation is carried below the grade elevation shown on the Drawings,

the Contractor shall backfill the void thus made to the proper grade with Class B concrete at his own expense.

2.5 BACKFILLING

A. Materials for backfilling shall conform to the following requirements:

1. Select Earth Backfill: Fine, sound, loose earth containing optimum moisture content for compaction to 90 percent of maximum density, free from all wood, vegetable matter, debris, and other objectionable material, and having scattered clods, stones, or broken concrete less than 2 inches in maximum dimension except that the maximum particle size shall be ½ inch when used with PVC or other flexible thermoplastic pipe.
2. Common Earth Backfill: Sound, loose earth containing optimum moisture content for compaction to 90 percent of maximum density, free from all wood, vegetable matter, debris, and other objectionable material, and having scattered clods, stones, or broken concrete and pavement less than 6 inches in maximum dimension.
3. Sand: Natural or imported sand conforming to ASTM D 1073.
4. Crushed Rock: Crushed rock conforming to Section 800, Size 7 (½-inch to No. 4) of the Georgia Department of Transportation's Standard Specifications - Construction of Transportation Systems (latest edition).
5. Class B Concrete: Class B concrete as specified elsewhere in these Specifications or on the Drawings.

B. General

1. Earth backfill shall be compacted to not less than 90 percent of the maximum density as determined by ASTM D 698 at a moisture content within 3 percentage points, unless otherwise specified herein. Crushed stone and sand shall be compacted to not less than 83 percent of the solid volume density as determined from the bulk specific gravity by AASHTO T-84 and T-85 and the dry weight of the aggregate.
2. Material that is too dry for adequate compaction shall receive a prior admix of sufficient water to secure optimum moisture content. Material having excessive water content shall not be placed at any time.
3. Backfill material required to be compacted shall be placed in horizontal layers not to exceed 6 inches in thickness (before compaction) and compacted in place by ramming, tamping, or rolling, unless otherwise specified herein. Compaction shall be accomplished by power-driven tools and machinery wherever possible. Compaction and consolidation of sand and crushed stone backfill shall be accomplished using vibrating equipment in a manner acceptable to the Engineer.

C. Backfilling Trenches

1. The backfilling of sewers, water, and other pipeline trenches shall be started immediately after the construction of same has been inspected and approved by

the Engineer. Select backfill or crushed stone as shown on the Drawings shall be placed in the trench under and on each side of the pipe in 6-inch layers for the full width of the trench and thoroughly and uniformly compacted by ramming and/or tamping to a minimum of 90 percent of the maximum density determined as specified herein. Select earth backfilling or crushed stone as shown on the Drawings shall start above the pipe bedding. Sufficient select backfill or crushed stone as shown on the Drawings shall be placed around the pipe and compacted to provide a cover of not less than 12 inches over the top of the pipe. Mechanical compactors or tampers shall not be used within 12 inches of pipe. Compaction in this area shall be accomplished by hand methods. Sand or specified crushed stone bedding material shall be substituted for select earth backfill when the pipe material is other than ductile iron or when crushed stone trench backfill is required. Backfilling shall proceed simultaneously on both sides of the pipe to prevent lateral displacement.

2. Caution shall be used during backfill operations for PVC or other flexible thermoplastic pipe to prevent pipe deformation. PVC or other flexible thermoplastic pipe shall not be subjected to roller or wheel loads until a minimum of 30 inches of backfill has been placed over the top of the pipe. A hydrohammer shall NOT be used until a minimum depth of 48 inches of backfill has been placed over the top of the pipe.
3. Backfilling of PVC pressure pipe or other flexible thermoplastic pipe (water pipe) shall be as described in Paragraph 1 above.
4. In streets and alleys, across sidewalks and driveways, and at any other places subject to vehicular traffic or other superimposed loads, crushed rock backfill shall be placed and compacted in 12-inch layers from the bottom of the trench upward for the full depth of the trench. Crushed rock backfill shall be compacted by use of a hydrohammer or approved vibratory compactor. The top 6 inches of the finished subgrade shall be equal to not less than 100 percent of the maximum density as determined by ASTM D 698 at a moisture content of within 3 percentage points of optimum. When field tests show failure to meet the density requirement, the subgrade shall be loosened by disking, harrowing, or other approved methods to a depth of not less than 6 inches, then reshaped and recompacted as indicated in this paragraph.
5. Trenches under concrete slabs and footings of structures shall be completely backfilled with compacted sand or crushed rock or filled with Class B concrete as shown on the Drawings.
6. All backfilling shall be done in such a manner that the pipe or structure over or against which it is being placed will not be disturbed or injured. Any pipe or structure injured, damaged, or moved from its proper line or grade during backfilling operations shall be removed and repaired to the satisfaction of the Engineer and then rebackfilled.

D. Backfilling Around Structures

1. Backfilling around structures shall consist of common earth backfill placed in 6-inch layers and compacted by tamping to a minimum of 90 percent of the maximum density determined as specified herein for the full depth of the excavation from the bottom to the finished grade. No backfill shall be placed

against concrete structures until the concrete has reached its specified 28-day compressive strength. Where practical, compaction of structural backfill shall be accomplished by power-driven tamping equipment.

2. Where crushed rock mats under slabs and foundations are called for on the Drawings, excavate below grade to the depth of the crushed rock mat as shown on the Drawings and install a compacted crushed rock bed. This shall be finished to a true line or plane and even with the subgrade of the concrete foundations, piers, footings, or slabs. Before placing any crushed stone, remove all loose earth or debris. This crushed rock mat shall extend 12 inches beyond all slabs and foundations or to edges of sheet piling.
3. Crushed rock mats 12 inches or less in thickness shall be constructed of compacted layers of crushed rock conforming to Section 800, Size 7 (½-inch to No. 4) of the Georgia Department of Transportation's Standard Specifications - Construction of Transportation Systems (latest edition).
4. Crushed rock mats of thickness greater than 12 inches shall have the top 12 inches constructed of compacted layers of crushed rock as specified above. That portion below the top 12 inches shall be constructed of compacted layers of crushed rock conforming to Section 800, Georgia Department of Transportation Specifications, with a modified gradation of 6 inches to dust as received from the crusher.
5. The use of earth backfill to support footings, foundations, and structures shall not be permitted, unless otherwise shown on the Drawings.

2.6 FILLS AND EMBANKMENTS

- A. Fills and embankments shall consist of all earth fills except backfills in trenches or around structures. Unless special material is specified or shown on the Drawings, material for fills and embankments shall consist of excavated material from structures or of a mixture of such excavated materials and materials borrowed from other sources by the Contractor. All material used for fills and embankments shall be free from wood, vegetable matter, debris, soft or spongy earth or clay, large rock, or other objectionable material and shall be acceptable to the Engineer.
- B. Materials shall be placed in the fill or embankment in successive layers 8 inches or less in thickness before compaction, each layer being approximately horizontal and extending to the full limit of the required cross section, and shall be compacted over the entire surface to not less than 95 percent of the maximum density as determined by ASTM D 698 at a moisture content of within 3 percentage points of optimum. The process shall be repeated for each layer of material until the fill or embankment conforms to the plan lines, grades, and cross sections. The degree of compaction and moisture content required, the method of tamping, and the equipment used shall be approved by the Engineer.
- C. The area over which the fill or embankment is to be constructed shall first be cleared of all vegetation, debris, and other objectionable material and, if the ground is in a loose, uncompacted condition, it shall be compacted to a minimum 95 percent of maximum density determined as specified herein.

- D. No material shall be placed beyond the sloping lines of embankment unless so ordered by the Engineer. Material allowed to be placed beyond the lines of embankment shown on the Drawings will be compacted as required above unless otherwise authorized by the Engineer.
- E. Material for embankments or roadway fills shall be placed in 6-inch maximum lifts and shall be compacted by rolling with power rollers weighing not less than 10 tons, with sheepsfoot rollers, with vibrating rollers, or with pneumatic tire rollers, as required to accomplish the work. While and as each layer is deposited, water shall be applied in sufficient amount to ensure optimum moisture to secure the compaction specified.
- F. The use of trucks, carryalls, scrapers, tractors, or other heavy hauling equipment shall not be considered as rolling in lieu of rollers, but the traffic of such hauling equipment shall be distributed over the fill in such a manner as to make the use of the compaction afforded thereby as an addition to compaction by the use of rollers.
- G. Wherever a trench passes through a fill or embankment, the fill or embankment material shall be placed as compacted to an elevation 12 inches above the top of the pipe before the trench is excavated.
- H. Subgrades for all roadbeds shall meet the requirements of Subsection 2.5 C.4.

2.7 DISPOSAL OF WASTE AND UNSUITABLE MATERIALS

- A. All materials removed by excavation which are suitable for the purpose shall be used to the extent possible for backfilling pipe trenches, foundations, and footings and for making embankment fills or for such other purposes as may be shown on the Drawings. All materials not used for such purposes shall be considered as waste materials and the disposal thereof shall be made in a manner and at locations approved by the Engineer.
- B. Waste materials shall be spread in uniform layers and neatly leveled and shaped. Spoil banks shall be provided with sufficient and adequate openings to permit surface drainage of adjacent lands.
- C. Unsuitable materials, consisting of wood, vegetable matter, debris, soft or spongy clay, peat, and other objectionable material so designated by the Engineer, shall be removed from the work site and disposed of in a manner and at a location approved by the Engineer.
- D. No unsuitable or waste material shall be dumped on private property unless written permission is furnished by the owner of the property and unless a dumping permit is issued from the local jurisdiction.
- E. The Contractor is responsible for any and all permits and other requirements, such as sediment runoff control necessitated by the disposal of waste material.

2.8 FINAL GRADING

- A. After other earthwork operations have been completed, the sites of all structures, roads, and embankments shall be graded within the limits and to the elevations shown on the Drawings. Grading operations shall be so conducted that materials shall not be removed or loosened beyond the required limits. The finished surfaces shall be left in

smooth and uniform planes such as are normally obtainable from the use of hand tools. If Contractor is able to obtain the required degree of evenness by means of mechanical equipment, the use of hand labor methods will not be required. Neatly trim and finish slopes and ditches to slopes shown on the Drawings unless otherwise approved by the Engineer.

- B. Grade and dress all finished ground surfaces to present a surface varying not more than plus or minus 0.10 foot as regards local humps or depressions, unless otherwise specified or shown on the Drawings, and shall be acceptable to the Engineer.

2.9 TOPSOIL

- A. All areas to be planted with trees or shrubs, or with sprigged grass as shown on the plans, shall be prepared by grading to a smooth, even surface to a level 4 inches below the elevation of the finished grade shown on the Drawings. It shall then be brought to a neat and finished grade by the addition of 4 inches of approved topsoil.
- B. Topsoil removed from the construction area may be stockpiled and reused or topsoil may be obtained from approved borrow areas. If obtained from borrow areas, make suitable arrangements with the property owner and pay all costs incident to the borrowed material including royalties.

2.10 SETTLEMENT

- A. The Contractor shall be responsible for all settlement of backfill, fills, and embankments which may occur within 1 year after final acceptance of the work by the Owner.
- B. Make, or cause to be made, all repairs or replacements made necessary by settlement within 30 days after receipt of written notice from the Engineer or Owner.

2.11 DUST CONTROL

- A. The Contractor shall use all means necessary to control dust on and near the work and all off-site borrow areas.
- B. The Contractor shall thoroughly moisten all surfaces as required to prevent dust being a nuisance to the public, neighbors and concurrent performance of work on the site.

END OF SECTION

SECTION 31 25 00

SLOPE PROTECTION AND EROSION CONTROL

PART 1 - GENERAL

1.1 SCOPE

- A. This section shall consist of temporary control measures as shown in the plans or directed by the Engineer during the life of the Contract to control erosion and water pollution through the use of berms, dikes, dams, sediment basins, fiber mats, netting, mulches, grasses, slope drains, temporary silt fences, and other control devices.
- B. The temporary pollution control provisions contained herein shall be coordinated with the permanent erosion control features to assure economical, effective, and continuous erosion control throughout the construction and post-construction periods.
- C. All designs will conform to and all work will be performed in accordance with the standards and specifications of the publication entitled "Manual for Erosion and Sediment Control in Georgia."
- D. Implementation and Maintenance. Contractor shall designate one individual to be responsible for implementation and maintenance of erosion and sedimentation controls on 24-hour, everyday basis. Contractor shall furnish the individual's name, address, and 24-hour telephone number. Contractor shall update contact information as necessary.

PART 2 - PRODUCTS

2.1 TEMPORARY BERMS

- A. A temporary berm is constructed of compacted soil, with or without a shallow ditch, at the top of fill slopes or transverse to centerline on fills.
- B. These berms are used temporarily at the top of newly constructed slopes to prevent excessive erosion until permanent controls are installed or slopes stabilized.

2.2 TEMPORARY SLOPE DRAINS

- A. A temporary slope drain is a facility consisting of stone gutters, fiber mats, plastic sheets, concrete or asphalt gutters, half-round pipe, metal pipe, plastic pipe, sod, or other material acceptable to the Engineer that may be used to carry water down slopes to reduce erosion.

2.3 SEDIMENT STRUCTURES

- A. Sediment basins, ponds, and traps are prepared storage areas constructed to trap and store sediment from erodible areas in order to protect properties and stream channels below the construction areas from excessive siltation.

2.4 CHECK DAMS

- A. Check dams are barriers composed of logs and poles, large stones, sand bags, or other materials placed across a natural or constructed drainway.
- B. Stone check dams shall not be utilized where the drainage area exceeds 50 acres. Log and pole structures shall not be used where the drainage area exceeds five acres.

2.5 TEMPORARY SEEDING AND MULCHING

- A. Temporary seeding and mulching are measures consisting of seeding, mulching, fertilizing, and matting utilized to reduce erosion. All cut and fill slopes, including waste sites and borrow pits, shall be seeded when and where necessary to eliminate erosion.

2.6 BRUSH BARRIERS

- A. Brush barriers shall consist of brush, tree trimmings, shrubs, plants, and other approved refuse from the clearing and grubbing operation.
- B. Brush barriers are placed on natural ground at the bottom of fill slopes, where the most likely erodible areas are located, to restrain sedimentation particles.

2.7 BALED HAY OR STRAW CHECKS

- A. Baled hay or straw erosion checks are temporary measures to control erosion and prevent siltation. Bales shall be either hay or straw containing 5 cubic feet or more of material.
- B. Baled hay or straw checks shall be used where the existing ground slopes toward or away from the embankment along the toe of slopes, in ditches, or other areas where siltation, erosion, or water run-off is a problem.

2.8 TEMPORARY SILT FENCES

- A. Silt fences shall be Type C utilizing woven wire reinforcement attached to posts with filter cloth composed of plastic filter fabric attached to the upstream side of the fence to retain the suspended silt particles in the run-off water. Fence and fabric shall meet the minimum standards set forth in the Department of Transportation, State of Georgia, Standard Specification, current edition.

PART 3 - EXECUTION

3.1 PRECONSTRUCTION CONFERENCE

- A. At the Preconstruction Conference, submit for acceptance the schedule for accomplishment of temporary and permanent erosion control work as applicable for clearing and grubbing, grading, bridges and other structures at watercourses, construction, and paving. Also submit for acceptance the proposed method of erosion control on haul roads and borrow pits and the plan for disposal of waste materials. No work shall be started until the erosion control schedules and methods of operation have been accepted by the Engineer.

3.2 CONSTRUCTION REQUIREMENTS

- A. The Engineer has the authority to limit the surface area of erodible earth material exposed by clearing and grubbing, and the surface of erodible earth material exposed by excavation, borrow, and fill operations and to direct the Contractor to provide immediate permanent or temporary pollution control measures to prevent contamination of adjacent streams or other watercourses, lakes, ponds, or other water impoundment. Such work may involve the construction of temporary berms, dikes, dams, sediment basins, or slope drains, and the use of temporary mulches, mats, seeding, or other control devices or methods as necessary to control erosion. Cut and fill slopes shall be seeded and mulched as the excavation proceeds to the extent directed by the Engineer.
- B. Incorporate all permanent erosion control features into the project at the earliest practicable time as outlined in the accepted schedule. Temporary pollution control measures shall be used to correct conditions that develop during construction that were not foreseen during the design stage; that are needed prior to installation of permanent pollution control features; or that are needed temporarily to control erosion that develops during normal construction practices, but are not associated with permanent control features on the project.
- C. Where erosion is likely to be a problem, clearing and grubbing operations should be so scheduled and performed that grading operations and permanent erosion control features can follow immediately thereafter if the project conditions permit; otherwise, erosion control measures may be required between successive construction stages. Preconstruction vegetation ground cover shall not be destroyed, removed, or disturbed more than 20 calendar days prior to grading or earth moving unless approval is granted otherwise.
- D. The Engineer will limit the area of excavation, borrow, and embankment operations in progress commensurate with the Contractor's capability and progress to keep the finish grading, mulching, seeding, and other such permanent pollution control measures current in accordance with the accepted schedule. Should seasonal limitations make such coordination unrealistic, temporary erosion control measures shall be taken immediately to the extent feasible and justified.
- E. Under no conditions shall the amount of surface area or erodible earth material exposed at one time by excavation or fill within the project area exceed 50,000 square feet without prior approval by the Engineer.
- F. The Engineer may increase or decrease the amount of surface area of erodible earth material to be exposed at one time by clearing and grubbing, excavation, and borrow and fill operations as determined by his analysis of project conditions.
- G. In the event of conflict between these requirements and pollution control laws, rules, or regulations of other federal, state, or local agencies, the more restrictive laws, rules, or regulations shall apply.

3.3 CONSTRUCTION MANAGEMENT TECHNIQUES

- A. Clearing and grubbing must be held to the minimum necessary for grading and equipment operation.
- B. Construction must be sequenced to minimize the exposure time of cleared surface area.
- C. Construction must be staged or phased for large projects. Areas of one phase must be stabilized before another phase can be initiated. Stabilization shall be accomplished by temporarily or permanently protecting the disturbed soil surface from rainfall impacts and runoff.
- D. Erosion and sediment control measures must be in place and functional before earth moving operations begin, and must be constructed and maintained throughout the construction period. Temporary measures may be removed at the beginning of the work day, but must be replaced at the end of the work day.
- E. All control measures shall be checked, and repaired as necessary, weekly in dry periods and within 24 hours after any rainfall of 0.5 inch within a 24-hour period. During prolonged rainfall, daily checking and repairing is necessary. The Contractor shall maintain records of checks and repairs.
- F. A specific individual shall be designated to be responsible for erosion and sediment controls on each project site.

3.4 CONSTRUCTION OF STRUCTURES

- A. **Temporary Berms.** A temporary berm shall be constructed of compacted soil, with a minimum width of 24 inches at the top and a minimum height of 12 inches with or without a shallow ditch, constructed at the top of fill slopes or transverse to centerline on fills. Temporary berms shall be graded so as to drain to a compacted outlet at a slope drain. The area adjacent to the temporary berm in the vicinity of the slope drain must be properly graded to enable this inlet to function efficiently and with minimum ponding in this area. All transverse berms required on the downstream side of a slope drain shall extend across the grade to the highest point at approximately a 10 degree angle with a perpendicular to centerline. The top width of these berms may be wider and the side slope flatter on transverse berms to allow equipment to pass over these berms with minimum disruptions. When practical and until final roadway elevations are approached, embankments should be constructed with a gradual slope to one side of the embankment to permit the placement of temporary berms and slope drains on only one side of the embankment.
- B. **Temporary Slope Drains**
 - 1. Temporary slope drains shall consist of stone gutters, fiber mats, plastic sheets, concrete or asphalt gutters, half-round pipe, metal pipe, plastic pipe, flexible rubber, or other materials which can be used as temporary measures to carry water accumulating in the cuts and on the fills down the slopes prior to installation of permanent facilities or growth of adequate ground cover on the slopes.

2. Fiber matting and plastic sheeting shall not be used on slopes steeper than 4:1 except for short distances of 20 feet or less.
3. All temporary slope drains shall be adequately anchored to the slope to prevent disruption by the force of the water flowing in the drains. The base for temporary slope drains shall be compacted and concavely formed to channel the water or hold the slope drain in place. The inlet end shall be properly constructed to channel water into the temporary slope drain. Energy dissipaters, sediment basins, or other approved devices shall be constructed at the outlet end of the slope drains to reduce erosion downstream. An ideal dissipater would be dumped rock or a small sediment basin which would slow the water as well as pick up some sediment. All temporary slope drains shall be removed when no longer necessary and the site restored to match the surroundings.

C. Sediment Structures

1. Sediment structures shall be utilized to control sediment at the foot of embankments where slope drains outlet, at the bottom as well as in the ditchlines atop waste sites, and in the ditchlines or borrow pits. Sediment structures may be used in most drainage situations to prevent excessive siltation of pipe structures. All sediment structures shall be at least twice as long as they are wide.
2. When use of temporary sediment structures is to be discontinued, all sediment accumulation shall be removed, and all excavation backfilled and properly compacted. The existing ground shall be restored to its natural or intended condition.

D. Check Dam

1. Utilize check dams to retard stream flow and catch small sediment loads. Materials utilized to construct check dams are varied and should be clearly illustrated or explained in the Contractor's erosion control plan.
2. Key all check dams into the sides and bottom of the channel a minimum depth of 2 feet. A design is not needed for check dams but some typical designs are shown in the standard plans.
3. Do not use stone check dams where the drainage area exceeds 50 acres. Log and pole structures should generally not be used where the drainage area exceeds five acres.

E. Temporary Seeding and Mulching. Perform seeding and mulching in accordance with Section 32 92 19, Seeding.

F. Brush Barriers. Brush barriers shall consist of brush, tree trimmings, shrubs, plants, and other approved refuse from the clearing and grubbing operation. The brush barriers shall be constructed approximately parallel to original ground contour. Each brush barrier shall be compressed to an approximate height of 3 to 5 feet and approximate width of 5 to 10 feet. The embankment shall not be supported by the construction of brush barriers.

G. Baled Hay or Straw Erosion Checks. Hay or straw shall be embedded in the ground 4 to 6 inches to prevent water flowing underneath. The bales shall also be anchored securely to the ground by wooden stakes driven through the bales into the ground. Bales can remain in place until they rot, or be removed after they have served their purpose, as determined by the Engineer. Keep the checks in good condition by replacing broken or damaged bales immediately after damage occurs. Normal debris clean-out will be considered routine maintenance.

H. Temporary Silt Fences

1. Temporary silt fences shall be placed on the natural ground, at the bottom of fill slopes, in ditches, or other areas where siltation is a problem. Silt fences are constructed of wire mesh fence with a covering of burlap or some other suitable material on the upper grade side of the fence and anchored into the soil.
2. Maintain the silt fence in a satisfactory condition for the duration of the project or until its removal is requested by the Engineer. The silt accumulation at the fence may be left in place and seeded, removed, etc., as directed by the Engineer. The silt fence becomes the property of the Contractor whenever the fence is removed.

3.5 MAINTENANCE

- A. The temporary erosion control features installed by the Contractor shall be acceptably maintained by the Contractor until no longer needed or permanent erosion control methods are installed. Any materials removed shall become the property of the Contractor.
- B. In the event that temporary erosion and pollution control measures are required due to the Contractor's negligence, carelessness, or failure to install permanent controls as a part of work as scheduled, and are ordered by the Engineer, such work shall be performed by the Contractor at his own expense.
- C. Where the work to be performed is not attributed to the Contractor's negligence, carelessness, or failure to install permanent controls and falls within the specifications for a work item that has a contract price, the units of work shall be paid for at the proper contract prices.

3.6 EROSION CONTROL OUTSIDE PROJECT AREA

- A. Temporary erosion control shall include construction work outside the project area where such work is necessary as a result of construction such as borrow pit operations, haul roads, and equipment storage sites. Bid price in such cases shall include all necessary clearing and grubbing, construction incidentals, maintenance, and site restoration when no longer needed.

END OF SECTION

SECTION 31 37 00

RIPRAP

PART 1 - GENERAL

1.1 SCOPE

- A. The work covered by this section includes furnishing all labor, materials, and equipment required to furnish, place, and set rock riprap, concrete block riprap, and sacked sand-cement riprap as shown on the Drawings and/or specified herein.
- B. Riprap shall be placed on slopes of embankments or other surfaces or around structures as protection against the erosive action of water.
- C. A filter blanket course of crushed rock, sand and gravel, or an approved filter fabric shall be placed under the riprap, where shown on the Drawings.

1.2 SUBMITTALS

- A. Provide the Engineer with written evidence in the form of mill test reports or test reports from a qualified testing laboratory that all sands, cements, and filter blanket materials used conform to the applicable requirements of this Specification section.
- B. Furnish representative samples of rock riprap material for classification, gradation, or other tests as the Engineer may direct, when requested by the Engineer.

PART 2 - PRODUCTS

2.1 ROCK RIPRAP

- A. Rock riprap shall be constructed using sound, dense, durable stones or rock fragments, free from cracks, pyrite intrusions, and other structural defects. Stones which will be used with mortar shall be free from dirt, oil, or other material that might prevent good adhesion with the mortar. Stones with a laminated structure shall be avoided. Field stones shall not be used as a source of rock for riprap. Only rock that has been approved by the Engineer shall be used for riprap.
- B. When the crushed aggregate is subjected to 5 alternations of the sodium sulfate soundness test, the weighted percentage of loss shall be not more than 12 percent.
- C. Shape of the stones shall be generally rectangular or cubic. Flat or elongated stones having a small dimension less than 1/3 of the large dimension shall not be used.
- D. At least 50 percent of the stones or rock fragments for plain rock riprap shall weigh 150 pounds or more. The sizes of the stones shall be well graded from the smaller to the larger.

- E. At least 90 percent of the stones or rock fragments for hand-placed rock riprap shall weigh 100 pounds or more and shall be not less than 12 inches long, 12 inches deep, and 8 inches wide.

2.2 FILTER BLANKET MATERIAL

- A. Filter blanket material shall consist of fragments of sound, durable stone or crushed rock, free from disintegrated stone, alkali, salt, vegetable matter, or adherent coating. Aggregate shall be reasonably free from thin or elongated pieces. The percentage of wear of the aggregate as outlined in AASHTO Test No. T-96 shall not exceed 7 percent.
- B. Aggregate shall have the following gradation:

<u>Sieve Size</u>	<u>Total Percent Passing by Weight</u>
1 1/4"	100
1"	95 - 100
3/4"	70 - 100
3/8"	50 - 85
No. 4	33 - 65
No. 10	20 - 45
No. 40	8 - 25
No. 200	0 - 10

- C. Material finer than the No. 10 sieve shall be of such characteristics and gradation that will prevent the mass from setting up or becoming cemented together. Stone or crushed rock may be used, provided the percentage of aggregate passing the No. 100 sieve is less than 10 percent.

PART 3 - EXECUTION

3.1 EQUIPMENT

- A. All equipment necessary for the satisfactory performance of the work shall be on hand and approved by the Engineer before construction will be permitted to begin.
- B. The equipment shall include wooden or metal tamps of sufficient weight and number to properly compact the slopes on which the riprap or slope pavement is to be placed.
- C. Wooden hand tamps, having a tamping face not greater than 1 square foot, and of sufficient weight and number to properly tamp the riprap, shall be furnished when sacked sand-cement is used.
- D. Equipment for mixing cement grout or sand cement shall include a mechanical mixer or, if the Engineer approves hand mixing for cement grout, a watertight mixing platform or mixing box of adequate size.

3.2 PREPARATION OF FOUNDATION

- A. Immediately prior to the construction of riprap, the slopes or ground surface shall be trimmed within reasonably close conformity to the lines and grades indicated on the Drawings or as directed by the Engineer, and shall be thoroughly compacted by the use of hand or mechanical tamps.
- B. On slopes, the bottom of the riprap shall be placed at least 2 feet below the natural ground surface, unless otherwise shown or directed.
- C. No material shall be placed on a frozen or otherwise unsuitable slope.

3.3 PLACEMENT OF FILTER BLANKET

- A. A filter blanket course shall be placed under the riprap on the prepared subgrade, where shown on the Drawings.
- B. Filter blanket shall be placed immediately prior to placement of riprap. Compaction of the filter blanket is not required except where called for on the Drawings.
- C. A synthetic filter fabric may be substituted for the filter blanket course, where specifically permitted by the Engineer. Filter fabric shall be especially designed for use as slope stabilization under riprap and shall be acceptable to the Engineer. Placement of filter fabric shall be in strict conformance with the manufacturer's written instructions and recommendations.

3.4 CONSTRUCTION OF PLAIN ROCK RIPRAP

- A. Plain rock riprap shall be constructed using a crane and clam-shell or other suitable equipment approved by the Engineer, unless otherwise shown or specified. The rock shall be placed as nearly as practicable in final position using powered equipment. If necessary, larger rocks shall be worked up to the surface when the material on the surface does not meet the weight specification or when the voids next to the foundation material are too large.
- B. The quantity of small stones shall be kept as low as possible, sufficient only to fill the voids between the larger stones. Care shall be taken that this small material is well distributed throughout the mass and not allowed to segregate or form pockets of small stone. All bridging shall be broken down. Large interstices, open channels, or voids shall be filled by chinking or otherwise manipulating the stones.
- C. When riprap is to be built on existing riprap, special care shall be taken to provide positive anchorage of the new riprap to the existing riprap.
- D. The finished riprap surface shall in general conform to the slope lines shown on the Drawings. No objectionable, hazardous, or unsightly projections above the general plane surface will be permitted.

3.5 CONSTRUCTION OF HAND-PLACED, PLAIN ROCK RIPRAP

- A. Hand-placed, plain rock riprap shall be constructed upon the prepared foundation by hand placing so that the stones shall be as close together as is practicable in order to

reduce the voids to a minimum. Construction of riprap on sloped surfaces shall begin at the bottom and shall progress upward in approximately horizontal layers.

- B. When rock riprap is constructed in more than one layer, it shall be so placed that it will be thoroughly tied together, with the larger stones protruding from one layer into the other.
- C. The standard depth of rock riprap shall be 12 inches unless otherwise indicated or directed and in no instance shall be less than 10 inches in depth. Rock riprap shall have an average depth for each 25 square feet of surface of not less than the depth indicated on the Drawings or directed by the Engineer, or the standard depth required in these Specifications.
- D. Each stone shall be so placed that the depth will be perpendicular to the surface upon which it is set. The length shall be placed so that it will be against the adjoining stones. The stones shall be placed in such a manner as to stagger all joints as far as it is possible and practicable.
- E. The main stones shall be thoroughly chinked and filled with the smaller stones by throwing them over the surface in any manner that is practicable for the smaller stones to fill the voids. This work shall continue with the progress of the construction. Tamping of the stones will not be required if the stones have been placed in a reasonable and satisfactory manner.
- F. Knapping of the stones will not be required except for stone protruding more than 4 inches above what is considered the normal surface of the stones, in which case these stones shall be broken down to come within 4 inches of the normal surface.

3.6 PROTECTION OF STRUCTURES

- A. All structures shall be carefully protected from damage by equipment or impact of stones or blocks. All damage shall be corrected by the Contractor at his own expense and in a manner acceptable to the Engineer.

END OF SECTION

DIVISION 32

EXTERIOR IMPROVEMENTS

SECTION 32 10 00

NEW AND REPLACEMENT PAVING

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes provisions for hot-mixed asphalt paving and mineral aggregate subbase over prepared subgrade for trench width, full pavement width paving, and other areas as shown on the Drawings.
- B. Prepared subgrade is specified in Section 31 20 00, Earthwork.
- C. Proof rolling of prepared subgrade is included in this section.
- D. Saw-cutting of edges of existing pavement is required to minimize subsidence of the pavement into the trench and to minimize the width of pavement replacement.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplemental Conditions and Division 1 Specification sections, apply to this section.

1.3 SUBMITTALS

- A. General. Submit the following in accordance with Conditions of Contract and Division 1 Specification sections.
- B. Material certificates signed by material producer and Contractor, certifying that each material item complies with or exceeds specified requirements.
- C. Pavement marking plan indicating lane separations and defined parking spaces. Note dedicated handicapped spaces with international graphics symbol.

1.4 SITE CONDITIONS

- A. Weather Limitations. Apply prime and tack coats when ambient temperature is above 50°F (10°C) and when temperature has not been below 35°F (1°C) for 12 hours immediately prior to application. Do not apply when base is wet or contains an excess of moisture.
- B. Construct hot-mixed asphalt surface course when atmospheric temperature is above 40°F (4°C) and when base is dry. Base course may be placed when air temperature is above 30°F (-1°C) and rising.
- C. Grade Control. Establish and maintain required lines and elevations.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General. Use locally available materials and gradations that exhibit a satisfactory record of previous installations.
- B. Coarse Aggregate. Sound, angular crushed stone, crushed gravel, or properly cured crushed blast furnace slag, complying with ASTM D 692-00.
- C. Fine Aggregate. Sharp-edged natural sand or sand prepared from stone, properly cured blast furnace slag, gravel, or combinations thereof, complying with ASTM D 1073-99.
- D. Mineral Filler. Rock or slag dust, hydraulic cement, or other inert material complying with ASTM D 242.
- E. Asphalt Cement. ASTM D 3381 for viscosity-graded material; ASTM D 946 for penetration-graded material.
- F. Prime Coat. Cut-back asphalt type, ASTM D 2027; MC-30, MC-70, or MC-250.
- G. Tack Coat. Emulsified asphalt; ASTM D 977.
- H. Graded Aggregate Subbase (GAB). GAB per Georgia Department of Transportation (GDOT) standard specifications.
- I. Geotextile Fabric. 6 oz/sy, woven, polypropylene fabric; Mirafi, Inc., Type 600x, or equal.
- J. Lane Marking Paint. Alkyd-resin type, ready-mixed complying with AASHTO M 248, Type I.
 - 1. Color: White.
 - 2. Color: Yellow.

2.2 TYPES OF PAVEMENT

- A. Replace all existing pavement in streets, driveways, or parking areas which is removed, destroyed, or damaged by construction of sewage or water works as specified below, **as shown on the Drawings**, or as called for in the Bid Schedule. Unless otherwise shown or specified, all paved surfaces shall be replaced using the applicable pavement replacement Type 1 through 5 as shown on the Drawings. Pavement shown or specified to be replaced for the full width of the street shall be Type 6,7, or 8 as applicable and as shown on the Drawings. Materials, equipment, and construction methods used for paving work shall conform to the Specifications applicable to the particular type required for replacement, repair, or new pavements.
 - 1. Type 1 asphaltic concrete pavement for heavy-duty use shall have a minimum thickness of 3 inches placed in two equal layers. Type 1 pavement shall be composed of plant mix, asphaltic concrete E Mix (12.5 mm) conforming to "Hot Mix Asphaltic Concrete Construction," Section 400 of the GDOT specifications.

2. Type 2 asphaltic concrete pavement for light-duty use shall have a minimum thickness of 2 inches of H Mix (9.5 mm Type I) over 6 inches of compacted GAB to 100 percent of Standard Proctor placed in one layer. Type 2 pavements shall be composed of asphaltic concrete pavement, H mix (9.5mm Type 1), conforming to Section 400, "Hot Mix Asphaltic Concrete Construction," GDOT specifications.
3. Type 3 pavement replacement shall consist of 2 inches of asphaltic concrete over a portland cement concrete base and shall be constructed according to the detail shown on the Drawings.
 - a. Replace portland cement concrete base courses with Class "A" concrete in accordance with Section 03 30 00, Cast-In-Place Concrete. The surface of the replaced concrete base course shall be left rough. The slab shall be of depth equivalent to the existing concrete base course, but in no case less than 7 inches thick. Replace expansion joints removed. Concrete base courses shall be reinforced and conform to details shown on the Drawings and applicable specifications of Section 326, "Portland Cement Concrete Subbase," GDOT specifications.
 - b. Asphaltic concrete shall be constructed on one layer and shall be the same as described for Type 2 paving above or Type 8 paving below.
4. Type 4 bituminous penetration pavement shall be a minimum of 1 inch in thickness and shall conform to Section 424, "Bituminous Surface Treatment," GDOT specifications.
5. Type 5 portland cement concrete pavement shall be Class "A" concrete conforming to Section 03 30 00, Cast-In-Place Concrete. The surface finish of the concrete pavement replaced shall conform to that of the existing pavement. The slab shall be of depth equivalent to the existing concrete pavement, but in no case less than 7 inches thick. Replace expansion joints removed. Concrete pavements shall be reinforced and shall conform to details shown on the Drawings and applicable specifications of Section 430, "Portland Cement Concrete Pavement," GDOT specifications.
6. Type 6 asphaltic concrete pavement for heavy-duty use for full street width replacement shall consist of one 2-inch layer of bituminous plant mix base (hot mix), B Mix (19 mm), conforming to Section 400, "Hot Mix Asphaltic Concrete Construction," GDOT specifications; and one 1-inch layer of asphaltic concrete pavement, F Mix (9.5 mm Type II), 100 percent limestone conforming to Section 400, "Hot Mix Asphaltic Concrete Construction," GDOT specifications.
7. Type 7 asphaltic concrete pavement for light-duty use where designated by Engineer for full street width replacement shall consist of one 2-inch layer of E Mix (12.5 mm) conforming to Section 400, "Hot Mix Asphaltic Concrete Construction," GDOT specifications.
8. Type 8 asphaltic concrete pavement for light-duty use where designated by Engineer for full-width replacement shall consist of one 2-inch layer of asphaltic concrete pavement, H Mix (9.5 mm Type I), conforming to Section 400, "Hot Mix Asphaltic Concrete Construction," GDOT specifications.

9. Where sewerage or water lines and appurtenances are constructed in or across unpaved, chert, or crushed stone surfaced streets, roadways, driveways, or parking areas, repair or replace the surface removed or damaged with a minimum of 6 inches of crushed stone in accordance with Section 310, "Graded Aggregate Construction," GDOT specifications.
 10. Temporary paving shall consist of a single application of bituminous surface treatment. The bituminous surface treatment pavement shall conform to Section 424, "Bituminous Surface Treatment," GDOT specifications.
- B. In no case shall paving repair be commenced without prior approval of the Engineer of the type of pavement, the equipment to be used, and the method or procedure to be used. The designation of "light-duty" or "heavy-duty" use as applied to Type 1, Type 2, Type 6, Type 7, or Type 8 pavement replacement shall be determined by the Engineer.
- C. The pavement mixture shall not be spread until the designated surface has been previously cleaned and prepared, is intact, firm, properly cured, dry, and the tack coat has been applied.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

- A. General. Remove loose material from compacted subgrade surface immediately before applying subbase.
- B. Roll prepared subgrade surface to check for unstable areas and areas requiring additional compaction.
- C. Do not begin paving work until deficient subgrade areas have been corrected and are ready to receive subbase.
- D. Place mineral aggregate subbase and compact in accordance with the applicable GDOT specifications to provide a minimum of 6 inches or as shown on Drawings. Subbase thickness greater than 8 inches shall be placed in two or more layers.
- E. Roll prepared subbase surface to check for unstable areas and areas requiring additional compaction.
- F. Do not begin paving work until deficient subbase areas have been corrected and are ready to receive paving.
- G. Prime Coat. Apply at rate of 0.20 to 0.50 gallon per square yard over compacted subbase. Apply material to penetrate and seal, but not flood, surface. Cure and dry as long as necessary to attain penetration and evaporation of volatile components.
- H. Tack Coat. Apply to contact surfaces of previously constructed asphalt or Portland cement concrete and surfaces abutting or projecting into hot-mixed asphalt pavement. Distribute at rate of 0.05 to 0.15 gallon per square yard of surface.

- I. Allow to dry until at proper condition to receive paving.
 - J. Exercise care in applying bituminous materials to avoid smearing of adjoining concrete surfaces. Remove and clean damaged surfaces.
- 3.2 PLACING MIX
- A. General. Place hot-mixed asphalt mixture on prepared surface, spread, and strike off. Spread mixture at minimum temperature of 225°F (107°C). Place areas inaccessible to equipment by hand. Place each course to required grade, cross-section, and compacted thickness.
 - B. Paver Placing. Place in strips not less than 10 feet wide, unless otherwise acceptable to Engineer. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete base course for a section before placing surface course.
 - C. Immediately correct surface irregularities in finish course behind paver. Remove excess material forming high spots with shovel or lute.
 - D. Joints. Make joints between old and new pavements, or between successive days' work, to ensure continuous bond between adjoining work. Construct joints to have same texture, density, and smoothness as other sections of hot-mixed asphalt course. Clean contact surfaces and apply tack coat.
 - E. Curbs. Construct curbs over compacted pavement surfaces. Apply a light tack coat unless pavement surface is still tacky and free from dust.
 - F. Place curb materials to cross-section indicated or, if not indicated, to local standard shapes, by machine or by hand in wood or metal forms. Tamp hand-placed materials and screed to smooth finish. Remove forms as soon as material has cooled.
- 3.3 ROLLING
- A. General. Begin rolling when mixture will bear roller weight without excessive displacement.
 - B. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.
 - C. Breakdown Rolling. Accomplish breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling and repair displaced areas by loosening and filling, if required, with hot material.
 - D. Second Rolling. Follow breakdown rolling as soon as possible, while mixture is hot. Continue second rolling until mixture has been evenly compacted.
 - E. Finish Rolling. Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained 95 percent laboratory density.

- F. Patching. Remove and replace paving areas mixed with foreign materials and defective areas. Cut out such areas and fill with fresh, hot-mixed asphalt. Compact by rolling to specified surface density and smoothness.
- G. Protection. After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.4 TRAFFIC AND LANE MARKINGS

- A. General. Provide traffic and lane markings in all areas where markings have been damaged due to trench width pavement. On full width pavement, provide markings in all areas where markings were present at beginning of project or where markings are designated to be provided on the Drawings.
- B. Cleaning. Sweep and clean surface to eliminate loose material and dust.
- C. Striping. Use chlorinated-rubber base traffic lane-marking paint, factory-mixed, quick-drying, and nonbleeding.
- D. Do not apply traffic and lane marking paint until layout and placement have been verified with Engineer.
- E. Apply paint with mechanical equipment to produce uniform straight edges. Apply at manufacturer's recommended rates to provide minimum 12 to 15 mils dry thickness.

3.5 WHEEL STOPS

- A. General. Secure wheel stops to hot-mixed asphalt surface with not less than two 3/4-inch-diameter galvanized steel dowels embedded in precast concrete at 1/3 points. Size length of dowel to penetrate at least 1/2 hot-mixed asphalt depth.

3.6 FIELD QUALITY CONTROL

- A. General. Testing in-place hot-mixed asphalt courses for compliance with requirements for thickness and surface smoothness will be done by Owner's testing laboratory. Repair or remove and replace unacceptable paving as directed by Engineer.
- B. Thickness. In-place compacted thickness tested in accordance with ASTM D 3549 will not be acceptable if exceeding following allowable variations:
 - 1. Base Course: Plus or minus 1/2-inch.
 - 2. Surface Course: Plus or minus 1/4-inch.
- C. Surface Smoothness: Test finished surface of each hot-mixed asphalt course for smoothness, using 10-foot straightedge applied parallel with and at right angles to centerline of paved area. Surfaces will not be acceptable if exceeding the following tolerances for smoothness:
 - 1. Base Course Surface: 1/4-inch.

2. Wearing Course Surface: 3/16-inch.
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4-inch.

D. Check surface areas at intervals as directed by Engineer.

END OF SECTION

SECTION 32 32 23

SEGMENTAL CONCRETE UNIT MASONRY RETAINING WALLS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Furnish and install segmental concrete unit masonry retaining walls (SRWs) to the lines and grades designated on the Drawings and as specified herein.

1.2 APPLICABLE SECTIONS OF RELATED WORK

- A. Section 31 20 00 - Earthwork

1.3 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)

- 1. ASTM C-1372 Specification for Segmental Retaining Wall Units
- 2. ASTM D-422 Particle Size Analysis
- 3. ASTM D-698 Laboratory Compaction Characteristics of Soil - Standard Effort
- 4. ASTM D-4318 Liquid Limit, Plastic Limit and Plasticity Index of Soils
- 5. ASTM D-4595 Tensile Properties of Geotextiles - Wide Width Strip
- 6. ASTM D-5262 Unconfined Tension Creep Behavior of Geosynthetics
- 7. ASTM D-3034 Polyvinyl Chloride Pipe (PVC)
- 8. ASTM D-1248 Corrugated Plastic Pipe
- 9. ASTM D-4475 Horizontal Shear Strength of Pultruded Reinforced Plastic Rods

- B. Geosynthetic Research Institute (GRI)

- 1. GRI-GG4 Determination of Long Term Design Strength of Geogrids
- 2. GRI-GG5 Determination of Geogrid (Soil) Pullout

- C. National Concrete Masonry Association (NCMA)

- 1. NCMA SRWU-1 Test Method for Determining Connection Strength of SRW
- 2. NCMA SRWU-2 Test Method for Determining Shear Strength of SRW

- D. American Association of State Highway and Transportation Officials (AASHTO)

- 1. Standard Specifications for Highway Bridges, 17th Edition, 2002

1.4 SUBMITTALS

- A. General. Submit the following in accordance with the General Provisions and Division 1 Specification requirements.
- B. Product data and instructions for manufactured materials and products. Include manufacturer's certifications and laboratory test reports as required.

C. Shop drawings describing the complete installation of the modular block retaining wall system. Indicate general layout dimensions; base requirements; location of special blocks (as required); final wall cross-section; and location, size, and embedment of reinforcement.

D. Design Requirements

1. Design Method: Design of SRWs using geosynthetic reinforcement shall be in accordance with the NCMA design guidelines for segmental walls utilizing AASHTO earth pressure and stability design criteria.
2. Design Parameters: The design of the SRW system shall be based on the following soil parameters provided by the Owner.

<u>Soil</u>	<u>'</u>	<u>c'</u>	
Reinforced Backfill	30°	0	120 pcf
Retained Backfill	45°	250 psf	110 pcf
Foundation Backfill	30°	0	120 pcf

3. Required Design Safety Factors

<u>Design Parameter</u>	<u>Minimum Factor of Safety</u>
Internal Stability	
Pullout (Peak)	1.5
Facing Shear (Peak/serviceability)	1.5/NA
Facing Connection (Peak/serviceability)	1.5/NA
Uncertainties	1.5
External Stability	
Base Sliding (static)	1.5
Overturning	2.0
Bearing	2.0
Global	1.3

4. Additional Design Considerations

- a. Address hydrostatic, seismic, rapid drawdown, surcharge and backslope loading as shown on the Drawings. Minimum live loads of 100 psf (4.8 kPa) and 250 psf (12 kPa) shall be for all walls and walls supporting areas subject to traffic, respectively.
- b. Provide a minimum reinforcement length of 60% the total height of the wall for each layer or longer as required by calculation.
- c. Provide continuous, 100% geosynthetic coverage at each reinforcement layer (no gaps).
- d. Where required, place adjacent reinforcing layers every other course unless the calculations confirm the acceptability of a greater separation.

- e. Only the weight of the mass vertically over the plane of sliding shall be included in the resisting forces for sliding and overturning.
- f. Hinge height shall only apply to wall systems with 10 of batter.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Modular Block

1. Check materials upon delivery to assure that proper material has been received.
2. Prevent excessive mud, wet cement, epoxy, and the materials which may affix themselves, from coming in contact with the materials.
3. Protect the materials from damage. Damaged material shall not be incorporated into the reinforced soil embankments.

B. Geogrid

1. Check the geogrid upon delivery to assure that the proper material has been received.
2. Store geogrids above -20°F.
3. Prevent excessive mud, wet cement, epoxy and like materials which may affix themselves to the gridwork, from coming in contact with the geogrid material.
4. Rolled geogrid material may be laid flat or stood on end for storage.

PART 2 - RETAINING WALL

2.1 MATERIALS

A. Concrete Units

1. Masonry units shall be KeyStone® Retaining Wall Units by Keystone Retaining Wall Systems, Inc.; Diamond Retaining Wall Units by Anchor Wall Systems, Inc.; or approved equal.
2. Concrete wall units shall have a minimum 28-day compressive strength of 3,000 psi. The concrete shall have adequate freeze/thaw protection with a maximum moisture absorption rate of 7 percent.
3. Exterior dimensions may vary.
4. Retaining wall units shall have a "split face" finish.
5. Units shall have angled sides and be capable of attaining concave and convex alignment curves with a minimum radius of 3.5 feet.

6. Units shall be interlocked with non-corrosive fiberglass pins or overlapping concrete ledges.
 7. Units shall be interlocked to provide a setback per each course of wall height.
- B. Fiberglass Connecting Pins
1. Nylon resin rods with fiberglass reinforcement.
 2. Pins shall have a minimum flexural strength of 128,000 psi.
- C. Base Material. Material for footing shall consist of compacted crushed stone. A minimum of 6 inches of compacted base is required.
- D. Unit Fill
1. Fill for units shall be free draining crushed stone or coarse gravel. No more than 10 percent shall pass the No. 200 sieve with a maximum size of $\frac{3}{4}$ inch. Gradation of the fill shall be approved by the Engineer.
 2. A minimum of 12 inches of drainage fill must extend behind the wall.
- E. Backfill
1. Material shall be insitu soils when approved by the Engineer unless otherwise specified in the Drawings. Unsuitable soils for backfill shall not be used within the reinforced soil mass when using geogrid for tiebacks.
 2. Where additional fill is required, submit sample and specifications to the Engineer for approval.
- F. Geogrid products shall be of high density polyethylene or polyester fiber specifically fabricated for use as a soil reinforcement material.

PART 3 - INSTALLATION

3.1 RETAINING WALL INSTALLATION

- A. Excavation. Excavate to the lines and grades shown on the Drawings. Over excavation shall not be paid for and the replacement for compacted fill and/or wall system components will be required at Contractor's expense. Embankment materials beyond lines shown shall not be disturbed.
- B. Foundation Soil Preparation
1. Foundation soil shall be excavated as required for footing dimensions shown on the Drawings, or as directed by the Engineer.
 2. Foundation soil shall be examined by the Engineer to assure that the actual foundation soil strength meets or exceeds assumed design strength. Soils not

meeting required strength shall be removed and replaced with acceptable material.

3. Over-excavated areas shall be filled with approved compacted backfill material.

C. Base Footing

1. Footing material shall be placed as shown on the Drawings with a minimum thickness of 6 inches.
2. Footing materials shall be installed upon undisturbed insitu soils.
3. Material shall be compacted so as to provide a level hard surface on which to place the first course of units. Compaction will be with mechanical plate compactors to 95% of standard.
4. Footing shall be prepared to ensure complete contact of retaining wall unit with base. Gaps shall not be allowed.
5. Footing materials shall be to the depths and widths shown. Contractor may use reduced depth of sands and gravel with an unreinforced concrete topping a maximum of one-inch-thick.

D. Unit Installation

1. First course of concrete wall units shall be placed on the footing. The units shall be checked for level and alignment. The first course is the most important to ensure accurate and acceptable results.
2. Ensure that units are in full contact with base.
3. Units are placed side by side for full length of wall alignment. Alignment may be done by means of a string line or offset from base line.
4. Install fiberglass connecting pins and fill all voids at units with coarse granular material. Tamp fill.
5. Sweep all excess material from top of units and install next coarse. Ensure each course is completely filled prior to proceeding to next coarse.
6. Lay up each course ensuring that pins protrude into adjoining courses a minimum of 1 inch. Two pins are required per unit. Pull each unit forward, away from the embankment, against pins in the previous course and backfill as the course is completed. Repeat procedure to the extent of wall height.
7. As appropriate where the wall changes elevation, units can be turned into the embankment with a convex return end. A minimum of 2 units shall be installed below grade at these ends. Only the front face of the units shall be visible from the side of the wall.

E. Geogrid Installation for Retaining Walls

1. The geogrid soil reinforcement shall be laid horizontally on compacted backfill, connected to the concrete wall units and embedded a minimum of 12 inches. Hook grid over fiberglass pins, pull taut, and anchor before backfill is placed on the geogrid.
2. Slack in the geogrid at the wall unit connections shall be removed in a manner, and to such a degree, as approved by the Engineer.
3. Geogrid shall be laid at the proper elevation and orientation as shown on the Drawings or as directed by the Engineer.
4. Verify the correct orientation (roll direction) of the geogrid.
5. Geogrid may be secured in place with staples, pins, sand bags, or backfill as required by fill properties, fill placement procedures, weather conditions, or as directed by the Engineer.
6. Follow manufacturer's guidelines relative to overlap requirements of uniaxial and biaxial geogrids.

F. Fill Placement

1. Wall fill material shall be placed in 8-inch lifts and compacted to 95 percent of standard proctor.
2. Backfill shall be placed, spread, and compacted in such a manner that minimizes the development of wrinkles in and/or movement of the geogrid.
3. Only hand-operated compaction equipment shall be allowed within 3 feet of the wall face.
4. Backfill shall be placed from the wall outward, to ensure that the geogrid remains taut.
5. Tracked construction equipment shall not be operated directly on the geogrid. A minimum backfill thickness of 6 inches is required prior to operation of tracked vehicles over the geogrid. Turning of tracked vehicles should be kept to a minimum to prevent tracks from displacing the fill and damaging the geogrid.
6. Rubber-tired equipment may pass over the geogrid reinforcement at slow speeds, less than 10 mph. Sudden braking and sharp turning shall be avoided.

END OF SECTION

SECTION 32 92 19

SEEDING

PART 1 - GENERAL

1.1 SCOPE

- A. The work covered by this section consists of furnishing all labor, equipment, and material required to place topsoil, seed, commercial fertilizer, agricultural limestone, and mulch material, including seedbed preparation, harrowing, compacting, and other placement operations on graded earthen areas as described herein and/or shown on the Drawings. In general, seeding operations shall be conducted on all newly graded earthen areas not covered by structures, pavement, or sidewalks; all cleared or grubbed areas which are to remain as finish grade surfaces; and on all existing turf areas which are disturbed by construction operations and which are to remain as finish grade surfaces. Areas disturbed by borrow activities shall also be seeded according to these Specifications.
- B. Temporary Seeding and Erosion Control
 - 1. This practice is applicable on areas subject to erosion for up to 12 months or until establishment of finished grade or permanent vegetative cover. Temporary vegetative measures shall be coordinated with permanent measures to assure economical and effective stabilization.
 - 2. Temporary seeding shall be applied to exposed soil surfaces which are not to be fine-graded for periods from 30 days to one year. Such areas include denuded areas, soil stockpiles, dikes, dams, sides of sediment basins, temporary roadbanks, backfilled and rough graded utility line trenches, and disturbed areas along utility lines, etc.
 - 3. Temporary seeding shall be in accordance with the temporary seeding schedule and shall meet the same requirements for seed bed preparation and mulching with the exception that lime and fertilizer need not be applied unless the soil is very low fertility and low pH.

1.2 QUALITY ASSURANCE

- A. Prior to seeding operations, furnish to the Engineer labels or certified laboratory reports from an accredited commercial seed laboratory or a state seed laboratory showing the analysis and germination of the seed to be furnished. Acceptance of the seed test reports shall not relieve the Contractor of any responsibility or liability for furnishing seed meeting the requirements of this section.
- B. Prior to topsoil operations, obtain representative samples and furnish soil test certificates including textural, pH, and organic ignition analysis from the State University Agricultural Extension Services or other certified testing laboratory.

PART 2 - PRODUCTS

2.1 TOPSOIL

- A. Place a minimum of 4 inches of topsoil over all graded earthen areas and over any other areas to be seeded. Sources of topsoil shall be approved by the Engineer prior to disturbance.
- B. Topsoil shall be a friable loam containing a large amount of humus and shall be original surface soil of good, rich, uniform quality, free from any material such as hard clods, stiff clay, hardpan, partially disintegrated stone, pebbles larger than 1/2 inch in diameter, lime, cement, bricks, ashes, cinders, slag, concrete, bitumen or its residue, boards, sticks, chips, or other undesirable material harmful or unnecessary to plant growth. Topsoil shall be reasonably free from perennial weeds and perennial weed seeds, and shall not contain objectionable plant material, toxic amounts of either acid or alkaline elements, or vegetable debris undesirable or harmful to plant life.
- C. Topsoil shall be natural topsoil without admixture of subsoil material, and shall be classifiable as loam, silt loam, clay loam, sandy loam, or a combination thereof. The pH shall range from 5.5 to 7.0. Topsoil shall contain not less than 5 percent nor more than 20 percent, by weight, of organic matter as determined by loss on ignition of samples oven-dried to 65°C.

2.2 SEED

- A. Deliver seed in new bag or bags that are sound and labeled in accordance with the U.S. Department of Agriculture Federal Seed Act.
- B. All seed shall be from the last crop available at time of purchase and shall not be moldy, wet, or otherwise damaged in transit or storage.
- C. Seed shall bear the grower's analysis testing to 98 percent for purity and minimum 85 percent for germination. At the discretion of the Engineer, samples of seed may be taken for check against the grower's analysis.
- D. Species, rate of seeding, fertilization, and other requirements are shown in the Seeding Requirements Table.

2.3 FERTILIZER AND LIMING MATERIALS

- A. Fertilizer and liming materials shall comply with applicable state, local, and federal laws concerned with their production and use.

TEMPORARY SEEDING REQUIREMENTS TABLE					
			Rates per 1,000 Square Feet		
Area	Sowing Season	Species	Seed	Fertilizer*	Limestone**
All Areas	4/15 to 8/15	Sudangrass (Sorghum Sudanese)	1.5 lbs.	10 lbs. 10-20-20	100 lbs.
	8/16 to 4/14	Annual Ryegrass (Lolium Temulentum)	1 lb.	10 lbs. 10-20-20	100 lbs.

*Fertilizer is not required on fertile soils. Apply on very low fertility soil.
**Apply limestone on highly acidic soils (pH 5.5 and lower).

PERMANENT SEEDING REQUIREMENTS TABLE					
			Rates per 1,000 Square Feet		
Area	Sowing Season	Species	Seed	Fertilizer	Limestone
Flat to rolling terrain with slopes less than 3:1	3/1 to 6/1	Kentucky 31 Fescue Ladino White Clover*	4 lbs. 1/4 lb.	30 lbs. 6-12-12	100 lbs.
	8/1 to 11/1	Kentucky 31 Fescue Ladino White Clover* Annual Ryegrass	4 lbs. 1/4 lb. 2 lbs.	30 lbs. 6-12-12	100 lbs.
Embankments with slopes greater than 3:1	3/1 to 6/1	Hulled Sericea Lespedeza* Kentucky 31 Fescue Weeping Lovegrass	1 lb. 3 lbs. 1/4 lb.	30 lbs. 6-12-12	100 lbs.
	8/1 to 11/1	Unhulled Sericea Lespedeza* Kentucky 31 Fescue Annual Ryegrass	1 lb. 3 lbs. 2 lbs.	30 lbs. 6-12-12	100 lbs.

*Requires inoculation.

- B. Commercial fertilizer shall be a ready-mixed material and shall be equivalent to the grade or grades specified in the Seeding Requirements Table. Container bags shall be labeled with the name and address of the manufacturer, brand name, net weight, and chemical composition.
- C. Agricultural limestone shall be a pulverized limestone with a calcium carbonate content not less than 85 percent by weight. Agricultural limestone shall be crushed so that at least 85 percent of the material will pass a No. 10 mesh screen and 50 percent will pass a No. 40 mesh screen.

2.4 MULCH MATERIAL

- A. All mulch materials shall be air-dried and reasonably free of noxious weeds and weed seeds or other materials detrimental to plant growth.
- B. Mulch shall be composed of wood fiber, straw, or stalks, as specified herein. Mulch shall be suitable for spreading with standard mulch-blowing equipment.
- C. Wood fiber mulch shall be as manufactured by Conwed Corporation, or equal.
- D. Straw mulch shall be partially decomposed stalks of wheat, rye, oats, or other approved grain crops.

- E. Stalks shall be the partially decomposed, shredded residue of corn, cane, sorghum, or other approved standing field crops.

2.5 MULCH BINDER

- A. Mulch on slopes exceeding a 3 to 1 ratio shall be held in place by the use of an approved erosion control fabric, such as Curlex I as manufactured by American Excelsior Company, or approved equal. Fabric shall consist of strips of biodegradable paper interwoven with yarn that is subject to degradation by ultraviolet light.

2.6 INOCULANTS FOR LEGUMES

- A. All leguminous seed shall be inoculated prior to seeding with a standard culture of nitrogen-fixing bacteria that is adapted to the particular seed involved.

2.7 WATER

- A. Water shall be clean, clear, and free from any objectionable or harmful chemical qualities or organisms and shall be furnished by the Contractor.

PART 3 - EXECUTION

3.1 SECURING AND PLACING TOPSOIL

- A. Topsoil shall be secured from areas where topsoil has not been previously removed, either by erosion or mechanical methods. Topsoil shall not be removed to a depth in excess of the depth approved by the Engineer.
- B. The area or areas from which topsoil is secured shall possess such uniformity of soil depth, color, texture, drainage, and other characteristics as to offer assurance that when removed the product will be homogeneous in nature and will conform to the requirements of these Specifications.
- C. All areas from which topsoil is to be secured shall be cleaned of all sticks, boards, stones, lime, cement, ashes, cinders, slag, concrete, bitumen or its residue, and any other refuse which will hinder or prevent growth.
- D. When securing topsoil from a designated pit or elsewhere, should strata or seams of material occur which do not come under the requirements for topsoil, such material shall be removed from the topsoil or if required by the Engineer, the pit shall be abandoned.
- E. Before placing or depositing topsoil upon any area, all improvements within the area shall be completed, unless otherwise approved by the Engineer.
- F. The areas in which topsoil is to be placed or incorporated shall be prepared before securing topsoil for use.

3.2 SEEDBED PREPARATION

- A. Before fertilizing and seeding, the topsoil surfaces shall be trimmed and worked to true line free from unsightly variations, bumps, ridges, and depressions, and all detrimental material, roots, and stones larger than 3 inches in any dimension shall be removed from the soil.
- B. Not earlier than 24 hours before the seed is to be sown, the soil surface to be seeded shall be thoroughly cultivated to a depth of not less than 2 inches with a weighted disc, tiller, pulvimixer, or other equipment, until the surface is smooth and in a condition acceptable to the Engineer.
- C. If the prepared surface becomes eroded as a result of rain or for any other reason, or becomes crusted before the seed is sown, the surface shall again be placed in a condition suitable for seeding.
- D. Ground preparation operations shall be performed only when the ground is in a tillable and workable condition, as determined by the Engineer.

3.3 FERTILIZATION AND LIMING

- A. Following seedbed preparation, fertilizer shall be applied to all areas to be seeded so as to achieve the application rates shown in the Seeding Requirements Table.
- B. Fertilizer shall be spread evenly over the seedbed and shall be lightly harrowed, raked, or otherwise incorporated into the soil for a depth of 1/2 inch.
- C. Fertilizer need not be incorporated in the soil as specified above when mixed with seed in water and applied with power sprayer equipment. The seed shall not remain in water containing fertilizer for more than 30 minutes when a hydraulic seeder is used.
- D. Agricultural limestone shall be thoroughly mixed into the soil according to the rates in the Seeding Requirements Table. The specified rate of application of limestone may be reduced by the Engineer if pH tests indicate this to be desirable. It is the responsibility of the Contractor to obtain such tests and submit the results to the Engineer for adjustment in rates.

3.4 SEEDING

- A. Seed of the specified group shall be sown as soon as preparation of the seedbed has been completed. No seed shall be sown during high winds, nor until the surface is suitable for working and is in a proper condition. Seeding shall be performed during the dates shown in the Seeding Requirements Table unless otherwise approved by the Engineer. Seed mixtures may be sown together, provided they are kept in a thoroughly mixed condition during the seeding operation.
- B. Seeds shall be uniformly sown by any approved mechanical method to suit the slope and size of the areas to be seeded, preferably with a broadcast type seeder, windmill hand seeder, or approved mechanical power-drawn seed drills. Hydroseeding and hydromulching may be used on steep embankments, provided full coverage is obtained. Care shall be taken to adjust the seeder to the proper rate before seeding operations are started and to maintain the adjustment during seeding. Seed in

hoppers shall be agitated to prevent segregation of the various seeds in a seeding mixture.

- C. Immediately after sowing, the seeds shall be covered and compacted to a depth of 1/8 to 3/8 inch by a cultipacker or suitable roller.
- D. Leguminous seeds shall be inoculated prior to seeding with an approved and compatible nitrogen-fixing inoculant in accordance with the manufacturer's mixing instructions.

3.5 MULCHING

- A. All seeded areas shall be uniformly mulched in a continuous blanket immediately after seeding. The mulch shall be applied so as to permit some sunlight to penetrate and air to circulate, and at the same time shade the ground, reduce erosion, and conserve soil moisture. Approximately 25 percent of the ground shall be visible through the mulch blanket.
- B. One of the following mulches shall be spread evenly over the seeded areas at the following application rates:
 - 1. Wood Fiber 1,400 lbs/acre
 - 2. Straw 4,000 lbs/acre
 - 3. Stalks 4,000 lbs/acre

These rates may be adjusted at the discretion of the Engineer at no additional cost to the Owner, depending on the texture and condition of the mulch material and the characteristics of the seeded area.

- C. Mulch on slopes greater than a 3 to 1 ratio shall be held in place by the use of an approved erosion control fabric. Fabric shall be installed immediately after seeding and fertilizing area (mulch shall not be used under fabric).
- D. Erosion control fabric shall be installed and applied in accordance with the manufacturer's recommendations. Any fabric which becomes torn, broken loose from securing staples, or undermined shall be immediately and satisfactorily repaired. Areas where seed is washed out before germination shall be fertilized, reseeded, and restored. Any required restoration work shall be performed without additional compensation.

3.6 WATERING

- A. Maintain the proper moisture content of the soil to ensure adequate plant growth until a satisfactory stand is obtained. If necessary, watering shall be performed to maintain an adequate water content in the soil.
- B. Watering shall be accomplished by hoses, tank truck, or sprinklers in such a way to prevent erosion, excessive runoff, and overwatered spots.

3.7 MAINTENANCE

- A. Upon completion of seeding operations, the Contractor shall clear the area of all equipment, debris, and excess material, and the premises shall be left in a neat and orderly condition.
- B. Maintain all seeded areas without additional payment until final acceptance of the work by the Owner. Regrading, refertilizing, reliming, reseeding, or remulching shall be done at Contractor's expense. Seeding work shall be repeated on defective areas until a satisfactory uniform stand is achieved. Damage resulting from erosion, gullies, washouts, or other causes shall be repaired by filling with topsoil, compacting, and repeating the seeding work.

END OF SECTION

DIVISION 33

UTILITIES

SECTION 33 12 13

WATER SERVICES

PART 1 - GENERAL

1.1 SCOPE

- A. The work described by this section includes furnishing all labor, materials, and equipment required to install new water meters, including all meter boxes and covers, meter yokes, valves, fittings, accessories, etc., as specified herein and/or shown on the Drawings.

PART 2 - PRODUCTS

2.1 COPPER SERVICE TUBING

- A. Copper service tubing shall be seamless Type K soft copper, ASTM B88. Goosenecks shall be a minimum of 5 feet long.

2.2 METER FITTINGS AND ACCESSORIES

- A. Service saddles shall be utilized in connecting corporation stops and service lines to all water mains. Service saddles shall be Ford, S-70 Series with 2-inch outlet, or in accordance with Utility requirements.
- B. Corporation stops shall be provided on each service connection to the water main. Corporation stops shall be of the plug type and shall be designed and manufactured in accordance with AWWA Standard C800 and shall be constructed of red brass. Corporation stop shall be Ford, Series F-1000 for 2-inch service, or in accordance with Utility requirements and shall have compression fittings.
- C. Install Ford, B-41 Series curb stop or in accordance with Utility requirements and plastic cap protector.

PART 3 - EXECUTION

- A. A meter service shall be installed for each opposite street connection to the water distribution system. Service lines shall be installed between the water main and the property line. Meter boxes shall be set at the property line by the Utility and connected to the new service line. The exact field location of the meter box shall be determined by the Utility and shall be located to provide easy access to the meter reader and serviceman; not be a hazard to the customer or public; and be reasonably well protected against frost, mechanical damage, and tampering.
- B. Water meters shall not be installed in meter boxes by the Utility until construction of the residence has been completed and all pipelines have been flushed clean of all mud and grit deposits, and have been disinfected.

END OF SECTION

SECTION 33 12 13.13

BACKFLOW PREVENTION DEVICES

PART 1 - GENERAL

1.1 SCOPE

- A. The work covered by this section includes furnishing all labor, materials, and equipment required to furnish, install, and test backflow prevention devices as specified herein and/or shown on the Drawings.
- B. Reduced pressure backflow preventer shall be provided and installed.

1.2 SHOP DRAWINGS AND ENGINEERING DATA

- A. Complete shop drawings and engineering data shall be submitted to the Engineer in accordance with the requirements of Section 01 33 23 - Shop Drawings, Product Data and Samples.

1.3 STORAGE AND PROTECTION

- A. Backflow prevention devices shall be stored and protected in accordance with the requirements of Section 01 66 00, Storage and Protection.

1.4 OPERATION AND MAINTENANCE DATA

- A. Submit complete operation and maintenance data on the backflow prevention devices in accordance with the requirements of Section 01 78 23, Operating and Maintenance Data.

1.5 GUARANTEE

- A. Provide a guarantee against defective or deficient equipment and workmanship in accordance with the requirements of Section 01 78 36, Warranties and Bonds.

1.6 QUALITY ASSURANCE

- A. The manufacturer shall provide the Engineer with written certification that all reduced pressure backflow prevention devices furnished comply with all applicable requirements of AWWA C510 or C511, latest edition.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Backflow prevention devices shall operate on the reduced pressure principle and shall conform to the applicable requirements of AWWA C511, latest edition.

- B. Backflow prevention devices shall be suitable for a working pressure of not less than 150 psig. Pressure loss at rated flow shall not exceed that given in Table 1 of AWWA C511. Size of relief valve waterway and relief rate shall not be less than that given in Table 2 of AWWA C511.
- C. Backflow prevention devices shall have the number of the manufacturer, size and model number, serial number, pressure rating, and direction of flow cast in the metal or stamped on a permanently attached, corrosion-resistant metal nameplate.

2.2 CONSTRUCTION

- A. The backflow prevention device shall consist of two independently acting, internal-loaded check valves; an automatically operated, differential pressure relief valve located between the two check valves; two shut-off valves, one on each end of the device; four test cocks; and relief piping to drain.
- B. The backflow prevention device shall operate so that the pressure in the reduced pressure zone is at least 2 psi lower than the supply pressure during normal and no-flow conditions. Should the supply pressure drop below 2 psi, the relief valve shall open fully to atmosphere. If backflow occurs, the relief valve shall open to maintain the pressure in the reduced pressure zone at least 0.5 psi lower than supply pressure. Check valves shall be located so that the valves will be drip-tight in the direction of flow at 1 psi inlet pressure.
- C. The device shall be constructed so that all internal parts are accessible for maintenance or replacement without removing the device from the line.
- D. Valve body and bonnets shall be constructed of cast iron conforming to ASTM A126, Class B, or cast bronze conforming to ASTM B61. Seat rings, stems, springs, and bushings shall be bronze or 18-8 stainless steel. Diaphragms shall be cotton-reinforced neoprene. Cast iron components shall be galvanized or epoxy-coated for corrosion resistance.
- E. Valves 1½ inches in size and smaller shall have threaded ends per ANSI B2.1. Valves 2 inches through 2½ inches in size may be threaded or flanged. Valves 3 inches in size and larger shall be furnished with 125-pound flanged ends per ANSI B16.1 or B16.24.

2.3 SPARE PARTS

- A. The following spare parts shall be furnished for backflow prevention devices:

1. Seats, springs, and diaphragm	1 set each valve
2. O-rings and gaskets	1 set each valve
3. Packing	1 set each valve
4. Special tools	1 each
- B. Spare parts shall be suitably protected against corrosion and impact for long-term storage. Parts shall be clearly identified by manufacturer's name and number and the equipment to which they belong.

2.4 SIZE

- A. As indicated on the Drawings.

PART 3 - EXECUTION

3.1 FACTORY TESTING

- A. All backflow prevention devices shall be tested at the place of manufacture at a hydrostatic pressure of 300 psi in accordance with AWWA C510/C511.

3.2 INSTALLATION

- A. Backflow prevention devices shall be installed in accordance with the Drawings and approved manufacturer's shop drawings. Devices shall be installed above grade so that no part of the unit can be submerged. Relief drain piping shall be provided with an air gap as shown on the Drawings. Drain piping shall be no smaller than the drain opening. Devices located outdoors shall be installed in a suitable concrete or masonry enclosure for freeze protection. The device shall be easily accessible for maintenance and testing.
- B. After installation, the device shall be tested in the presence of the Engineer. The ability of the device to operate properly without leakage or backflow shall be demonstrated to the satisfaction of the Engineer. The Contractor shall modify or adjust the device as necessary at his own expense for satisfactory operation.

END OF SECTION

SECTION 33 13 00

DISINFECTION OF POTABLE WATER LINES AND WATER STORAGE TANKS

PART 1 - GENERAL

1.1 SCOPE

- A. The work covered by this section includes furnishing all labor, equipment, materials, and chemicals required to disinfect all potable water lines and water storage tanks in accordance with the procedures specified herein.
- B. Disinfect all plant units, piping, pumps and connections thereto, all distribution system piping and storage tanks and any surfaces that shall be in contact with potable water, upon completion of the construction and installation of equipment.
- C. No portion of new work shall be placed in service until disinfection has been completed and approved by the Engineer. Should the initial treatment fail to result in acceptable water, the chlorination procedure shall be repeated until satisfactory results are obtained.

1.2 STANDARDS

- A. Procedures for disinfecting potable water lines, unless otherwise modified herein, shall conform to the requirements of AWWA C651.
- B. Procedures for disinfecting water storage facilities, unless otherwise modified herein, shall conform to the requirements of AWWA C652.

PART 2 - PRODUCTS

2.1 DISINFECTION AGENT

- A. The disinfection agent shall be free chlorine or chlorine compound. The method of application and type of disinfecting agent shall both be acceptable to the Engineer.

PART 3 - EXECUTION

3.1 DISINFECTION PROCEDURE

- A. All new water mains, as well as those taken out of service for inspection, repair or other activities that might lead to contamination of water shall be disinfected before they are placed in or returned to service. Disinfection of the new mains and the disposal of the heavily chlorinated water, following the disinfection, shall be accomplished in accordance with the latest edition of AWWA Standard C651. The "tablet method" of disinfection which consists of placing calcium hypochlorite granules or tablets in the water main as it is being installed and then filling the main with potable water when installation is complete is not allowed. Before the main is chlorinated, it shall be filled

to eliminate air pockets and shall be flushed to remove particulates. A flushing velocity of not less than 2.5 feet/second is usually maintained in pipe sizes less than 24 inches in diameter. For larger diameter mains, alternative to flushing, such as broom-sweeping of the main, is acceptable prior to chlorinating the main. During disinfection of the water mains, an appropriate cross-connection control device, consistent with the degree of hazard, shall be provided for backflow protection of the active distribution system. Quality of the water used during the disinfection procedures shall meet the required drinking water standards.

The chlorine solution used for disinfection of water mains shall have a free chlorine residual concentration not less than 25 mg/L. This heavily chlorinated water shall be retained in the main for at least 24 hours, during which time all valves and hydrants shall be operated to ensure disinfection of the appurtenances. At the end of the 24-hour period, the treated water in all portions of the main shall have a residual of not less than 10 mg/L free chlorine. Re-chlorinate if required results are not obtained on all samples.

After the applicable retention period, the heavily chlorinated water must not be disposed in a manner that will harm the environment. Neutralizing chemicals, such as Sulfur Dioxide, Sodium Bisulfite, Sodium Sulfite or Sodium Thiosulfate can be used to neutralize the chlorine residual remaining in the water to be wasted. Flush all lines until residual is equal to existing system. After final flushing and before the water main is placed into service, water samples shall be collected from the main and tested for microbiological quality in accordance with the Georgia Rules for Safe Drinking Water, Chapter 391-3-5. The laboratory results must show the absence of coliform organisms in the water. Reflush and re-disinfect the lines, as necessary, until satisfactory bacteriological results are obtained.

- B. Prior to disinfection, all surfaces shall be thoroughly flushed with clear water. Disinfection of water storage facilities (including clearwells) shall be accomplished by the following AWWA standard method:
 - 1. Chlorination Method No. 3. Water and chlorine shall be added to the storage facility in amounts such that initially the solution will contain 50 mg/l available chlorine and will fill approximately 5 percent of the total storage volume. This solution shall be held in the storage facility for a period of not less than 6 hours. The storage facility shall then be filled to the overflow level by flowing potable water into the highly chlorinated water. It shall be held full for a period of not less than 24 hours. The actual volume of the 50 mg/l chlorine solution shall be such that, after the solution is mixed with filling water and the storage facility is held full for 24 hours, there will be a free chlorine residual of not less than 2 mg/l.
- C. Following these procedures, two bacteriological tests shall be taken and the results of the tests be negative before the facility is put into service. If either of the samples is positive, the disinfection procedure must be repeated.
- D. In the process of chlorinating newly constructed units and newly installed pipe, all valves or other appurtenances shall be operated at least five times while the units and pipelines are filled with the chlorinating agent.

END OF SECTION

SECTION 33 40 00

STORM SEWERAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes storm sewerage system piping and appurtenances from a point 5 feet outside the building to the point of disposal.
- B. Related Sections. The following sections contain requirements that relate to this section:
 - 1. Section 03 30 00, Cast-In-Place Concrete, for cast-in-place concrete drainage structures.
 - 2. Section 31 20 00, Earthwork, for excavation and backfill required for storm sewerage system piping and structures.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplemental Conditions and other Division 1 Specification sections, apply to this section.

1.3 SUBMITTALS

- A. General. Submit the following in accordance with Conditions of Contract and Division 1 Specification sections.
- B. Product data for drainage piping specialties.
- C. Shop drawings for precast concrete storm drainage manholes and catch basins, including frames, covers, and grates.

1.4 SEQUENCING AND SCHEDULING

- A. Coordinate with other utility work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers. Subject to compliance with requirements, provide products by one of the following:
 - 1. Cleanouts
 - a. Josam Co.
 - b. Smith (Jay R.) Mfg. Co.
 - c. Wade Div.; Tyler Pipe.

2. Trench Drain System
 - a. ACO Polymer Products, Inc.
 - b. Innovative Plastic Products, Inc.
 - c. PolyDrain, Inc.
 - d. Advanced Drainage System, Inc.

3. Underground Warning Tapes
 - a. Brady (W.H.) Co.; Signmark Div.
 - b. Carlton Industries, Inc.
 - c. Seton Name Plate Co.

2.2 PIPE AND FITTINGS

- A. General. Provide pipe and pipe fittings materials compatible with each other. Where more than one type of materials or products is indicated, selection is installer's option.

- B. Polyvinyl Chloride (PVC) Sewer Pipe and Fittings. ASTM D 3034, SDR 35, for elastomeric gasket joints.
 1. Gaskets: ASTM F 477, elastomeric seal.

- C. Corrugated Metal Drainage Structures
 1. AASHTO M36, M274, M196, M167, or M219.
 2. For bituminous coated corrugated metal, the following standards apply:
 - a. Railroads - AREA Manual, Volume 1, Chapter 1, Part 4.
 - b. Non-Railroad - AASHTO M90.

- D. Corrugated Polyethylene Drainage Pipe
 1. ASTM F 405 (3- to 6-inch diameter) and ASTM F 667 (8- to 36-inch diameter)
 2. AASHTO Designation M252 and M294
 3. Corrugated pipe, having a Manning's n-value of 0.018 or 0.020
 4. Smooth interior wall corrugated pipe, having a Manning's n-value of 0.010. (Advanced Drainage Systems, Inc., Type N-12, or equal.)
 5. Pipe and fittings shall be made of polyethylene compounds which meet or exceed the requirements of Type III, Category 4 or 5, Grade P33 or P34, Class C per ASTM D 1248.
 6. Joints shall be made with split couplings, corrugated to engage the corrugations, with at least 4 corrugations, 2 on each side of the joint. Provide a neoprene gasket to make a soil-tight connection.

- E. Reinforced Concrete Sewer Pipe and Fittings. ASTM C 76, Class III, Wall B, for tongue and groove or bell and spigot joints.

1. Gaskets: ASTM C443, rubber.
- F. Couplings. Rubber or elastomeric compression gasket, made to match pipe inside diameter or hub, and adjoining pipe outside diameter.
1. Gaskets: ASTM C 443, rubber for concrete pipe; and ASTM F 477, elastomeric seal for plastic pipe. Gaskets for dissimilar or other pipe materials shall be compatible with pipe materials being joined.

2.3 MANHOLES

- A. Precast Concrete Manholes. ASTM C 478, precast reinforced concrete, of depth indicated with provision for rubber gasket joints.
1. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having a separate base slab or base section with integral floor.
 2. Riser Sections: 4-inch minimum thickness, 48-inch diameter, and lengths to provide depth indicated.
 3. Top Section: Eccentric cone type, unless concentric cone or flat-slab-top type is indicated. Top of cone to match grade rings.
 4. Grade Rings: Provide 2 or 3 reinforced concrete rings, of 6 to 9 inches total thickness and match 24-inch-diameter frame and cover.
 5. Gaskets: ASTM C 443, rubber.
 6. Steps: As indicated on Drawings.
 7. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.
 8. Channel and Bench: Concrete.
- B. Brick Manholes. Brick and mortar, of depth indicated.
1. Base, Channel, and Bench: Concrete.
 2. Wall: ASTM C 32, Grade MS, manhole brick; 8-inch minimum thickness, 48-inch diameter, with tapered top for a 24-inch frame and cover. Thickness of section of wall deeper than 8 feet shall be 12 inches minimum.
 3. Mortar and Parging: ASTM C 270, Type S, using ASTM C 150, Type II portland cement.
- C. Cast-in-Place Manholes. Reinforced concrete of dimensions and with appurtenances indicated.
1. Bottom, Walls, and Top: Reinforced concrete.
 2. Channel and Bench: Concrete.

3. Steps: Cast into sidewall at 12- to 16-inch intervals.
- D. Manhole Step. Wide enough for an adult to place both feet on one step and designed to prevent lateral slippage off the step.
1. Material: Ductile iron, cast aluminum, or steel reinforced plastic (½-inch, Grade 60).
- E. Manhole Frames and Covers. ASTM A 536, Grade 60-40-18, heavy-duty, ductile iron, 24-inch inside diameter by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch-diameter cover, indented top design, with lettering "STORM SEWER" cast into cover.

2.4 CLEANOUTS

- A. General. Provide cast-iron ferrule and countersunk brass cleanout plug, with round cast-iron access frame and heavy-duty, secured, scoriated cast-iron cover.

2.5 CATCH BASINS

- A. Precast Concrete Catch Basins. ASTM C 478 or ASTM C 858, precast reinforced concrete, of depth indicated. Sections shall have provision for rubber gasket joints. Base section slab shall have minimum thickness of 6 inches, riser sections shall have minimum thickness of 4 inches and be 48 inches inside diameter, and top section and grade rings shall match 24-inch frame and grate, unless otherwise indicated.
1. Base Section: Base riser section and separate base slab, or base riser section with integral floor.
 2. Riser Sections: Sections shall be of lengths to provide depth indicated.
 3. Top Section: Flat slab type with opening to match grade rings.
 4. Grade Rings: Provide 2 or 3 reinforced concrete rings, of 6 to 9 inches total thickness.
 5. Gaskets: ASTM C 443, rubber.
 6. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.
 7. Channel and Bench: Concrete.
- B. Catch Basin Frames and Grates. ASTM A 536, Grade 60-40-18, heavy-duty, ductile iron, 24-inch inside diameter by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch-diameter flat grate having small square or short slotted drainage openings.
- C. Curb Inlets. Precast concrete, brick, or other materials, of dimensions conforming to utility standards.

2.6 OUTFALLS

- A. General. Construct of cast-in-place reinforced concrete pipe, head wall, apron, tapered sides, and with riprap, as indicated.
 - 1. Riprap: Broken stone, irregular size and shape, weighing 15 to 50 pounds each.

2.7 IDENTIFICATION

- A. Metallic-Lined Plastic Underground Warning Tapes: Polyethylene plastic tape with metallic core, 6 inches wide by 4 mils thick, solid green in color with continuously printed caption in black letters "CAUTION - SEWER LINE BURIED BELOW."

PART 3 - EXECUTION

3.1 PREPARATION OF FOUNDATION FOR BURIED STORM SEWERAGE SYSTEMS

- A. Grade trench bottom to provide a smooth, firm, stable, and rock-free foundation, throughout the length of the pipe.
- B. Remove unstable, soft, and unsuitable materials at the surface upon which pipes are to be laid, and backfill with clean sand or pea gravel to indicated level.
- C. Shape bottom of trench to fit bottom of pipe. Fill unevenness with tamped sand backfill. Dig bell holes at each pipe joint to relieve the bells of all loads and to ensure continuous bearing of the pipe barrel on the foundation.

3.2 PIPE APPLICATIONS FOR UNDERGROUND STORM SEWERS

- A. Pipe Sizes 12 Inches and Larger: Reinforced concrete sewer pipe and fittings.
- B. Pipe Sizes 15 Inches and Smaller: PVC gasket joint sewer pipe and fittings.
- C. Pipe Sizes 12 Inches and Larger: HDPE gasket joint corrugated drainage pipe and fittings, Type I - Smooth Interior Wall.
- D. Pipe Sizes 12 Inches and Larger: HDPE gasket joint corrugated drainage pipe, Type II - Corrugated Interior Wall.

3.3 INSTALLATION GENERAL

- A. General Locations and Arrangements. Drawings (plans and details) indicate the general location and arrangement of the underground storm sewerage system piping. Location and arrangement of piping layout take into account many design considerations. Install the piping as indicated, to the extent practical.
- B. Install piping beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings in accordance with manufacturer's recommendations for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.

- C. Use manholes or catch basins for changes in direction, except where a fitting is indicated. Use fittings for branch connections, except where direct tap into existing sewer is indicated.
- D. Use proper size increasers, reducers, and couplings, where different size or material of pipes and fittings are connected. Reduction of the size of piping in the direction of flow is prohibited.
- E. Install piping pitched down in direction of flow, at minimum slope of 1 percent, except where indicated otherwise.
- F. JOIN AND INSTALL PVC PIPE:
 - 1. Pipe and gasketed fittings, joining with elastomeric seals in accordance with ASTM D 3212.
 - 2. Installation in accordance with ASTM D 2321.
- G. Join concrete pipe and fittings with rubber gaskets in accordance with ASTM C 443, and install piping in accordance with applicable provisions of ACPA "Concrete Pipe Installation Manual."
- H. Join different types of pipe with standard manufactured couplings and fittings intended for that purpose.
- I. Join HDPE with rubber or neoprene gaskets according to manufacturer's requirements.

3.4 MANHOLES

- A. General. Install manholes complete with accessories as indicated. Form continuous concrete or split pipe section channel and benches between inlets and outlet. Set tops of frames and covers flush with finish surface where manholes occur in pavements. Elsewhere, set tops 3 inches above finish surface, unless otherwise indicated.
- B. Place precast concrete manhole sections as indicated, and install in accordance with ASTM C 891.
- C. Apply bituminous mastic coating or sand-cement grout at joints of sections.

3.5 CLEANOUTS

- A. Install cleanouts and extension from sewer pipe to cleanout at grade as indicated. Set cleanout frame and cover in concrete block 18 by 18 by 12 inches deep, except where location is in concrete paving. Set top of cleanout 1 inch above surrounding earth grade or flush with grade when installed in paving.

3.6 CATCH BASINS

- A. Construct catch basins to sizes and shapes indicated.
- B. Set frames and grates to elevations indicated.

3.7 OUTFALLS

- A. Construct outfalls of reinforced concrete which will attain 28-day compressive strength of not less than 3,000 psi.

3.8 TAP CONNECTIONS

- A. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus 6-inch overlap, with not less than 6 inches of 3,000 psi 28-day compressive-strength concrete.
- B. Make branch connections from side into existing 24-inch or larger piping or to underground structures by cutting opening into existing unit sufficiently large to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall, unless otherwise indicated. On outside of pipe or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.
 - 1. Provide concrete that will attain minimum 28-day compressive strength of 3,000 psi, unless otherwise indicated.
 - 2. Use epoxy bonding compound as interface between new and existing concrete and piping materials.

3.9 FIELD QUALITY CONTROL

- A. Cleaning. Clear interior of piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed.
 - 1. Place plugs in ends of uncompleted pipe at end of day or whenever work stops.
 - 2. If inspection indicates poor alignment, debris, displaced pipe, infiltration, or other defects, correct such defects and reinspect.

END OF SECTION

SECTION 33 42 16

CONCRETE PIPE SEWERS

PART 1 - GENERAL

1.1 SCOPE

- A. The work included in this section includes furnishing all labor, equipment, and materials required to install, test, and inspect precast concrete sewers including all risers, plugs, fittings, and bedding as shown on the Drawings and/or specified herein.

1.2 QUALITY ASSURANCE

- A. Submit to the Owner and Engineer the concrete pipe manufacturer's evidence of a working Quality Control Program for approval, prior to any pipe being manufactured. The program and standards of manufacturing must be established and well defined. The program must include the minimum following requirements:
 - 1. A full time quality control technician.
 - 2. A complete and working quality control laboratory capable of testing and recording the requirements set forth in these Specifications for concrete pipe.
 - 3. Written documentation of the concrete pipe manufacturers performance on a recent sewer project. The performance results must be from a tested and approved installation of the pipe material set forth in this specification from either the Owner and/or Engineer stating that the pipe tested and met the requirements.
 - 4. A zero defect program for daily material testing and finished product testing to assure quality control as the pipe is being manufactured and shipped for this particular project.
 - 5. Provide the services of a competent factory representative of the pipe manufacturer for purposes of supervising and/or inspecting the installation of pipe. This service shall be for the duration of the project.
 - 6. Provide equipment and labor to air test each joint of pipe (30-inch diameter and smaller) as it is installed. For pipe larger than 30-inch-diameter, joint tester shall be "Cherne Large Diameter Joint Tester" or equal. This testing shall in no way relieve the Contractor from the responsibility of performing infiltration/exfiltration tests as detailed in Item 3.06 of this section.
- B. Each joint of pipe, each fitting and special shall be inspected by an independent commercial testing laboratory acceptable to the Engineer prior to delivery. Each piece of pipe shall be stenciled or otherwise clearly and legibly marked with the laboratory's mark of acceptance.
- C. Each pipe shall be clearly marked as required by the governing ASTM standard specifications to show its class, date of manufacture, and the name of trademark of the manufacturer.

- D. Any pipe or specials which have been broken, cracked or otherwise damaged before or after delivery or which have failed to meet the required tests, shall be removed from the site of the work and shall not be used therein. All pipe interiors shall be completely free from voids and holes. Any pipe section which fails any test after installation shall be removed and replaced at no additional cost to the Owner.
- E. Pipe shall be designed for the anticipated external dead and live loads. Unless otherwise shown or specified, pipe and fittings shall be designed for a working pressure of 35 feet, a transient surge pressure of 70 feet; also, pipe shall be designed for maximum loads due to soil, vehicles, hydrostatic (500-year flood), flotation, etc. Unless otherwise shown or specified, bedding shall be as shown on the Drawings. Pipe located under roads or driveways shall be designed for AASHTO H20 wheel loading.

1.3 GUARANTEE

- A. Provide a guarantee against defective materials and workmanship in accordance with the requirements of Section 01 78 36, Warranties and Bonds.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Pipe and special fittings shall be furnished in sizes, types, and classes at the locations shown on the Drawings, and/or specified herein.
- B. All pipe and specials shall be new materials which have not been previously used.

2.2 BEDDING

- A. Bedding for concrete pipe shall be provided in three classes, Class A, Class B, and Class C, as shown on the Drawings to fit the depth of trench, type and size of pipe, width of trench, and bearing value of subgrade.
- B. Class A bedding shall consist of Class B concrete cradles constructed as shown on the Drawings. Wherever the Contractor places concrete for cradles outside the dimensions shown on the Drawings, the cost of such concrete will be at the expense of the Contractor.
 - 1. Where concrete cradle is used, the pipe shall be laid on concrete saddles so constructed as to provide both vertical and lateral support for the pipe while the cradle is being placed. Pipe supports of wood blocks, loose brick, etc., will not be permitted. The concrete cradle shall be poured after the joints have been made, care being taken to prevent movement of the pipe.
- C. Class B bedding shall consist of ½ inch or smaller crushed rock or gravel, sand, or other approved granular materials as shown on the Drawings. Placement of this material shall be done carefully. Material shall be thoroughly compacted by tamping.

- D. Class C bedding shall consist of ½ inch or smaller crushed rock or gravel, sand, or other approved materials as shown on the Drawings. Placement of this material shall be done carefully. Material shall be thoroughly compacted by tamping.
- E. The determination of the bedding class shall be from actual width of trench. If Contractor increases width of trench for his convenience or due to collapse of trench walls so that a higher class of bedding is required, the increased cost of same shall be borne by the Contractor. If the bearing value of the subgrade is determined by the Engineer to be inadequate for a particular class of bedding, substitute a higher class of bedding as directed by the Engineer.
- F. Bedding shall be in accordance with the schedule and dimensions shown on the Drawings.

2.3 CONCRETE PIPE

- A. All concrete pipe and fittings 15 inches in diameter and larger shall be reinforced concrete culvert, storm drain and sewer pipe conforming to the latest requirements of ASTM C 76 or ASTM C655, as applicable, with the following modifications:
 - 1. Pipe installed in railroad crossings shall be Class V. All other pipe shall be Class IV unless a different class is specifically called for on the Drawings. Wall thickness shall be in accordance with Wall B for the required class of pipe as shown in ASTM C76.
 - 2. The minimum cement content of the concrete used in the manufacture of the pipe 24 inches and smaller in diameter shall be six bags per cubic yard of concrete.
 - 3. Concrete shall have a minimum compression strength of 5,000 psi.
 - 4. Absorption rate of sample from the pipe wall shall not exceed 6 percent when tested in accordance with ASTM C 497.
- B. Pipe shall have circumferential reinforcement as required for the particular class of pipe furnished. The bell and spigot of the joint shall contain circumferential and longitudinal reinforcement. Reinforced concrete pipe shall be centrifugally cast or Vibrated Pre-Bed, horizontally or vertically cast or made on a Packerhead machine and shall be furnished in lengths not more than 16 feet and not less than 8 feet, except where short lengths are required for construction conditions. Reinforced concrete pipe shall have bell and spigot joints suitable for the use of a rubber gasket to be provided as a part of this item.
- C. Concrete pipe for sanitary sewers shall have bell and spigot joints consisting of self-centering steel joint rings conforming to ASTM C 361. Joint rings shall be securely welded to the pipe reinforcing steel. The rings which form the joint shall be made so that they will join with a close, sliding fit. The joint surfaces shall be such that the rubber gasket shall be confined on all sides and shall not support the weight of the pipe.
 - 1. The spigot ring shall have an external groove accurately sized to receive the gasket. Special section steel for spigot rings shall conform to ASTM A 283, Grade A, or ASTM A 306, Grade 50.

2. The bell ring shall be flared to permit gradual deformation of the gasket when the joint is assembled. Minimum thickness of bell rings shall be 3/16 inch. Bell rings for pipe sizes 78 inches and larger shall have a minimum thickness of 1/4 inch. Bell rings 1/4 inch or thicker shall conform to ASTM A 283, Grade A, or ASTM A 306, Grade 50. Bells less than 1/4 inch thick shall conform to ASTM A 570, Grade A.
3. The steel end ring on both the spigot and bell ends shall be provided with a 6-inch-wide, 14-gauge steel skirt welded full circumference to the ring. The skirt shall also be welded to the reinforcing of the pipe barrel.
4. Each ring shall be precisely sized by expansion beyond the elastic limit of the steel and then gauged on an accurate template. All exposed surfaces of both rings shall be protected by a corrosion-resistant coating of zinc applied by an approved metallizing process after proper cleaning.
5. Spacer bars or chairs provided to maintain reinforcement cage or cages in proper position within the forms during placement and consolidation of the concrete shall be plastic or similarly nonoxidizable material.

PART 3 - EXECUTION

3.1 PIPE LAYING

- A. Before sewer pipe is placed in position in the trench, the bottom and sides of the trench shall be carefully prepared and bracing and sheeting installed where required. A mason's line, supported at intervals not exceeding 50 feet, shall be stretched tightly above ground level at a grade parallel to and directly above the axis line of the pipe. Each pipe shall be accurately placed to the exact line and grade called for on the Drawings by measuring down from this line to the invert of the pipe in place. Furnish all labor and materials necessary for erecting banner boards and establishing lines and grades therefor.
- B. Use the laser beam method of setting a line and grade for the sewer by using the laser beam coaxially through the center of the sewer being laid. The laser beam projector is to be rigidly mounted to its support platforms, with a two-point suspension, or equivalent, assuring that all ground and equipment vibrations are kept to an absolute minimum. Furnish all equipment including equipment necessary to control atmospheric conditions in the pipe to keep line and grade to acceptable standards of accuracy. The laser beam system must be operated by competent experienced men who have been properly trained to operate the equipment used.
- C. Stake check pegs at all manholes throughout the job. Provide check pegs midway between manholes and any other check points deemed necessary to assure accuracy of the equipment.
- D. Each piece of pipe and special fitting shall be carefully inspected before it is placed and no defective pipe shall be laid in the trench. Pipe laying shall proceed upgrade, starting at the lower end of the grade and with the bells uphill. No pipe shall be laid except in the presence of an inspector representing the Engineer. Trench booms found to be

unsuitable for foundations after pipe laying operations have started shall be corrected and brought to exact line and grade with approved compacted materials.

- E. Bell holes shall be of sufficient size to allow ample room for making the pipe joints properly. Bell holes shall not be cut out more than ten joints ahead of pipe laying. The bottom of the trench between bell holes shall be carefully graded so that the pipe barrel will rest on a solid foundation for its entire length as shown on the Drawings. Each joint shall be laid so that it will form a close concentric joint with adjoining pipe in order to avoid sudden offsets or inequalities in the flow line.
- F. Water shall not be allowed to run or stand in the trench while pipe laying is in progress or before the joints are completely set or before the trench has been backfilled. The Contractor at no time shall open up more trench than his available pumping facilities are able to dewater. Where sewer pipelines are located in or across stream beds or drainage ditches, divert the stream flow and dewater each section as the work progresses.
- G. No joints shall be made where pipe or joint materials have been soiled by earth in handling until such soiled surfaces are thoroughly cleaned by wire brushing and wiping until all traces of the earth are removed.
- H. The interior of all pipe shall be kept thoroughly clean as the work progresses. After each line of pipe has been laid, it shall be carefully inspected and all earth, trash, rags, and other foreign matter removed from the interior. A filled bag or other approved type of follower shall be pulled through the line immediately after each joint is made in order to remove any debris which may be left on the inside of the pipe.
- I. Backfilling of trenches shall be started immediately after the pipe in place has been inspected and approved by the Engineer and backfill shall be deposited and compacted as provided under Section 31 20 00, Earthwork.

3.2 JOINT CONSTRUCTION

A. Rubber O-Ring Gasket Joints

- 1. Laying O-ring rubber gasket pipe shall be done in accordance with the pipe manufacturer's instructions using all the necessary materials, lubricants, and equipment recommended by the manufacturer.
- 2. Where wet conditions prevail always use Vreem" or a vegetable type shortening for lubrication. Never use "Flaxoap in water.

- #### B. Rubber Gasket and Bituminous Joints.
- Joints between consecutive bell and spigot or tongue and groove pipe made with a rubber gasket and compatible bituminous compound of a type recommended by the gasket manufacturer shall be constructed as follows: The gasket shall be fitted over the tongue or spigot of each pipe, the space behind the gasket filled with the bituminous compound on tongue and groove joints, and the pipe entered into the bell or groove and shoved home. The remainder of the joint space shall be filled with bituminous compound beveled off with the outside of the pipe.

C. Compression Type Joints

1. Defective joints discovered after laying shall be removed and replaced with new sections of pipe having undamaged joints. Defective pipes shall be removed and proper replacement made.
2. All openings shall be closed with an approved type concrete plug held securely in place. Dead ends of sewer lines shall be similarly stoppered.

3.3 INSTALLATION OF TEES, RISERS AND PLUGGED STUBS

- A. Tee branches shall be installed in the sewer lines at all places shown on the Drawings, specified herein or otherwise directed by the Engineer.
- B. Riser connections, of the size and type shown on the Drawings shall be installed at the locations shown on the Drawings or directed by the Engineer. A plastic film marking tape 5-foot long shall be placed 12 inches over the top of each riser during backfilling to mark the location of the riser. The marking tape shall be heavy gauge polyethylene film (.004 inch thick). Tape shall be standard red color imprinted with the words "Warning - Buried Sewer Line Below." Tape shall be Allen Marking Tape No. AMT-1212 as manufactured by the Allen System Inc., Glen Ellyn, Illinois, or equal. A second marking tape containing a metallic core which can be located with a metal detector shall be laid on top of the first marking tape. This tape shall be 5 feet long and 3 inches wide. Tape shall be Allen Detectotape Catalogue No. ADT-1003 for buried sewer line as manufactured by the Allen System Inc., or equal.
- C. Plugged pipe stubs for future connections to manholes and sewerage structures shall be installed where shown on the Drawings or directed by the Engineer. The pipe stubs shall be installed with the bell encased in the wall of the manhole and the bell opening flush with the outside wall of the manhole or structure.
- D. Plugged stubs and such branches of pipelines that are not to be used immediately shall be closed with compatible stoppers held securely in place.
- E. Connections to reinforced concrete pipe over 18 inches in diameter shall be made in accordance with details shown on the Drawings.

3.4 CONNECTIONS

- A. If the work consists of the construction of sewer that is to replace an existing sewer, all of the existing service lines shall be kept in operation and connected to the new line.
- B. Connections shall be made to all existing sewer lines in the vicinity of the work by removing a section of the sewer from the existing line and inserting in the space a tee branch of proper size, or by the construction of a manhole, regulator chamber or other structure as shown on the Drawings.
- C. Connections to manholes, inlets, or pipe where no plugged stubs exist shall be made by coring a hole at the required location. The hole shall be cored at a diameter to allow for the installation of a resilient connector such as Kor-N-Seal rubber boot or equal in the cored opening. The resilient connector shall meet the requirements set forth in ASTM C 923 (latest edition). Connections using mortar or other rigid materials will not

be acceptable. On connections to manholes, the bottom of the manhole shall be shaped to fit the invert of the sewer pipe as specified under Section, Sewer Manholes and Covers.

- D. Connections to building services shall be made in a neat and workmanlike manner. Cleanout plugs shall be installed, wherever feasible, by making the connection with a standard wye or tee.

3.5 EXISTING UTILITIES

- A. Carefully protect from damage at all times all existing sewers, water lines, gas lines, underground conduits, telephone lines, sidewalks, curbs, gutters, pavements, electric lines, or other utilities or structures in the vicinity of the work. Where it is necessary for the proper accomplishment of the work to repair, remove and/or replace any such utility, the work shall be done under the provisions set forth in the General Conditions. No separate payment shall be made for removing and replacing and/or repairing damaged existing sewers, water, gas, electric, telephone lines or conduits or other utilities, culverts, drains or conduits of similar existing services or structures. The removal, replacement and/or repair of these items shall be paid for in the lump sum price bid by the Contractor. Similar repair and replacement of sidewalks, curbs, gutters and pavements are provided elsewhere in these Specifications.

3.6 INSPECTION AND TESTING

- A. After completion of any section of sewerage, the grades, joints, and alignment shall be true to line and grade. Joint surfaces shall be smooth. There shall be no visual leakage and the sewer shall be completely free from any cracks and from protruding joint materials, deposits of sand, mortar or other materials on the inside.
- B. All pipe installed in this contract shall be subjected to a hydrostatic exfiltration test by filling the pipe and manholes with water, pumping to 10 psig for 2 hours continuous and a maximum leakage rate of 25 gallons per inch diameter per mile of sewer per 24 hours. All pipe not passing this maximum allowance shall be removed and replaced at no additional cost to the Owner. Furnish all supplies, materials, labor, services, etc., needed to make infiltration or exfiltration tests including water. No separate payment will be made for equipment, supplies, material, water, or services.
- C. Correct any leakage, including active seepage, by removal and replacement of pipe or joint where such leakage exists until the pipelines meet the requirements of the allowable leakage specifications.
- D. The sewers installed under this contract will be subject to television inspection by the Owner and/or Engineer. It is the intent to televise sewers which are suspected to contain defects. The Owner will furnish all equipment and materials for such supervision.
- E. Provide access for the Owner's crews and equipment for the television inspection and shall have his representative present during inspection.
- F. The television work shall be scheduled so as to take advantage of the time when the groundwater table is most likely to cause infiltration. Work shall be scheduled during

or after rainy periods rather than after prolonged periods of dry weather. Logs and/or tapes of the inspections will be made available to the Contractor.

- G. All sewer pipe shall be tested using low pressure air testing in accordance with the procedures and standards listed below:
1. Clean pipe to be tested by propelling snug-fitting inflated rubber ball through pipe with water.
 2. Plug all pipe outlets with suitable test plugs. Brace each plug securely to prevent blowouts. As a safety precaution, pressurizing equipment shall include a regulator set at slightly above test pressure to avoid overpressurizing and damaging an otherwise acceptable line. No one shall be allowed in the manhole during testing.
 3. During manhole fabrication, a ½-inch-diameter threaded pipe nipple shall be cast through the manhole wall directly on top of one of the sewer pipes entering the manhole. The threaded end of the nipple shall extend no more than two inches on the inside of the manhole. The total length of the nipple shall exceed the manhole wall thickness by no less than four inches. The pipe nipple shall be non-corrosive and resistant to chemicals common in domestic sewage. Special attention shall be given to providing a permanent, watertight seal around the pipe nipple at the manhole wall. The pipe nipple shall be sealed with a threaded ½-inch cap or plug. Every manhole need not have a pipe nipple, but 20 percent of all manholes on each line shall have an installed nipple. The Engineer shall assist the Contractor in selecting appropriate locations for manholes with pipe nipples installed.
 4. Add air slowly to the portion of the pipe installation under test until the internal air pressure is raised to 4.0 psig greater than the average back pressure of any groundwater above the pipe (0.43 psi per foot of groundwater above the pipe invert), but not greater than 9.0 psig.
 5. After an internal pressure of 4.0 psig is obtained, allow at least two minutes for air temperature to stabilize, adding only the amount of air required to maintain pressure.
 6. When pressure decreases to 3.5 psig, start stopwatch. Determine the time in seconds that is required for the internal air pressure to reach 3.0 psig. Minimum permissible pressure holding times for runs of single pipe diameter are indicated in the table in seconds. No separate allowance shall be given for laterals. Times for other sizes and lengths shall be calculated as described in ASTM C 828 using the formula $t = K D^2 L/Q$.

**TIME REQUIRED FOR A 0.5 PSIG PRESSURE DROP
FOR SIZE AND LENGTH OF PIPE INDICATED**

Pipe Dia. (in)	Min. Time (min: sec)	Length for Min. time (ft)	Time for Longer Length (sec)	Specification Time for Length (L) Shown (min:sec)								
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft	
15	7:05	159		7:05	7:05	8:54	11:08	13:21	15:35			
18	8:30	133		8:30	9:37	12:49	16:01	19:14	22:26	25:38		
21	9:55	114		9:55	13:05	17:27	21:49	26:11	30:32	34:54		
24	11:20	99	6.837xL	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17	
27	12:45	88	8.653xL	14:25	21:38	28:51	36:04	43:16	50:30	57:42	64:54	
30	14:10	80	10.683xL	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07	
33	15:35	72	12.926xL	21:33	32:19	43:56	53:52	64:38	75:24	86:10	96:57	
36	17:00	66	15.384xL	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23	
42	19:74	57	20.942xL	34:54	52:21	69:49	87:15	104:42	122:10	139:37	157:04	
48	22:67	50	27.352xL	45:35	68:23	91:11	113:58	136:46	159:33	182:21	205:09	

3.7 CLEANUP

- A. After completing each section of the sewer line, remove all debris and construction materials and equipment from the site of the work, grade and smooth over the surface on both sides of the line, and leave the entire right-of-way in a clean and neat condition. Unless otherwise called for on the Drawings, restore all disturbed areas to as close to its original condition as possible. Restoration shall include but not be limited to grassing, replacing shrubbery, trees, fences and other improvements which have been disturbed.
- B. Cleanup and restoration shall be completed within 60 calendar days after each section of sewer line is installed. Should the Contractor fail to do the cleanup within 60 calendar days, payment made for pipe sewers and service lines for that section of the sewer not cleaned up shall be removed from the periodic estimate until the cleanup work is completed.

END OF SECTION

DIVISION 40

PROCESS INTEGRATION

SECTION 40 05 13.53

DUCTILE IRON PIPE AND FITTINGS

PART 1 - GENERAL

1.1 SCOPE

- A. The work covered by this section includes furnishing all labor, equipment, and materials required to furnish, install, and test ductile iron piping, including all fittings, wall pipe and sleeves, couplings, tapings, anchor blocks, and accessories, as specified herein and/or shown on the Drawings.

1.2 QUALITY ASSURANCE

- A. Submit to the Engineer written evidence that the pipe furnished under this Specification is in conformance with the material and mechanical requirements specified herein. Certified copies of independent laboratory test results or mill test results from the pipe supplier may be considered evidence of compliance provided such tests are performed in accordance with the appropriate ASTM or AWWA testing standards by experienced, competent personnel. In case of doubt as to the accuracy or adequacy of mill tests, the Engineer may require that the Contractor furnish test reports from an independent testing laboratory on samples of pipe materials.
- B. Clearly mark each ductile iron pipe length and fitting with the pressure rating, metal thickness class, heat mark, net weight (excluding lining or coating), and name of the manufacturer. In addition, each item of piping shall be marked with an identifying mark corresponding to the appropriate mark on the shop drawings for that particular item of piping.

1.3 SHOP DRAWINGS AND ENGINEERING DATA

- A. Submit complete shop drawings and engineering data on all piping and accessories to the Engineer in accordance with the requirements of Section 01 33 23 - Shop Drawings, Product Data, and Samples.
- B. Shop drawings shall indicate piping layout in plan and elevations as may be required and shall be completely dimensioned. The Drawings shall include a complete schedule of all pipe, fittings, specials, hangers, and supports. Special castings shall be clearly detailed showing all pertinent dimensions.
- C. Furnish the Engineer with lists, in duplicate, of all pieces of pipe and fittings in each shipment received. These lists shall give the serial or mark number, weight, class, size, and description of each item received.

1.4 STORAGE AND PROTECTION

- A. Equipment and products stored outdoors shall be supported above the ground on suitable wooden blocks or braces arranged to prevent excessive deflection or bending between supports. Items such as pipe, structural steel, and sheet construction products shall be stored with one end elevated to facilitate drainage.

1.5 SHOP PAINTING

- A. All ductile iron pipe and fittings shall be cleaned and provided with a bituminous coating and cement lining applied at the factory, unless otherwise specified herein.

1.6 GUARANTEE

- A. Provide a guarantee against defective materials and workmanship in accordance with the requirements of Section 01 78 36, Warranties and Bonds.

1.7 ACCEPTABLE MANUFACTURERS

- A. Ductile iron pipe and fittings must be the products of member companies of the Ductile Iron Pipe Research Association (DIPRA). Products from manufacturers who are not DIPRA member companies shall not be utilized in the work covered by these Specifications.

PART 2 - PRODUCTS

2.1 GENERAL

- A. No broken, cracked, deformed, misshapen, imperfectly coated, or otherwise damaged or defective pipe or fittings shall be used. All such material shall be removed from the site of the work.
- B. Minimum pipe wall thickness and pressure class of pipe shall be as follows, unless otherwise shown on the Drawings or directed by the Engineer:

<u>Pipe Size</u>	<u>Pressure Class (psi)</u>	<u>Metal Wall Thickness in Inches</u>
3-Inch Ductile Iron	350	0.25
4-Inch Ductile Iron	350	0.25
6-Inch Ductile Iron	350	0.25
8-Inch Ductile Iron	350	0.25
10-Inch Ductile Iron	350	0.26
12-Inch Ductile Iron	350	0.28
14-Inch Ductile Iron	350	0.31
16-Inch Ductile Iron	350	0.34
18-Inch Ductile Iron	300	0.34
20-Inch Ductile Iron	300	0.36
24-Inch Ductile Iron	250	0.37
30-Inch Ductile Iron	250	0.42
36-Inch Ductile Iron	250	0.47
42-Inch Ductile Iron	250	0.52
48-Inch Ductile Iron	250	0.58
54-Inch Ductile Iron	250	0.65
60-Inch Ductile Iron	250	0.68
64-Inch Ductile Iron	250	0.72

2.2 DUCTILE IRON PIPE

- A. Ductile iron pipe shall be designed in accordance with ANSI/AWWA C150/A21.50, "Thickness Design of Ductile Iron Pipe," using 60,000-psi tensile strength, 42,000-psi yield strength, and 10 percent elongation. Additionally, ring bending stress is limited to 48,000 psi to provide a 2.0 safety factor based upon ultimate bending stress.
- B. Ductile iron pipe shall be manufactured in accordance with ANSI/AWWA C151/A21.51, "Ductile Iron Pipe Centrifugally Cast for Water," and shall be made of ductile iron having a minimum tensile strength of 60,000 psi, a minimum yield strength of 42,000 psi, and 10 percent minimum elongation.

2.3 DUCTILE IRON FITTINGS

- A. All fittings shall conform in every respect to ANSI/AWWA C110/A21.10, "Ductile Iron Compact Fittings for Water Service" or ANSI/AWWA C153/A21.53, "3 Inch through 16 Inch for Water and Other Liquids."
- B. All fittings shall be for pressure rating of 250 psi, unless otherwise shown on the Drawings, directed, or specified.
- C. Flanged fittings, in general, shall be ANSI pattern using long radius elbows except where space limitations prohibit the use of same. Design of all fittings, whether long or short pattern, shall be as indicated or dimensioned on the Drawings. Special fittings, wall pipes, and sleeves shall conform to the dimensions and details shown on the Drawings.

2.4 JOINTS FOR DUCTILE IRON PIPE AND FITTINGS

A. General

- 1. Joints for ductile iron pipe and fittings shall be mechanical joints, flanged joints, push-on joints, or bell and spigot joints, as shown on the Drawings or specified herein.
- 2. All ductile iron pipe laid underground shall be joined using mechanical joints or push-on type joints, unless otherwise shown on the Drawings, specified, or directed.

B. Mechanical Joints

- 1. Mechanical joints shall consist of a bolt joint of the stuffing box type as detailed in ANSI A21.10 and described in ANSI A21.11.
- 2. Mechanical joints shall be thoroughly bolted in accordance with the manufacturer's recommendations with Tee Head Bolts and bolts of high strength, low-alloy steel having a minimum yield point strength of 40,000 psi and an ultimate tensile strength of 70,000 psi.
- 3. Gaskets, bolts, and nuts shall conform to ANSI A21.11. Gaskets shall be of neoprene or rubber of such quality that they will not be damaged by the liquid or gases with which they will come into contact.

4. Glands shall be of high strength ductile iron.

C. Flanged Joints

1. Flanged joints shall conform to ANSI B16.1, Class 125, in accordance with Table 10.23 of ANSI A21.10.
2. Flanged joints shall be bolted with through stud or tap bolts of required size as directed. Bolts and nuts shall conform in dimensions to the American Standard heavy series. Nuts shall be hexagonal, cold pressed. Bolts and nuts shall be cadmium plated, cold pressed, steel machine bolts, conforming to ASTM A 307, Grade B. Cadmium plating shall be by an approved process and shall be between 0.003 and 0.0005 inch thick. After each joint has been made, all bolts, heads, and nuts shall be coated with two coats of coal tar epoxy (total of 16 mil dry film thickness [DFT]), or approved equal coating.
3. Gaskets shall be full face type, 1/16 inch thick, conforming to the requirements of AWWA C111.
4. Flanges on ductile iron pipe shall be screw type. Pipe threads shall be of such length that with flanges screwed home, the end of the pipe shall project beyond the face line of the flange. Flange and pipe shall then be machined to give a flush finish to the pipe and the flange and surface shall be normal to the axis of the pipe. Ductile iron flanges shall be of such design that the flange neck completely covers the threaded portion of the pipe to protect same against corrosion. All pipe with screw type flanges shall be assembled, faced, and drilled at the point of manufacture, unless otherwise approved by the Engineer.
5. Where tap or stud bolts are required, flanges shall be drilled and tapped accordingly.

D. Push-On Joints

1. Push-on joints shall conform to ANSI A21.11. Details of the joint design shall be in accordance with the manufacturer's standard practice.
2. Gaskets shall be in accordance with ANSI A21.11 and shall be of such quality that they will not be damaged by the liquid or gases with which they will come into contact.

2.5 PIPE COATING AND LINING

- A. All ductile iron pipe and fittings buried underground shall have a standard bituminous outside coating conforming to ANSI A21.6 or A21.51. All exposed or immersed ductile iron pipe and fittings shall have an outside shop (prime) coat of epoxy coating, Tnemec Series N69 Hi-Build Epoxoline II (or equal) at 4 to 6 mils DFT and two additional coats of Tnemec Series N69 at 4 to 6 mils DFT per coat.
- B. All ductile iron pipe used for water or wastewater shall have cement mortar lining of standard thickness in accordance with ANSI A21.4. Cement mortar lining for ductile iron fittings shall be double the standard thickness under ANSI A21.4.

- C. Where a special lining is indicated on the Drawings for resistance to corrosive wastewater, all ductile iron pipe and fittings for wastewater shall have a ceramic filled, amine-cured, novolac epoxy lining. Coating shall be Induron Protecto 401 Ceramic Epoxy, by Induron Coatings, Inc., Novocoat SP-2000W by Superior Environmental Products, Inc., or approved equal. Coating shall be applied at 40-mil DFT. Follow manufacturer's recommendations for lining bell sockets, spigot ends, flange faces, etc.; and for touch up and repair of field cuts.
- D. No lining shall be provided for ductile iron piping and fittings used for air.
- E. Surface preparation of ductile iron prior to coating application shall be in accordance with the following:
 - 1. NAPF 500-03-01 "Solvent Cleaning": Solvent cleaning is a method for removing all oil, small deposits of asphalt paint, grease, soil, drawing and cutting compounds and other soluble contaminants from iron surfaces.
 - 2. NAPF 500-03-04 "Abrasive Blast Cleaning of Ductile Iron Pipe": An abrasive blast cleaned, exterior pipe surface when view without magnification, shall be free of all visible dirt, dust, loose annealing oxide, loose rust, loose mold coating and other foreign matter. All oils, small deposits of asphalt paint and grease shall have been removed by solvent cleaning per NAPF 500-03-01. After the entire surface to be coated has been struck by the blast media, tightly adherent annealing oxide, mold coating and rust staining may remain on the surface provided they cannot be removed by lifting with a dull putty knife.
 - 3. Ductile and Cast Iron
 - a. Immersion, Interior and Exterior Exposed: "Solvent Cleaning" and "Abrasive Blast Cleaning of Ductile Iron Pipe" in accordance with NAPF 500-03-01 and -04, respectively. Abrasive blasting shall achieve an anchor pattern or blast profile as recommended by the coatings manufacturer.
 - b. Field Preparation of Shop Primed Surfaces: "Solvent Cleaning" in accordance with NAPF 500-04-01. Shop primed iron surfaces which have been damaged or which show signs of corrosion shall be abrasive blasted and/or cleaned in accordance with the specifications given above for both asphaltic and non-asphaltic coating systems.

2.6 SPECIAL PIPE PROTECTION

- A. Provide polyethylene wrap protection of ductile iron piping and fittings installed underground where aggressive soils exist or where possible stray currents from cathodic protected piping or structures exist or could exist in the future.
- B. Ductile iron piping and fittings shall be continuously wrapped with a single layer (wrap) of 4-mil, high density, cross-laminated (HDCL) or 8-mil, linear low-density (LLD) polyethylene film whenever piping system is within 10 feet of direct current protected piping or structure. Provide continuous double wrap when piping system is within 5 feet of direct current protected piping or structure.

- C. Install protective wrap in accordance with AWWA C105/A21.5-05.

2.7 PIPE COUPLINGS

- A. Pipe couplings shall be installed where shown on the Drawings, required for installation, or directed by the Engineer.
- B. Pipe couplings shall conform to the requirements of Section 40 05 33, Pipe Couplings and Expansion Joints.

2.8 WALL PIPE AND WALL SLEEVES

- A. Furnish and install ductile iron wall pipe or wall sleeves where ductile iron piping connects with or passes through concrete walls or floors and in locations where small piping and electric wiring and conduits connect with or pass through concrete walls or floors.
- B. Where wall pipes or sleeves are to be installed flush with the wall or slab, the flange or bell shall be tapped for studs. Where the flange or bell will project beyond the wall, the projection shall be sufficient to allow for installation of connecting bolts.

2.9 SPARE PARTS

- A. Furnish 4 spare gaskets for each size and type of joint requiring the use of a gasket. Furnish 8 bolts and nuts of each size and type used for ductile iron pipe joints.

PART 3 - EXECUTION

3.1 LAYING

- A. Proper and suitable tools and appliances for safe and convenient handling and laying of pipe and fittings shall be used. Great care shall be taken to prevent the pipe coating from being damaged, particularly cement linings on the inside of the pipes and fittings. Any damage shall be remedied as directed by the Engineer.
- B. Carefully examine all pipe and fittings for defects just before laying and no pipe or fitting shall be laid which is defective. If any defective pipe or fitting is discovered after having been laid, it shall be removed and replaced in a satisfactory manner with a sound pipe or fitting by the Contractor at his own expense.
- C. Thoroughly clean all pipes and fittings before they are laid and keep clean until they are used in the completed work. Open ends of pipe shall be kept plugged with a bulkhead during construction.
- D. Pipe laid in trenches shall be laid true to line and grade on a firm and even bearing for its full length at depths and grades as shown on the Drawings. Adequate precautions shall be taken to prevent flotation of pipelines prior to backfilling. Installation of ductile iron pipe in underground pressure piping systems shall conform to the requirements of AWWA C600. Excavation of trenches and backfilling around pipes shall conform to the requirements of the Section 31 20 00, Earthwork.

- E. All ductile iron piping laid underground shall have a minimum of 36 inches of cover above the top of the pipe unless otherwise shown on the Drawings.
- F. All elbows, tees, branches, crosses, and reducers in pressure piping systems shall be adequately restrained against thrust. Underground pressure piping shall be restrained by thrust restrained joints (EBAA Meg-a-Lug Series 1100SD, or approved equal). Install restraints in accordance with manufacturer's recommendations. Install number of restraints recommended by manufacturer for size of pipe, type of fitting, and type of soil.
- G. All ductile iron pipes entering buildings or basins shall be adequately supported between the structure and undisturbed earth as shown on the Drawings to prevent breakage resulting from settlement of backfill around the structure.
- H. Wall pipe and wall sleeves shall be accurately located and securely fastened in place before concrete is poured. All wall pipe and wall sleeves shall have wall collars properly located to be in the center of the wall where the respective pipes are to be installed.
- I. Wall pipe and wall sleeves shall be installed when the wall or slab is constructed. Blocking out or breaking of the wall for later insertion shall not be permitted.
- J. Cutting or weakening of structural members to facilitate pipe installation shall not be permitted. All piping shall be installed in place without springing or forcing.
- K. Sufficient couplings and flanged joints shall be provided to facilitate equipment installation and removal.
- L. Exposed ductile iron piping shall be supported as shown on the Drawings.

3.2 CUTTING

- A. Whenever pipe requires cutting to fit the lines, the work shall be done in such manner as to leave a smooth end at right angles to the axis of the pipe. When a piece of pipe is cut to fit into the line, no payment will be made for the portion cut off and not used.
- B. Whenever existing pipe requires cutting to install new fittings, the work shall be done in such manner as to leave a smooth end at right angles to the axis of the pipe and special care shall be exercised to guard against breaking or splitting the existing piping.
- C. All cutting of ductile iron pipe shall be done with a cutting saw. All burrs shall be removed from the inside and outside edges of all cut pipe.

3.3 JOINING

A. Mechanical Joints

1. The successful operation of the mechanical joint specified requires that the spigot be centrally located in the bell and that adequate anchorage be provided where abrupt changes in direction and dead ends occur.
2. The surfaces with which the rubber gasket comes in contact shall be brushed thoroughly with a wire brush just prior to assembly to remove all loose rust or

foreign material which may be present and to provide clean surfaces which shall be brushed with a liberal amount of soapy water or other approved lubricant just prior to slipping the gasket over the spigot end and into the bell. Lubricant shall be brushed over the gasket prior to installation to remove loose dirt and lubricate the gasket as it is forced into its retaining space.

3. Joint bolts shall be tightened by the use of approved wrenches and to a tension recommended by the pipe manufacturer. When tightening bolts, it is essential that the gland be brought up toward the pipe flange evenly, maintaining approximately the same distance between the gland and the face of the flange at all points around the socket. This may be done by partially tightening the bottom bolt first, then the top bolt, next the bolts at either side, and last, the remaining bolts. This cycle shall be repeated until all bolts are within the range of acceptable torques. If effective sealing is not attained at the maximum torque indicated above, the joint shall be disassembled and reassembled after thorough cleaning. Overstressing of bolts to compensate for poor installation shall not be permitted.
4. After installation, bolts and nuts in buried or submerged piping shall be given 2 heavy coats of a bituminous paint.

B. Flanged Joints

1. All flanges shall be true and perpendicular to the axis of the pipe. Flanges shall be cleaned of all burrs, deformations, or other imperfections before joining. Flanged joints shall be installed so as to ensure uniform gasket compression. All bolting shall be pulled up to the specified torque by crossover sequence. Where screwed flanges are used, the finished pipe edge shall not extend beyond the face of the flange, and the flange neck shall completely cover the threaded portion of the pipe.
2. Connections to equipment shall be made in such a way that no strain is placed on the equipment flanges. Connecting flanges must be in proper position and alignment and no external force may be used to bring them together properly.
3. After installation, bolts and nuts in buried or submerged piping shall be given 2 heavy coats of a bituminous paint.

C. Push-On Joints

1. The inside of the bell and the outside of the pipe from the plain end to the guide stripe must be wiped clean immediately before assembling the pipe joint. Then the rubber gasket shall be inserted into a groove or shaped recess in the bell. Both the bell and spigot ends to be joined shall be wiped again to ensure they are thoroughly clean. A liberal coating of special lubricant furnished by the pipe manufacturer shall be applied to the outside of the pipe from the plain end to the yellow guide stripe and to the inside of the gasket. The plain end shall be centered in the bell and the spigot pushed home. Wherever possible the pipe shall be socketed by hand; however, jacking may be required to push the spigot in place on the larger sizes of pipe. The completed joint shall be permanently sealed and watertight.

2. Whenever the pipe is cut in the field, the cut end shall be conditioned so it can be used in making up a joint by filing or grinding the cut end to remove burrs or sharp edges that might damage the gasket.

D. Permissible Deflection of Joints

1. Deflection of ductile iron pipe at joints for long radius curves or for avoiding obstacles shall be permitted only upon approval of the Engineer.
2. Where deflection of joints is permitted, such deflection shall be made in accordance with and shall not exceed 80 percent of the maximum deflection angle provided in Tables 3 and 4 of AWWA C600-05.

- E. Joints of Dissimilar Metals. When a flanged joint consists of a ductile iron flange mated to a steel or alloy flange, the steel flanges shall be flat-faced and furnished with full-faced gaskets, insulating bushings, and stainless steel bolts.

3.4 SERVICE CONNECTIONS

- A. Small service lines and branches shall connect to larger ductile iron mains using ductile iron tapped tees and crosses, in general and unless otherwise shown.
- B. Tapped tees and crosses shall have minimum 2-inch NPT branch connections and shall be furnished with mechanical joint ends.

3.5 CUT-INS TO EXISTING PIPING

- A. Cut-ins to existing ductile iron piping for installation of new mechanical joint fittings and valves shall be made using ductile iron cutting-in sleeves, in general and unless otherwise shown.
- B. Cutting-in sleeves shall have a pressure rating not less than that of the existing pipeline and shall be furnished with a mechanical joint end on one end and a plain end on the other.

3.6 DRILLING AND TAPPING

- A. Wherever required, ductile iron pipe and fittings shall be drilled and tapped to receive drainage or any other piping. All holes shall be drilled accurately at right angles to the axis of any pipe or fitting. Where plugs are drilled, holes shall be at right angles to the face of the plug.
- B. Where the size of the pipe to be connected is such as to require bosses for connection and when the pipe wall thickness is too thin to permit the effective length of pipe threads to be utilized as necessary for the size pipe being connected by threads, furnish such pipe with cast-on bosses suitable for drilling, tapping, and connecting such pipe. Alternately, where shown or specified, a tapped saddle clamp may be used in lieu of a cast-on boss. Saddle clamp shall be of the heavy-duty type with O-ring gaskets and 2 heavy U-bolt clamps.
- C. All tapping shall be carefully and neatly done by skilled workmen with suitable tools.

- D. Where connections are made between new and old piping, the connections shall be made in a thorough and workmanlike manner using proper fittings and specials to suit actual conditions.
- E. Cut-ins to existing and operating pipelines shall be done at times agreeable to the Owner upon approval of the Engineer.
- F. Existing pipelines that may be cut or damaged during the performance of work under this item shall be repaired, reconnected, and returned to service in equal or better condition in which they were found and in accordance with the requirements of this Specification.
- G. No separate payment will be made for drilling, tapping, making connections, cut-ins, repairs to damaged existing pipelines, and reconnections in existing pipelines.

3.7 AIR RELIEF AND FLUSHING

- A. Expel all air from the pipe before applying the specified hydrostatic test. If hydrants, blow-offs, or air release valves are not available at the high points, make the necessary taps at points of highest elevation before the test is made and insert plugs after the test has been completed.
- B. Thoroughly flush the lines after expelling all the air to remove foreign material in the pipe during installation. Flush the lines at hydrants and blow-offs to maintain a minimum velocity in the main of 2.5 fps.

3.8 HYDROSTATIC TESTING

- A. After all piping has been placed, backfilled, and flushed, each run of newly laid pipe, or any valved section thereof, shall be tested by the Contractor in the presence of the Engineer, and tests shall be continued until all leaks have been made tight to the satisfaction of the Engineer.
- B. All piping shall be subject to a hydrostatic gauge pressure equal to 150 percent of the maximum operating pressure of the pipe section under test or 150 psig, whichever is greater, based on the elevation of the lowest point of the section of pipe under test and corrected to the elevation of the test gauge. The test shall be maintained for a minimum of two consecutive hours. The test pressure shall not exceed the rated pressure of the valves when the pressure boundary of the test section includes closed gate or butterfly valves.
- C. The specified test pressure shall be applied by means of a pump connected to the pipe.
- D. Allow the system to stabilize at the test pressure before conducting the test.
- E. The hydrostatic test (AWWA C600) shall be based upon leakage and pressure. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within 5 psi of the specified test pressure after the pipe has been filled with water and the air has been expelled. Leakage shall not be measured by a drop in pressure in a test section over a period of time.

1. Allowable leakage: No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{SD\sqrt{P}}{133200}$$

Where: L = allowable leakage, in gallons per hour
S = length of pipe tested, in feet
D = nominal diameter of the pipe, in inches
P = average test pressure during the leakage test, in pounds per square inch (gauge)

This formula is based on an allowable leakage of 11.65 gpd/mi/in. of nominal diameter at a pressure of 150 psi.

2. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gal/h/in. of nominal valve size shall be allowed.
 3. When hydrants are in the test section, the test shall be made against the main valve in the hydrant.
- F. Acceptance of Installation. Acceptance shall be determined on the basis of allowable leakage. If any test of laid pipe discloses leakage greater than that specified, repairs or replacements shall be corrected at the Contractor's expense by tightening, replacing packing or gaskets, or replacing defective portions of the piping system. Caulking will not be permitted. If the defective portion cannot be located, the Contractor, at his expense, shall remove and reconstruct as much of the original work as necessary to obtain an acceptable installation.
- G. All visible leaks are to be repaired regardless of the amount of leakage.
- H. The Contractor shall bear the complete cost of the tests, including set-up, labor, temporary piping, blocking, gauges, bulkheads, water, and any other materials required to conduct the tests.

END OF SECTION

SECTION 40 05 13.73

POLYVINYL CHLORIDE PIPE FOR PRESSURE APPLICATIONS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install the plastic piping in the locations shown on the Drawings and as specified herein.
- B. All PVC piping and accessories are not shown on the Drawings. Some PVC piping is simply shown in schematic form. Furnish and install all piping indicated or required for the proper operation of the equipment or services requiring such piping.

1.2 RELATED WORK

- A. The following sections contain requirements that relate to this section:
 - 1. Section 40 05 23: Valves.

1.3 DESCRIPTION OF SYSTEM

- A. Plastic pipe shall be used for pressure piping in water mains, sewage force mains, and process piping.
- B. Install piping in the locations shown on the Drawings.
- C. PVC valves and fittings shall be used in pressure sewers 1.25 inches in diameter through 3 inches in diameter.
- D. Use mechanical joint valves and fittings in all water mains and in sewage force mains 4 inches in diameter and larger.

1.4 QUALIFICATIONS

- A. All plastic pipe shall be furnished by a single manufacturer who is fully experienced, reputable, and qualified in the manufacture of the items to be furnished. The equipment shall be designed, constructed, and installed in accordance with ASTM and AWWA methods and shall comply with these Specifications.

1.5 SUBMITTAL

- A. Submit shop drawings to the Engineer for approval in accordance with these Specifications and include dimensioning and technical specification for all piping to be furnished.
- B. Submit samples of all materials specified herein to the Engineer for approval when requested.

1.6 PIPE MARKING

- A. All PVC pipe shall be marked with the following information:
1. Manufacturer's name or trademark.
 2. Nominal pipe size and OD base.
 3. AWWA or ASTM material code designation.
 4. Dimension ratio.
 5. AWWA pressure class.
 6. AWWA or ASTM specification designation (AWWA C900, ASTM D 2241, ASTM D 1785, Schedule 80).
 7. Product record code.
 8. Certification seal(s), if required.

1.7 RECEIVING, HANDLING, AND STORAGE

- A. Receive, handle, and store PVC pipe in accordance with AWWA Manual No. M23, "PVC Pipe Design and Installation," except that all PVC pipe stored longer than one week shall be covered with an opaque material.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Pipe shall meet ASTM D 2241, "Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe (SDR-PR)," Class 200, SDR 21; AWWA C900, Class 100; or ASTM D 1785, Schedule 80. Length shall be 20 feet.
- B. Potable water service certification shall be NSF No. 14, "National Sanitation Foundation Standard No. 14 for Thermoplastic Materials, Pipe, Fittings, Valves, Traps and Joining Materials."
- C. Gasket shall be ASTM F 477, "Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe." Gaskets for pipe 6 inch and larger shall be supplied with retainer rings.
- D. Push-on joint shall be ASTM D 3139, "Standard Specification for Joints for Plastic Pressure Pipe Using Flexible Elastomeric Seals."
- E. PVC material 12454-B (PVC 1120) shall be ASTM D 1784, "Standard Specification for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPC) Compounds."
- F. Fittings for water mains and sewage force mains shall be short or long body ductile iron and be equipped with Uni-Flange No. 1300 restrainers, or approved equivalent thrust restraint per Section 40 05 13.53, Ductile Iron Pipe and Fittings.
- G. Valves and fittings for buried pressure sewers 1.25 inches through 3 inches in diameter shall be Schedule 40 PVC with glued joints. Restrain by means of concrete thrust blocks.

- H. PVC pipe outside structures or buried underground and used to convey water or wastewater shall have push-on joints unless otherwise noted on the Drawings.
- I. Pipe in sizes 1½ inches through 3 inches (1½ inches through 12 inches for corrosive fluids) shall be SDR 21 with 200 psi pressure rating in accordance with ASTM D 2241.
- J. Pipe in sizes 4 inches through 12 inches shall be either SDR 21 with 200 psi pressure rating in accordance with ASTM D 2241 or Class 200 in accordance with AWWA C 900, depending on which is called for on the Drawings or in the Bid Schedule. Maximum lengths of pipe shall not exceed 20 feet.
- K. PVC pipe installed inside of structures or used to transport liquid or gaseous chlorine shall have threaded joints. **Solvent welding of field joints will not be permitted.** PVC for threaded joints shall be Schedule 80, National Sanitation Foundation approved and shall conform to the latest requirements of Commercial Standard CS 207 and ASTM D 1785 for Schedule 80 water pressure ratings. Fittings shall comply with the requirements of ASTM D 2464 for molded, Schedule 80, screwed fittings.
- L. PVC pipe conveying material with operating temperatures that exceed 140°F, shall be chlorinated polyvinyl chloride (CPC) in accordance with ASTM D 1784, Type 4, Grade 1, Class 23477-B.
- M. Threaded joints shall be made with American Standard IPS threads. All joints shall be made up with Teflon thread tape or thread dope or with pipe manufacturer's recommended joint compound for use with chlorine solution.

2.2 PVC VALVES AND STRAINERS

- A. Unless otherwise shown or required, all valves, unions, and strainers in PVC piping shall be constructed of Type I, Grade 1 PVC. Valves shall be NSF approved and shall have a working pressure of 150 psi.
- B. Ball valves shall have double union type body, Teflon seats, Viton seals, full diameter port, and NPT threaded ends. Ball valves in 4-inch size may have single union body.
- C. Check valves shall be ball type with union body, Viton seat, and NPT threaded ends.
- D. Strainers shall be wye type with NPT threaded ends and 8 or 10 mesh strainer basket.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Alignment and Grade. Lay and maintain all pipe at the established lines and grades. Install fittings, valves, air vents, and hydrants at the required locations with valve and hydrant stems plumb.
- B. Trench Construction
 - 1. Stockpiling Excavated Material. Stockpile all excavated material in a manner that will not endanger the work or obstruct sidewalks and driveways. Hydrants under

pressure, valve-pit covers, valve boxes, curb-stop boxes, fire and police call boxes, and other utility controls shall be kept accessible.

2. Trench Depth. Provide minimum of 48 inches of cover in traffic areas and 30 inches of cover in non-traffic areas.
3. Trench Width. Trench width at the ground surface may vary depending on depth, type of soil, and position of surface structures.
 - a. For construction with a backhoe the minimum clear width of the trench, sheeted or unsheeted, measured at the springline of the pipe shall be 1 foot greater than the outside diameter of the pipe. The maximum recommended clear width of the trench at the top of the pipe is equal to the pipe outside diameter plus 2 feet. If the maximum recommended trench width must be exceeded or if the pipe is installed in a compacted embankment, then pipe embedment shall be compacted to a point of at least 2½ pipe diameters from the pipe on both sides of the pipe or to the trench walls, whichever is less.
 - b. For construction with a trencher, provide at least 2 inches of clear space on each side of pipe to allow for pipe placement and embedment. The following trench widths are recommended:

<u>Pipe Size</u>	<u>Recommended Trench Width</u>
1) 1½" and 2"	6 inches
2) 3", 4", and 6"	12 inches
3) 8" and 10"	18 inches

- c. Quantities of crushed stone embedment in rock trenches shall be based upon the actual width of trench, not to exceed 2 feet plus the pipe outside diameter, unless authorized by the Engineer.
4. Dewatering. Where conditions are such that running or standing water occurs in the trench bottom or the soil in the trench bottom displays a "quick" tendency, remove the water by pumps and other suitable means (such as well points or pervious underdrain bedding) until the pipe has been installed and the backfill has been placed to a sufficient height to prevent flotation of pipe. Generally, a depth of backfill over the top of the pipe equal to 1½ pipe diameters is sufficient to prevent flotation.
5. Preparation of Trench Bottom. Construct the trench bottom to provide a firm, stable, and uniform support for the full length of the pipe. Provide bell holes at each joint to permit proper assembly and pipe support. Backfill to grade any part of the trench bottom excavated below grade and compact as required to provide firm pipe support. When an unstable subgrade condition is encountered that could provide inadequate pipe support, additional trench depth shall be excavated and refilled with suitable foundation material. Remove ledge rock, boulders, and large stones to provide 6 inches of cushion on all sides of the pipe and accessories.
6. Laying of Pipe. To prevent damage, use proper implements, tools, and equipment for placement of the pipe in the trench. Under no circumstances shall pipe or

accessories be dropped into the trench. Remove all foreign matter or dirt from the pipe interior. Assemble pipe joints with care. When pipe laying is not in progress, open ends of installed pipe shall be closed to prevent entrance of trench water, dirt, foreign matter, or small animals into the pipeline.

7. Restrained Joints. Provide restraint devices at each hydrant, valve, bend, tee, reducers and fittings where changes occur in pipe diameter or direction, and for the distance shown on the Drawings in all directions from the joints. Restraining device shall be Uni-Flange No. 1300, concrete thrust blocks or approved equal. Provide concrete thrust blocks in areas where runs of pipe are too short to provide adequate mechanical thrust restraint or where indicated on the Drawings.
8. Pipe Embedment and Backfill
 - a. Install PVC pipe with embedment and backfill in accordance with details and descriptions as shown in the Contract Drawings. If the Contract Drawings do not describe embedment and backfill requirements, comply with the following:
 - 1) Native Earth Embedment: PVC pipe shall be installed with native earth embedment and backfill in areas where the native earth materials are suitable for pipe embedment. Refer to Section 31 20 00, Earthwork. In areas where native earth materials are unsuitable, PVC pipe shall be installed as specified in the following paragraph entitled, "Rock Trench Embedment."
 - 2) Rock Trench Embedment: In areas having rock trenches, PVC pipe shall be installed with crushed stone (less than ¾-inch diameter) or sand bedding providing uniform longitudinal support under the pipe. Work backfill material under the sides of the pipe to provide satisfactory haunching. Initial backfill material shall be crushed stone and placed to a minimum depth of 12 inches over the top of the pipe as shown on the Drawings. Carefully select and place all pipe embedment material. Exclude from the embedment material sharp stones and crushed rock (larger than ¾ inch) which could cause significant scratching or abrasion of the pipe. Compact bedding and initial backfill to a minimum of 90 percent standard proctor.
 - 3) Final Backfill: After placement and compaction of pipe embedment materials and initial backfill, the balance of backfill materials may be machined placed. The material shall contain no large stones or rocks, frozen material or debris. Exercise proper compaction procedures to provide required 90 percent density, standard proctor.
 - 4) Marking Tape: All non-ferrous pipe laid underground shall have magnetic marking tape installed 12 inches above the pipe.
 - C. All provisions with respect to connections and existing utilities shall comply with the applicable requirements of Section 40 05 13.53, Ductile Iron Pipe and Fittings.
 - D. Support exposed piping in accordance with the requirements of Section 40 05 53, Pipe Supports and Hangers. Support metal valves and valve boxes independently of piping.

Isolate PVC piping from direct contact with metal or concrete supports by a 1/32-inch sheet of neoprene.

- E. Furnish a full-face resilient gasket when a joint consists of a PVC flange and a flat-faced metal flange.
- F. Install PVC valves with the flow arrow in the proper direction. Union nuts on PVC valves shall be tightened only hand tight in accordance with manufacturer's instructions. Furnish spare O-ring seals and seats with each PVC valve.
- G. Service line taps into PVC pipe shall be made using tapping saddle constructed for use on PVC pipe. Saddles shall be constructed of bronze or brass and have all stainless steel bolts or screws and a resilient rubber gasket to provide a positive, watertight seal.

3.2 TESTING

- A. All piping shall be hydrostatic tested to the rated pressure class of the pipe being tested.
- B. Buried Pipe
 - 1. To prevent floating of the pipe, place sufficient backfill prior to filling pipe with water and subsequent field testing. Where local conditions require that the trenches be backfilled immediately after the pipe has been laid, the testing may be performed after backfilling has been completed, but before placement of permanent surface.
 - 2. At least seven days shall elapse after the last concrete thrust or reaction blocking, if used, has been cast with normal (Type I) portland cement. The elapsed time may be reduced to three days with the use of a high-early-strength (Type III) portland cement. It is suggested that testing be conducted first on short lengths of installed pipe line, thereby permitting the installer to verify that proper installation and joint assembly techniques have been employed.
 - a. Filling, Drainage, and Air Relief of Mains. Water mains shall be drained through drainage branches or blow-offs. Drainage branches and blow-offs shall be provided with valves and be located at low points and dead ends. Drainage branches or blow-offs must not be connected to any sewer, submerged in any stream, or be installed in any other manner that can permit back siphonage into the distribution system. Install permanent air vents at all high points. If permanent air vents are not required at all high points, install corporation cocks at all such points to expel air during initial filling and pressure testing of the lines. Fill lines slowly with maximum velocity of 2 fps, preferably 1 fps, while venting all air. After filling, flush lines at hydrants, blow-offs, and dead ends at minimum velocity of 2.5 fps. Valves shall be closed very slowly to prevent surges.
- C. Procedure. The following procedure is based on the assumption that the pressure and leakage tests will be performed at the same time. Separate tests may be made if desired, in which case the pressure test shall be performed first. Apply the specified test pressure by means of a pump connected to the pipe. Maintain the test pressure for the specified time (by additional pumping if necessary). While the line is under

pressure, carefully examine the system and all exposed pipe, fittings, valves, and hydrants for leakage. Repair or replace all defective elements and repeat the test until all visible leakage has been stopped and the allowable leakage requirements have been met.

1. Test Method. The installer may perform simultaneous pressure and leakage tests, or he may perform separate pressure and leakage tests on the installed system at test durations and pressures specified below.

SYSTEM TEST METHODS

Procedure	Pressure	Test Duration (hours)
Simultaneous pressure and leaking tests	150% of working pressure at point of test, but not less than 125% of normal working pressure at highest elevation	2
Separate pressure test	150% of working pressure at point of test, but not less than 125% of normal working pressure at highest elevation	1
Separate leakage test	150% of normal average working pressure of segment tested	2

Source: Recommended Standard for the Installation of Polyvinyl Chloride (PVC) Pressure Pipe, UNI-B-3, Uni-Bell Plastic Pipe Association.

2. Allowable Leakage
 - a. The duration of each leakage test shall be 2 hours, unless otherwise specified, and during the test the main shall be subjected to the pressure required in the following table.

ALLOWABLE LEAKAGE FOR AWWA PVC PIPE

Average Test Pressure in Line (psi)
(Allowable Leakage Per 1,000 Feet or 50 Joints [gal/hr])

Nominal Pipe Size (inches)	50	100	150	200	250
4	0.19	0.27	0.33	0.38	0.43
6	0.29	0.41	0.50	0.57	0.64
8	0.38	0.54	0.66	0.76	0.85
10	0.48	0.68	0.83	0.96	1.07
12	0.57	0.81	0.99	1.15	1.28

- b. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe, or any valved section thereof, to maintain pressure within 5 psi of the specified leakage test pressure after the pipe has been filled with water and the air in the pipeline has been expelled. No installation shall be

accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{ND\sqrt{P}}{7400}$$

Where:

- L = allowable leakage, gph
- N = number of joints in the length of pipeline tested
- D = nominal diameter of the pipe, inch
- P = average test pressure during the leakage test, psig

- c. Leakage values determined by the above formula are to be found in the preceding table.
- D. Take all precautions necessary to protect any equipment that might be damaged by the pressures used in the tests. Delicate equipment shall be valved off, removed, or otherwise protected.
- E. Securely anchor and restrain all piping against movement prior to application of test pressures. All joints, fittings, and valves will be left open where possible. Carefully examine all exposed pipe, fittings, valves, and joints during the pressure test.
- F. Expel all air from piping before applying the specified test pressure. If hydrants, blow-offs, or air release valves are not available at the high places, make the necessary taps at points of highest elevation before the test is made and insert plugs after the test has been completed.
- G. Excessive leakage developing during the test shall be corrected at the Contractor's expense. If the defective portion cannot be located, the Contractor, at his expense, shall remove and reconstruct as much of the original work as necessary to obtain a facility meeting the specified leakage limits.
- H. Contractor shall bear the complete cost of the tests, including set-up, labor, temporary piping, blocking, gauges, bulkheads, water, air, soap solutions, and any other materials required to conduct the tests.
- I. All pipe used for gaseous chlorine shall be tested with ammonia solution as recommended by the manufacturer of the chlorination equipment.

3.3 CLEANUP

- A. After completing each section of the sewer line, remove all debris and construction materials and equipment from the site of the work, grade and smooth over the surface of both sides of the line, and leave the entire right-of-way in a clean and neat condition. Unless otherwise called for on the Drawings, restore all disturbed areas to as close to its original condition as possible. Restoration shall include, but not be limited to, grassing and replacing of shrubbery, trees, fences, and other improvements which have been disturbed.

- B. Complete cleanup and restoration within 60 calendar days after each section of sewer line is installed. Should the Contractor fail to do the cleanup within 60 calendar days, payment made for pipe sewers and service lines for that section of the sewer not cleaned up shall be removed from the periodic estimate until the cleanup work is completed.

END OF SECTION

SECTION 40 05 23

VALVES

PART 1 - GENERAL

1.1 SCOPE

- A. The work covered by this section includes furnishing all labor, equipment, and materials required to furnish and install all metal valves, including operators, boxes, and accessories, as specified herein, shown on the Drawings, or required for proper completion of the work under these Contract Documents.
- B. The Contractor's attention is called to the fact that all valves, especially in the smaller sizes, are not necessarily shown completely on the Drawings, which are more or less schematic. Furnish and install all valves indicated or required for proper operation of the equipment or services requiring such valves.

1.2 SHOP DRAWINGS AND ENGINEERING DATA

- A. Submit complete shop drawings and engineering data to the Engineer in accordance with the requirements of Section 01 33 23 - Shop Drawings, Product Data and Samples.

1.3 STORAGE AND PROTECTION

- A. Store and protect valves and accessories in accordance with the requirements of the valve manufacturer or as directed by the Engineer.
- B. Completely drain valves prior to shipment. Protect ends of flanged and mechanical joint valves with full size wooden baffles securely bolted to the valve ends. Size of baffles shall be at least equal to outside diameter of flange. Secure valves 24 inches in size and larger to a wooden skid to facilitate handling and storage.

1.4 SHOP PAINTING

- A. Clean, shop prime, and shop paint valves and accessories in accordance with the requirements of these Specifications.
- B. All interior and exterior nonmachined, nonbearing ferrous surfaces on iron body valves, gates, and accessories shall be blast-cleaned and painted at the factory with two coats of asphaltic varnish conforming to Federal Specification TT-V-51c, unless otherwise specified. Exterior nonmachined, nonbearing ferrous surfaces on valve operators and on nonsubmerged or nonburied butterfly and eccentric plug valves shall be blast-cleaned and painted at the factory with one coat of zinc chromate primer conforming to Federal Specification TT-P-645 and one coat of compatible alkyd enamel. Other paint systems may be proposed by the valve supplier, subject to the Engineer's approval.

1.5 OPERATION AND MAINTENANCE DATA

- A. Submit complete operation and maintenance data on the valves in accordance with the requirements of Section 01 78 23, Operating and Maintenance Data.

1.6 QUALITY ASSURANCE

- A. The valve manufacturers shall furnish a written certification to the Engineer that all valves and operators furnished comply with all applicable requirements of the governing AWWA standards specified herein.

1.7 GUARANTEE

- A. Provide a guarantee against defective equipment and workmanship in accordance with the requirements of Section 01 78 36, Warranties and Bonds.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All castings, regardless of material, shall be free from surface defects, swells, lumps, blisters, sandholes, or other imperfections.
- B. All valves shall have the name of the manufacturer, rated working pressure, and size of the valve cast upon the body or bonnet in raised letters. Alternately, the name of the valve manufacturer, rated working pressure, and size may be stamped on a stainless steel identification plate permanently attached to the valve body or bonnet. Valves specified to conform with AWWA requirements shall have the letters "AWWA" cast upon the valve body or bonnet in raised letters.
- C. Valves and operating mechanisms shall be of the proper size and dimensions to fit the pipe connections thereto and shall be installed in the position and within the space shown on the Drawings.
- D. The direction of rotation of the operator to open the valve shall be to the left (counterclockwise), unless otherwise specified. Each valve body or operator shall have cast thereon the word OPEN and an arrow indicating the direction to open.
- E. A union or coupling shall be provided within 2 feet on each side of a threaded end valve unless the valve can be otherwise easily removed from the piping. This shall not apply to soldered end valves in copper plumbing.
- F. All exposed bolts and nuts on buried or submerged valves and operators shall be brass or stainless steel for corrosion resistance. Exposed bolts and nuts on exposed valves and operators shall be of corrosion-resistant materials or shall be zinc or cadmium plated.
- G. Valves and operators shall be of the proper size to fit the pipe connections and shall fit in the position and space as shown on the Drawings.

- H. Valve operators shall be of sufficient size and capacity to seat, unseat, and operate the valve under the maximum specified differential pressure. Where no maximum differential pressure is specified, the operator shall be designed for a differential pressure equal to the maximum working pressure of the valve. Additional allowances shall be made for the lubricating and/or scale-forming tendencies of the fluid.

2.2 GATE VALVES

- A. All gate valves smaller than 2 inches and those larger than 24 inches shall be of the single disc, double sealed, solid tapered wedge type, unless otherwise specified. Gate valves in sizes 2 through 24 inches shall be of the single disc, resilient seated type, unless otherwise specified. Valves shall have non-rising stems and be capable of being repacked under pressure when valve is fully open. Minimum working pressures shall be 200 psi for valves through 14 inches in size and 150 psi for valves 16 inches and larger.
- B. Gate valves smaller than 2 inches shall be bronze body, bronze fitted valves, and have 150-pound, cast bronze body, union bonnet, Teflon-impregnated asbestos packing, and threaded ends per ANSI B2.1. Bronze shall conform to ASTM B62. Brass for nuts and gland shall conform to ASTM V16. Valve discs shall be reversible. Bronze gate valves shall be Stockham Fig. B-130, Nibco Fig. T-136, or equal. For use in copper plumbing, furnish gate valves with solder ends per ANSI B16.18.
- C. Gate valves larger than 24 inches in water and wastewater shall be iron body, bronze mounted valves conforming in all respects to the applicable material and dimensional requirements of AWWA C500. Gate valves shall have an O-ring or self-adjusting chevron packing stem seal, and 125-pound flanged ends per ANSI B16.1, except for valves to be buried underground, which shall have mechanical joint ends per ANSI A21.11 (AWWA C111). Body seat rings shall be ASTM B62 bronze and be screwed into the body so as to be field replaceable. Disc faces and all moving parts shall be bronze or bronze mounted. Cast iron for body and bonnet shall conform to ASTM A126, Grade B. Iron body gate valves with solid wedge discs shall be M&H (Dresser) Fig. 2067, or equal. Iron body gate valves with double discs shall be M&H (Dresser) Fig. 67, Mueller Fig. A-2380, or equal.
- D. Gate valves in sizes 2 through 24 inches for use in water and wastewater shall be of the ductile iron body, resilient seated type, manufactured in conformance with AWWA C509. Gate shall be of ductile iron with bonded resilient seat and integral flush drain. Minimum working pressure shall be 200 psi when unbalanced pressure is applied to either side of the gate. Gate valves shall have a minimum of two O-ring stem seals; one above and one below the integral stem collar. The area between the O-rings shall be filled with permanent lubricant. Valve shall have no metal fasteners or screws exposed in the wetted portion of the valve. All ferrous surfaces shall be shot-blasted to a white metal finish. All interior and exterior valve surfaces, including the interior of the gate and all bolt holes shall be coated with an epoxy coating in accordance with AWWA C550. The minimum thickness of the coating shall be 8 mils. Valve ends shall be of the type required for the installation as specified herein or shown on the Drawings and meet the requirements as specified in Paragraph C of this section.
- E. Gate valves 3 inches in size and larger in steam service shall have 125-pound cast iron body, bronze trim, and outside stem and yoke.

- F. Furnish gate valves with nut, wrench, chain, or handwheel operators as shown on the Drawings. Unless otherwise shown or specified, valves shall have operators as specified in this section. Extension stems, floor stands, and valve boxes and covers shall be furnished where shown or required.
- G. Resilient wedge valves for buried service 16-inch-diameter and larger shall have bevel gear operators, unless otherwise noted.

2.3 BUTTERFLY VALVES

- A. Unless otherwise shown or specified, butterfly valves shall be of the resilient seated, tight-closing type and conform in all respects to the applicable material and dimensional requirements of AWWA C504. Wafer-type butterfly valves in sizes 24 inches and larger shall conform to all general requirements of AWWA C504 except laying length. Butterfly valves shall operate from fully open to fully closed with a 90-degree rotation of the valve stem.
- B. Valves shall be designed for the working pressures and/or pressure class designations shown on the Drawings or specified in these Specifications. If a working pressure or pressure rating is not given, the following requirements shall apply:

Service	AWWA Pressure Rating
Low Pressure Air	25B
Wastewater or Sludge	150B
Potable or Plant Water	150B

Wafer type valves shall have a pressure rating of not less than 150 psi. Valves shall be drip-tight and bubble-tight at rated pressure differential across the valve in both directions.

- C. Valve body shall be one-piece, constructed of cast iron conforming to ASTM A126, Class B. The diameter of the opening shall be not less than the diameter of the corresponding pipe size. Unless otherwise specified, valve body shall be of the short-body style in accordance with Table 2 of AWWA C504. This requirement shall not apply to wafer type valves. No part of the valve internals shall extend beyond the valve ends when the valve is in the closed position. Short-body valves shall have 125-pound flanged ends per ANSI B16.1. Wafer type valves shall be designed to fit between 125-pound flanges per ANSI B16.1.
- D. Disc shall be cast bronze conforming to ASTM B143, Alloy 1A, cast iron conforming to ASTM A126, Class B, Ni-resist cast iron conforming to ASTM A436, Type 1 or 2, or Ni-resist ductile iron conforming to ASTM A439, Type D2. When used in wastewater or raw water, disc shall be streamlined with no exterior ribbing or openings.
- E. Shafts shall be polished stainless steel conforming to ASTM A276, Type 304 or Type 316. All keys and pins used in securing valve disc to shafts shall be stainless steel or monel.
- F. Valve seat shall be one-piece, molded synthetic rubber, Buna-N (Hycar) for wastewater and Buna-N or neoprene for air. Where temperatures exceed 180°F, EPT or Viton seats shall be used. Retaining rings, if used, shall be stainless steel. The method of

mounting valve seat shall conform to the applicable requirements of AWWA C504, Section 3.5. Valve seats in sizes 24 inches and larger shall be field replaceable without necessity of chipping, burning, or cutting. Seats secured with retaining rings shall be fully adjustable. Metal seat mating surfaces shall be smoothly contoured and polished 18-8 stainless steel or monel. Alloy cast iron will not be acceptable as a seat mating surface. Sprayed or plated seat mating surfaces will not be acceptable.

- G. Shaft seals shall be O-ring or self-adjusting chevron packing of Buna-N or neoprene. Shaft seals shall conform to the requirements of AWWA C504, Section 3.7, and shall be of a design that allows replacement of the seal without removing the valve shaft. Alternately, pull-down packing is acceptable if the packing is adjustable and replaceable without removing valve operator.
- H. Valve bearings shall be self-lubricating, sleeve-type bearings of corrosion resistant materials. Bearing load shall not exceed 2,500 psi. Provide valves 24 inches in size and larger with an adjustable, two-way thrust bearing to center the disc in the valve and allow the valve to be installed with the valve stem vertical. Bearing shall be easily accessible for adjustment.
- I. Where the valve is installed adjacent to a fitting, flow meter, another valve, or similar items, furnish a spool piece or adaptor coupling as a spacer so that valve disc does not interfere with the operation of the adjacent meter or valve or contact cement linings on pipe or fittings.
- J. Furnish valve with a lever operator, rotary manual operator, electric motor operator, or pneumatic cylinder operator as shown on the Drawings. Unless otherwise shown or specified, furnish a lever operator on valves 6 inches and smaller and a rotary manual operator on valves 8 inches and larger. Furnish extension stem and floorstand where shown or required.
- K. Butterfly valves for drinking water service shall be coated interior and exterior with 10 mils, minimum, of TNEMEC Potapox 20, fully compliant with AWWA C550.
- L. Butterfly valves shall be as manufactured by Dezurik, Pratt, or equal.

2.4 TWO-WAY PLUG VALVES

- A. Two-way plug valves, unless otherwise shown or specified, shall be of the eccentric, non-lubricated type with resilient, neoprene-faced or epoxy-coated plugs providing drip-tight shut-off at rated pressure. Port area shall not be less than 80 percent of the corresponding full pipe area in sizes 16 inches and smaller and 100 percent of the corresponding full pipe area in valves 18 inches and larger. Two-way valves shall operate from fully open to fully closed with a 90 degree rotation of the valve stem.
- B. Valves shall be designed for a working pressure of not less than 175 psi in sizes through 16 inches and 150 psi in sizes 18 inches and larger. Valves shall be drip-tight at rated pressure differential in both directions.
- C. Valves shall have bodies of ASTM A126, Grade B or ASTM A48, Grade 40 cast iron. Valves 4 inches and larger in size shall have bolted bonnet.

- D. Body seats for resilient-faced plugs shall be welded in and contain a minimum of 90 percent nickel. Welded-in seats shall conform to the applicable requirements of AWWA C507, Section 3.2 and AWWA C504, Section 3.5.
- E. Plugs without a resilient coating or facing shall be epoxy coated and shall have a field replaceable, full-circle rubber seat securely attached to the plug. Body seats shall be nylon coated.
- F. Shaft seal shall be of the self-adjusting or split-V type of Buna-N and shall comply with the applicable requirements of AWWA C504, Section 3.7 and AWWA C507, Section 3.2. Seals requiring adjustment shall be adjustable and replaceable without bonnet or shaft removal.
- G. Supply bearings in both the upper and lower journals. Bearings shall be permanently lubricated and replaceable with stainless steel, bronze, or specially coated corrosion-resistant sleeves and bushings. Bearings shall conform to the applicable requirements of AWWA C504, Section 9 and AWWA C507, Section 8.
- H. Valves sized 2½ inches and smaller shall have threaded ends per ANSI B2.1. End connections for valves sized 3 inches and larger shall be 125-pound flanged per ANSI B16.1, except for valves to be buried underground, which shall have mechanical joint ends per ANSI A21.11 (AWWA C111). Flanged end valves in sizes 12 inches and smaller shall have a laying length equal to that of an AWWA gate valve of the same size.
- I. Valves intended for buried or submerged service shall be sealed against the entrance of water and dirt.
- J. Furnish valves with a lever operator, rotary manual operator, or electric motor operator as shown on the Drawings. Unless otherwise shown or specified, a lever operator shall be furnished on valves 6 inches and smaller, and a rotary manual operator with handwheel shall be furnished on valves 8 inches and larger. Extension stem, floorstand, and valve box shall be furnished where shown or required.
- K. Two-way plug valves shall be DeZurik "Series 100 Eccentric Plug Valve," Dresser "X-Centric," or equal.

2.5 CURB STOPS AND CORPORATION STOPS

- A. Curb stops shall be of all-bronze construction with straight-through unobstructed pattern flow, Teflon-coated plug, top and bottom O-ring plug seals, O-ring port seals, and solid tee handle. Valves shall be suitable for 175-psi minimum working pressure. A quarter turn shall operate the valve from fully open to fully closed position. Valves shall comply with the applicable requirements of AWWA C800.
- B. Furnish curb stops with cast iron foot pieces to permit the curb box to rest on a solid surface without bearing on the curb stop or piping.
- C. Curb boxes shall be of cast iron, have a 2-inch inside diameter, and be of the extension type with lid and plug. One compatible steel shut-off rod of suitable length shall be furnished. Coat curb boxes and bases with a suitable bituminous coating.

- D. Corporation stops for service line connections shall be precision fitted, individually lapped, ground joint key stops of all bronze construction. For tapped connections to water mains, inlet threads shall be of the steep taper, corporation stop type. Corporation stops shall conform to the applicable requirements of AWWA C800.

2.6 AIR RELEASE VALVES

- A. Air release valves shall have cast iron body and cover, stainless steel float, stainless steel or bronze trim, and Buna-N seat. All other attaching parts or internal parts shall be stainless steel or bronze.
- B. Valve shall be designed for a working pressure of 0 to 150 psi unless otherwise shown or specified and shall be equipped with an orifice appropriate to the venting needs of the pipeline.
- C. Sewage valves shall be equipped with an elongated body, a 2-inch NPT inlet connection, and a ½-inch NPT outlet connection and shall be provided with 2-inch inlet shut-off valve, 1-inch blow-off valve, and ½-inch back-flush valve with quick-disconnect coupling and flushing hose with quick-disconnect connections.
- D. Pressure water valves shall be installed in valve pit, complete with tapping saddle and connecting line to main, gate valve, etc., and at the location(s) shown on the Drawings. Clean, prime, and paint valve exterior with bituminous paint. Valves 2 inches and smaller shall have NP screwed inlet. Combination air vacuum/air release valve shall be Valve and Primer Corporation, APCO Air Release Valve (Standard), Crispin Universal Air Valve, or equal.

2.7 PRESSURE REDUCING VALVES FOR WATER

- A. Pressure reducing valves shall automatically reduce a higher inlet pressure to a preset, steady outlet pressure. The reducing valve shall be very sensitive to slight pressure changes and immediately control the main valve to maintain the desired pressure. Valve outlet pressure shall be adjustable between 3 and 30 psi.
- B. The main valve shall be direct acting, single seated, spring-loaded, diaphragm-actuated, globe type valve. When the downstream pressure exceeds the pressure setting, the main valve shall close drip-tight. Piston actuators will not be acceptable. Main valve shall be guided at two locations. No external packing glands shall be used and the diaphragm shall not be used as a seating surface.
- C. Pressure reducing valves sized 2 inches and smaller shall have cast bronze body; stainless steel seat ring; Teflon, Buna-N, or composition disc and diaphragm; and outside screw adjustment. Valves shall be suitable for 230-psi inlet pressure. Valves shall be furnished with threaded ends per ANSI B2.1. Bronze pressure reducing valves shall be Watts Regulator No. 223S-LP, or equal.
- D. Pressure reducing valves 2½ inches and larger shall have cast iron body, bronze trim, bolted cover, and pilot-controlled main valve. The pilot control system shall be external, connected to the valve with union fittings. Pressure setting shall be adjustable by a single screw adjustment enclosed in a tamperproof housing. Valve shall be suitable for an inlet pressure of not less than 175 psi. Valves sized 2½ inches shall have threaded ends per ANSI B2.1. Valves 3 inches and larger shall have 125-pound, flanged ends

per ANSI B16.1. Valve body and cover shall be of cast iron conforming to ASTM A48. Valve trim and pilot control shall be of ASTM B61 or B62 bronze. Pilot control trim shall be stainless steel. Pilot valve shall be supplied with an integral strainer constructed of heavy and fine mesh monel screens to protect the pilot control system from foreign particles. Pilot-controlled valves shall be Clayton Fig. 90G-01, GA Industries Fig. 45-D, or equal.

- E. A separate Y-pattern strainer with threaded or bolted cleanout shall be furnished and installed immediately upstream of each pressure reducing valve. Area through the screen shall be not less than 4 times the full pipe area. Strainers shall have a pressure rating not less than that of the protected pressure regulating valve.
- F. A 2-inch pressure gauge with tee-head, bronze gauge cock shall be installed on the upstream and downstream side of each pressure regulating valve unit. Pressure gauges on the upstream side shall have a range of approximately 0 to 160 psi. Pressure gauges on the downstream side shall have a range of approximately 0 to 80 psi.

2.8 BALL VALVES

- A. Ball valves shall be of the quarter turn type with full pipe size opening through the valve. Ball valves shall be suitable for a differential working pressure in either direction of not less than 400 psi.
- B. Ball valves shall have a three-piece, bolted body designed to allow the interior portion of the valve to be removed without disturbing adjacent piping.
- C. Unless otherwise specified or required, ball valves shall have brass body, self-aligning brass ball, blowout-proof brass stem, reinforced Teflon seats and seals, plastic-coated plated steel handle, and threaded ends per ANSI B2.1. Ball valves shall be Powell "Star," Worcester "Miser," or equal.
- D. In stainless steel piping, or where specified, valve shall have a forged Type 316 stainless steel body, ball, and trim.

2.9 CHECK VALVES

- A. Check valves shall be of the swing type suitable for use in either horizontal or vertical piping, unless otherwise shown or specified. Disc shall swing entirely clear of the path of flow when in the open position. All internal parts shall be readily accessible and easily replaced in the field.
- B. Check valves in sizes 2½ inches and smaller shall be Y-pattern, regrinding, bronze body, bronze mounted valves. Valves shall have 200-pound cast bronze body, renewable bronze disc, screwed cap, and threaded ends per ANSI B2.1. Bronze for body and cap shall conform to ASTM B61. Brass nuts and pin shall conform to ASTM B16. Valves shall have a hinge bumper capable of preventing the valve from sticking in the open position and an arrow cast on the valve body to indicate direction of flow. Bronze check valves shall be Powell Fig. 560Y, Stockham Fig. B-345, Nibco Fig. T-453-B, or equal.

- C. Check valves in sizes 3 inches and larger shall be iron body, bronze mounted valves conforming to AWWA C508, epoxy-coated inside and outside. Valves shall have 125-pound cast iron body, bolted and gasketed cover, stainless steel or bronze hinge pin, rubber faced, renewable, bronze or cast iron resilient disc, renewable bronze seat ring, outside lever and adjustable weight, and 125-pound flanged ends per ANSI B16.1. Cast iron for body and cap shall conform to ASTM A126, Grade B. Bronze for disc and seats shall conform to ASTM B584. Iron body check valves shall be Mueller Fig. A2602-0, Clow Style 1106A LW, or equal.
- D. Valves shall be installed with pressure under the disc.
- E. Check valves in air or gas piping sized 2½ inches or smaller shall be bronze, swing type check valves conforming to the requirements of Item B above, except that the disc shall have a replaceable, resilient seat of Buna-N or Teflon. Bronze check valves for air or gas service shall be Nibco Fig. T-453-W, Kennedy Fig. 442, or equal.
- F. Check valves in air or gas piping sized 3 inches and larger shall be of the double plate, spring-loaded, clapper type with cast iron body, aluminum bronze or bronze plates, stainless steel hinge pin and springs, and Buna-N seats. When operating temperatures exceed 180°F, Viton seats shall be used. Check valves shall be wafer style bodies suitable for mounting between two 125-pound ANSI B16.1 flanges. Check valves shall be rated for a working pressure of not less than 150 psi. Clapper style check valves shall be Mission "Duo-Check," FMC, or equal. Install clapper style check valves in horizontal piping with the pin in a vertical position.

2.10 HOSE BIBBS

- A. Hose bibbs shall be angle hose valves of bronze construction suitable for 125 psi minimum working pressure. Valves shall have a renewable Teflon or resilient disc and shall be furnished with a ¾-inch male hose outlet connection. Body and bonnet shall be ASTM B62 bronze. Valves shall be furnished with a suitable cap and chain. Inlet connection shall be threaded per ANSI B2.1.

2.11 ALTITUDE VALVES

- A. Altitude valves shall be single-acting, hydraulically operated, pilot actuated, diaphragm or piston type globe valves designed for ground level control of water level in storage tanks. Valve shall be of the non-throttling differential type and shall be air and water cushioned on closing to prevent surges on shutoff. Valve shall be suitable for 175 psi working pressure. Operating point and closing speed shall be adjustable.
- B. Valve shall have a cast iron body and bolted bonnet conforming to ASTM A126, Class B, bronze pilot control valve and main valve trim, resilient seat disc, stainless steel pilot trim, and reinforced synthetic rubber diaphragm. Seat ring, disc, and diaphragm shall be removable without removing the valve from the line. Piston type valves shall be constructed with removable resilient seals and guides to prevent metal-to-metal contact. No external packing glands shall be used and the diaphragm shall not be used as a seating surface. Main valve stem shall be guided at both ends. Pilot control shall be three-way, hydraulically balanced, diaphragm type.

- C. An indicator rod shall be provided to show valve position. A fine mesh stainless steel or Monel strainer shall be provided in the control piping. A 4½-inch pressure gauge calibrated in both psi and feet of water shall be provided on both sides of the altitude valve.
- D. Valve shall be furnished with flanged ends drilled per ANSI B16.1.
- E. A standard repair kit shall be supplied for the altitude valve. Kit shall include liner cap, seat ring, cover gasket, indicator packing, vent packing, and piston cup for main valve, seat ring, lower packing, upper packing, stem gasket, and diaphragm for pilot.
- F. Altitude valves shall be GA Industries Figure 3200-D; Clayton Figure 206, OCV Series 3331; or approved equal.

2.12 FLAP VALVES

- A. Flap valves shall be designed to withstand the stresses resulting from high-head seating applications and to maintain sensitivity to unseating heads.
- B. Flap valves shall have iron bodies and shall be bronze mounted. Valves shall be furnished with bronze hinge pins, flap rings, and seat rings.
- C. Valves shall be furnished with 125-pound flanged ends per ANSI B 16.1.
- D. Flap valves shall be Clow F-3012, Mueller A-2540-6, M&H (Dresser) Figure 47, or equal.

2.13 KNIFE GATE VALVES

- A. Knife gate valves shall be of the flanged wafer type with outside stem and yoke and a metal-seated, knife-blade gate with a beveled edge designed to push aside or cut through solids in its path. Knife gate valve shall have full round port opening and shall have a working pressure of at least 125 psi in sizes 24 inches and smaller and 50 psi in sizes 30 inches and larger. Valves shall be capable of providing bi-directional, drip tight shutoff.
- B. Knife gate valves shall have a heavy, one-piece body and end flanges of steel or cast iron. Valves shall be lined throughout with stainless steel, including the chest and packing areas. Liner shall extend beyond flange to form raised face mating surface. Knife gate shall be of ground and polished stainless steel of sufficient thickness to resist deformation of rated pressure across the gate. A full circle, raised-face seat with machined gate jambs at the sides and bottom shall be provided to hold the gate and assure positive seating. Seat shall have a neoprene or BNA-N elastomer D shaped ring recessed into the face of the valve seat for a driptight shutoff. All wetted parts of the valve shall be of Type 304 stainless steel.
- C. Knife gate shall be sealed with a minimum of four rings of Teflon or neoprene-impregnated asbestos packing. Gland shall be of corrosion-resistant material or shall be specially coated for corrosion resistance. Gland bolts and nuts shall be stainless steel.

service for which the valve is intended ("W" for water, "S" for drain or waste lines). Covers in roadways shall be of the deep locking type.

- C. All parts of valve boxes, bases, and covers shall be heavily coated with a suitable bituminous finish.
- D. Valves and boxes shall be set plumb. Each valve box shall be placed directly over the valve it serves with the top of the box flush with the finished grade.
- E. Valve box lids shall be provided with the word "Water" embossed in the lid surface.

2.16 T-HANDLE OPERATING WRENCH

- A. Furnish two T-handle, steel valve operating wrenches with sockets compatible with standard 2-inch-square valve operating nuts.
- B. The operating wrenches shall be at least 36 inches in length.

2.17 SPARE PARTS

- A. Furnish the following spare parts where applicable for the valves specified herein:
 - 1. Stem packing One set each type and size of valve
 - 2. Renewable stainless steel or bronze seat ring One each type and size of valve
 - 3. O-ring stem or shaft seals One set each type and size of valve
 - 4. Resilient seat or disc One each type and size of valve
 - 5. Shaft bearings or bushings One set each type and size of valve
 - 6. Hinge pin, disc, spring, and disc bolts One set each type and size of check valve
 - 7. Gaskets One set each type and size of valve
 - 8. Special tool or seat wrench required for valve servicing and maintenance One each
- B. Suitably protect spare parts against corrosion and impact to withstand long-term storage. All parts shall be clearly labeled and identified by manufacturer's name and number and the valve to which they belong.

PART 3 - EXECUTION

3.1 FACTORY TESTS

- A. Test all valves at the point of manufacture for proper and unobstructed operation and for leakage and adequacy of design.
- B. Test iron body gate valves in accordance with AWWA C500, Section 5.

- C. Test butterfly and plug valves in accordance with AWWA C504, Section 5.
- D. Test iron body check valves in accordance with AWWA C508, Section 5.
- E. All other valves shall be given an operation test, a leakage test at rated pressure differential, and a hydrostatic test at two times rated pressure. During the hydrostatic test, there shall be no leakage through the metal, the end joints, or the shaft or stem seal, nor shall any part be permanently deformed. During the leakage test, leakage shall not exceed that permitted by ANSI B16.104, Class IV for metal seated valves and Class VI for resiliently seated valves.

3.2 INSTALLATION

- A. Install all valves in strict conformance with the Drawings and approved shop drawings and manufacturer's instructions.
- B. Install all underground valves using a concrete valve box with cast iron frame and cover or in a cast iron valve box as specified herein.
- C. Install valves in such a way that operators and packing are easily accessible. Valves with field replaceable seats shall be installed with sufficient clearance to permit removal of valve bonnet and stem without removing valve from the line.

3.3 FIELD TESTING

- A. Following installation, test all valves under the anticipated operating conditions. The ability of the valves to operate properly without leakage, binding, sticking, fluttering, or excessive operating torque shall be demonstrated to the satisfaction of the Engineer. At Contractor's expense, adjust and/or replace any valve as necessary to ensure satisfactory operation.

END OF SECTION

SECTION 40 05 33

PIPE COUPLINGS AND EXPANSION JOINTS

PART 1 - GENERAL

1.1 SCOPE

- A. The work covered by this section includes furnishing all labor, equipment, and materials required to furnish and install pipe couplings and expansion joints, including grooved couplings, flanged adaptors, expansion couplings, and rubber expansion joints, as shown on the Drawings, specified herein, and/or required for proper installation of piping and equipment.

1.2 SHOP DRAWINGS AND ENGINEERING DATA

- A. Complete shop drawings and engineering data shall be submitted to the Engineer in accordance with the requirements of the Section 01 33 23 - Shop Drawings, Product Data and Samples.

1.3 STORAGE AND PROTECTION

- A. Equipment and products stored outdoors shall be supported above the ground on suitable wooden blocks or braces arranged to prevent excessive deflection or bending between supports. Items such as pipe, structural steel, and sheet construction products shall be stored with one end elevated to facilitate drainage.

1.4 SHOP PAINTING

- A. Clean, shop prime, and shop paint all pipe couplings as specified herein.

1.5 GUARANTEE

- A. Provide a guarantee against defective materials and workmanship in accordance with the requirements of the applicable provisions of Section 01 78 36, Warranties and Bonds.

PART 2 - PRODUCTS

2.1 EXPANSION COUPLINGS

- A. Unless otherwise shown or specified, expansion couplings shall be of a gasketed, short sleeve type, with a diameter to fit the pipe properly. Expansion couplings shall have a working pressure of not less than 150 psig.
- B. Each short sleeve coupling for joining ductile iron or steel pipe shall consist of one cylindrical steel middle ring without pipe stop, two steel follower rings, two rubber-compound, wedge section gaskets, and a sufficient number of track head, electroplated steel bolts to compress the gaskets properly. Steel couplings shall be Dresser Style 38, Rockwell Style 411, or equal.
- C. Where expansion couplings are required for joining ductile iron pipe to steel pipe of the same nominal size, steel transition couplings, Dresser Style 62, Rockwell Style 413, or equal, shall be used.

- D. Rubber gaskets shall be composed of a resilient synthetic rubber compound suitable for use in wastewater containing oil and grease.

2.2 GROOVED COUPLINGS

- A. Grooved couplings for ductile iron pipe shall consist of two or more ductile iron housing clamps, a single rubber-compound gasket and electroplated oval-neck track bolts with heavy hex nuts. Housing shall be ribbed for strength and self-centering. Rubber gasket shall be composed of a resilient synthetic rubber compound suitable for use in wastewater containing oil and grease.
- B. Grooved couplings shall provide for a pipe end separation of not less than 3/32-inch and a deflection of not less than 0°45'.
- C. Grooved couplings shall engage two circumferential grooves cut at the ends of the pipe sections to be joined. The grooves shall provide a positive mechanical grip that locks the pipe ends together such that they cannot blow apart under pressure, vibration, or sag. Grooves shall be cut with a radius at the inside corners of the grooves.
- D. Grooved couplings for joining ductile iron pipe shall be Vitaulic Style 31, Gustin-Bacon Gruvajoint No. 500, or equal.

2.3 FLANGED ADAPTORS

- A. Flanged adaptors shall be used for joining plain end ductile iron pipe to flanged valves, pumps, and fittings. Flanged adaptors shall be suitable for working pressures to 150 psig.
- B. Flanged adaptors in sizes 12-inch and smaller shall consist of an ASTM A 126, Class B cast iron flanged body drilled to mate with a 125-pound cast iron flange per ANSI B16.1, a cast iron follower ring, a rubber-compound, wedge section gasket, and a sufficient number of track head, electroplated steel bolts to compress the gasket properly.
- C. Flanged adaptors in sizes 14-inch and larger shall consist of a high strength steel flanged body drilled to mate with a 125-pound cast iron flange per ANSI B16.1, a high strength steel follower ring, a rubber-compound, wedge section gasket, and a sufficient number of electroplated steel bolts to compress the gasket properly.
- D. Rubber gasket shall be composed of a resilient synthetic rubber compound suitable for use in wastewater containing oil and grease.

2.4 FLANGED RUBBER EXPANSION JOINTS

- A. Flanged rubber expansion joints shall be standard spool-type single or multiple arch expansion joints constructed of abrasion-resistant rubber reinforced with high tensile strength synthetic fabric and steel rings.
- B. Ends of the expansion joint shall be integral with the body and shall be full faced and drilled per ANSI B16.1 for 125-pound flanges. Beveled and split, galvanized steel retaining rings shall be provided to prevent damage to flanges and to distribute bolting stresses during assembly.
- C. Tube, body, and flanges shall be constructed using Buna-N for wastewater, natural rubber for clean water, and Buna-N or neoprene for air. For working temperatures in

excess of 180°F or for chemical service, tube, body, and flanges shall be constructed of Viton. The exterior of the expansion joint shall be coated with Hypalon to resist weathering.

- D. When used to convey slurries, raw water, or untreated wastewater in horizontal piping, arches shall be filled with a special soft rubber compound integrally cured in the arches.
- E. In unrestrained piping systems or pipe systems subject to excessive longitudinal deflection, joints shall be furnished with two plated steel control rods fitted with nuts to limit compression and extension and prevent damage to the joint.
- F. Rubber expansion joints shall be "Redflex," as manufactured by Red Valve Company, "Invincible Expansion Joint," as manufactured by Mercer Rubber Company, or equal, subject to the requirements of this section.

2.5 SLIP-ON RUBBER EXPANSION JOINTS

- A. Slip-on rubber expansion joints for low pressure applications (less than 15 psig) up through 6-inch diameter in size shall be sleeve-type, single-arch expansion joints constructed of abrasion resistant rubber reinforced with high tensile strength synthetic fabric.
- B. Ends of the joint shall be designed to slip over pipe ends and shall be secured in place with adjustable stainless steel clamps. Two (2) clamps shall be provided on each end of the joint.
- C. Joint shall be constructed of Buna-N for wastewater and Buna-N or neoprene for air at working temperatures up to 180°F.

2.6 SHOP COATINGS

- A. Couplings and adaptors shall have finish as follows:

<u>Material</u>	<u>Location</u>	<u>Primer</u>	<u>Finish</u>
Ductile Iron	Buried, Submerged, or Exposed	Epoxy Primer Interior	Epoxy
Ductile Iron	Buried, Submerged, or Exposed	Epoxy Primer (Exterior)	Epoxy
Steel	Buried, Submerged, or Exposed	Epoxy Primer Interior	Epoxy Finish
Steel	Buried, Submerged, or Exposed	Epoxy Primer (Exterior)	Coal Tar Epoxy

2.7 LEAD CONTENT RESTRICTIONS

- A. All metal used in the distribution system shall contain less than 8.0% lead content. Any solders and/or fluxes used in the installation of the pipe shall contain less than 0.2% lead content.

2.8 NSF CERTIFICATION REQUIREMENTS

- A. All products or materials which will contact drinking water must have NSF/ANSI Standard 61 certification; and all chemicals which will contact drinking water shall have NSF/ANSI Standard 60 certification.

2.9 SPARE PARTS

- A. Furnish 2 spare gasket sets and 2 spare track head bolt sets for each size and type of coupling.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Pipe couplings and expansion joints shall be installed where shown on the Drawings, required, or directed by the Engineer. Couplings and joints shall be installed in strict conformance with the manufacturer's instructions.
- B. Pipe ends shall be cleaned, brushed, or filed to produce a mating surface for the gasket that is free from dirt, rust, chuck marks, mill scores, dents, burrs or other foreign substances that would impede proper gasket seating.
- C. Grooves for grooved couplings shall be accurately located and cut with a suitable grooving tool.
- D. A lubricant recommended by the coupling manufacturer shall be used in seating all gaskets.
- E. On expansion couplings and flanged adaptors, bolts shall be tightened diametrically opposite each other and in progression so that the inner rims project an equal distance over the flares of the middle ring at all points. Bolts shall be tightened sufficiently to ensure a watertight joint but shall not be tightened beyond the point of stretching.
- F. On grooved couplings, bolts shall be tightened alternately and uniformly so the housing clamps come together evenly and the gasket is not pinched. Bolts shall be tightened until the housing clamps meet.
- G. Couplings shall be field painted, following installation and testing, in accordance with the requirements listed previously in this section. Rubber expansion joints shall not be painted.

END OF SECTION

SECTION 40 05 53

PIPE SUPPORTS AND HANGERS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The work covered under this section consists of the furnishing of all necessary material, equipment, labor, and services for satisfactory completion of the work as described in this specification and/or shown on the Drawings.

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM) Publications

- 1. ASTM B633 Specification for Electrodeposited Coatings of Zinc on Iron and Steel
- 2. ASTM A123 Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip
- 3. ASTM A653 Specification for Steel Sheet, Zinc-Coated by the Hot-Dip Process
- 4. ASTM A1011 Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability

- B. Manufacturers Standardization Society (MSS)

- 1. MSS SP-58 Pipe Hangers and Supports- Materials, Design, and Manufacture
- 2. MSS SP-69 Pipe Hangers and Supports- Selection and Application

- C. National Fire Protection Association (NFPA)

- 1. NFPA 13 Standard for the Installation of Sprinkler Systems

1.3 QUALITY ASSURANCE

- A. Supports and hangers used in fire protection piping systems shall be listed and labeled by Underwriters Laboratories.
- B. Steel pipe supports and hangers shall have the manufacturer's name, part number, and applicable size stamped in the part itself for identification.
- C. Supports and hangers shall be designed and manufactured in conformance with MSS SP-58.
- D. Supports for sprinkler piping shall be in conformance with NFPA 13.

1.4 SUBMITTALS

- A. Submit product data on all support and hanger devices, including shields and attachment methods. Product data to include, but not limited to materials, finishes, approvals, load ratings, and dimensional information.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer: Subject to compliance with these specifications, pipe support and hanger systems shall be as manufactured by Anvil International (Anvil); Cooper B-Line, Inc. (B-Line); or approved equal. Note: Either part or figure number follows manufacturers' names.

2.2 PIPE SUPPORTS AND HANGERS

A. Hangers

1. Uninsulated pipes 2-inch and smaller:
 - a. Adjustable steel swivel ring (band type) hanger: Anvil 69 or B-Line B3100.
 - b. Adjustable steel swivel J-hanger: Anvil 67 or B-Line B3690.
 - c. Malleable iron hinged ring hanger: Anvil 138R or B-Line B3198H.
 - d. Malleable iron split-ring hanger with eye socket: Anvil 108 with 110R or B-Line B3173 with B3222.
 - e. Adjustable steel clevis hanger: Anvil 65 or B-Line B3104; or Anvil 260 or B-Line B3100.
2. Uninsulated pipes 2½-inch and larger:
 - a. Adjustable steel clevis hanger: Anvil 260 or B-Line B3100. For DI or CI pipe, use Anvil 590 or B-line B3102.
 - b. Pipe roll with sockets: Anvil 171 or B-Line B3114.
 - c. Adjustable steel yoke pipe roll: Anvil 181 or B-Line B3110.
3. Insulated pipe - Hot or steam piping:
 - a. 2-inch and smaller pipes: use adjustable steel clevis with galvanized sheet metal shield. B-Line B3100 with B3151 series.
 - b. 2½-inch and larger pipes:
 - 1) Adjustable steel yoke pipe roll with pipe covering protection saddle: Anvil 181 with 160-165 or B-Line B3110 with B3160-B3165 series.
 - 2) Pipe roll with sockets with pipe covering protection saddle: Anvil 171 with 160-165 series or B-Line B3114 with B3160-B3165 series.

4. Insulated pipe - Cold or chilled water piping:
 - a. 5 inch and smaller pipes: adjustable steel clevis with galvanized sheet metal shield: Anvil 260 with 167 series or B-Line B3100 with B3151 series.
 - b. 6 inch and larger pipes:
 - 1) Adjustable steel yoke pipe roll with pipe covering protection saddle: Anvil 181 with 160-165 or B-Line B3110 with B3160-B3165 series.
 - 2) Pipe roll with sockets with pipe covering protection saddle: Anvil 171 with 160-165 series or B-Line B3114 with B3160-B3165 series.

B. Pipe Clamps

1. When flexibility in the hanger assembly is required due to horizontal movement, use pipe clamps with weldless eye nuts: Anvil 212 or 216 with 290 or B-Line B3140 or B3142 with B3200. For insulated lines use double bolted pipe clamps: Anvil 295 or 295H with 290 or B-Line B3144 or B3146 with B3200.

C. Multiple or Trapeze Hanger

1. Trapeze hangers shall be constructed from 12 gauge roll formed ASTM A1011 SS Grade 33 structural steel channel, 1⁵/₈-inch by 1⁵/₈-inch minimum: Anvil AS 200 or B-Line B22 strut or stronger as required.
2. Mount pipes to trapeze with 2 piece pipe straps sized for outside diameter of pipe: Anvil AS 1300 or B-Line B2000.
3. For pipes subjected to axial movement:
 - a. Strut mounted roller support: Anvil AS 1911 or B-Line B3126. Use pipe protection shield or saddles on insulated lines.
 - b. Strut mounted pipe clamp or guide: Anvil AS 1300 or B-Line B2417.

D. Wall Supports

1. Pipes 4-inch and smaller:
 - a. Carbon steel hook: B-Line B3191 or approved equal.
 - b. Carbon steel J-hanger: Anvil 67 or B-Line B3690.
2. Pipes larger than 4-inch:
 - a. Welded strut bracket and pipe straps: B-Line B3064 and B2000 series or approved equal.
 - b. Welded steel brackets: Anvil 195 or 199 with roller chair or adjustable steel yoke pipe 175 or 181 OR B-Line B3066 or B3067 with roller chair or adjustable steel yoke pipe roll, B-Line B3120 or B3110. Use pipe protection shield or saddles on insulated lines.

E. Floor Supports

1. Hot piping under 6-inch and all cold piping:
 - a. Carbon steel adjustable pipe saddle and nipple attached to steel base stand sized for pipe elevation: Anvil 264 and 63, Type T [or 259 and 63, Type P], or B-Line B3093 and B3088T [or B3090 and B3088]. Pipe saddle shall be screwed or welded to appropriate base stand.
2. Hot piping 6-inch and larger:
 - a. [Adjustable] Roller stand with base plate, Anvil 271 [or 274P], or B-Line B3117SL [or B3118SL].

F. Vertical Supports

1. Steel riser clamp sized to fit outside diameter of pipe: Anvil 261 or B-Line B3373.

G. Copper Tubing Supports

1. Hangers shall be sized to fit copper tubing outside diameters.
 - a. Adjustable steel swivel ring (band type) hanger: Anvil CT69 or B-Line B3170CT.
 - b. Malleable iron hinged ring hanger: Anvil CT138R or B3198HCT.
 - c. Malleable iron split-ring hanger with eye socket: Anvil CT190 with 110R or B-Line B3173CT with B3222.
 - d. Adjustable steel clevis hanger: Anvil CT65 or B-Line B3104CT.
2. For supporting vertical runs use epoxy painted or plastic coated riser clamps: Anvil CT121 [or CT121C] or B-Line B3373CT [or B3373CTC].
3. For supporting copper tube to strut use epoxy painted pipe straps sized for copper tubing: Anvil AS1200 or B-Line B2000 series.

H. Plastic Pipe Supports

1. V-Bottom clevis hanger with galvanized 18-gauge continuous support channel: B-Line B3106, B3106V, or approved equal to form a continuous support system for plastic pipe or flexible tubing.

I. Supplementary Structural Supports

1. Design and fabricate supports using structural quality steel bolted framing materials. Channels shall be roll formed, 12 gauge ASTM A1011 SS Grade 33 steel, 1 $\frac{5}{8}$ inch by 1 $\frac{5}{8}$ inch or greater as required by loading conditions. Submit designs for pipe tunnels, pipe galleries, etc., to engineer for approval. Use clamps and fittings designed for use with the strut system.

2.3 UPPER ATTACHMENTS

A. Beam Clamps

1. Beam clamps shall be used where piping is to be suspended from building steel. Clamp type shall be selected on the basis of load to be supported, and load configuration.
2. C-Clamps shall have locknuts and cup point set screws; Anvil 95 [or 86] or B-Line B351L [or B3036L]. Top flange c-clamps shall be used when attaching a hanger rod to the top flange of structural shapes; Anvil 94 or B-Line B3033. Refer to manufacturer's recommendation for setscrew torque. Retaining straps shall be used to maintain the clamps position on the beam where required.
3. Center loaded beam clamps shall be used where specified.
 - a. Steel clamps shall be Anvil 133 [or 134] or B-Line B3050.
 - b. Malleable iron or forged steel beam clamps with cross bolt: Anvil 292(L) or B-Line B3291-B3297 (LH threads) series as required to fit beams.

B. Concrete Inserts

1. Cast in place spot concrete inserts shall be used where applicable; either steel or malleable iron body: Anvil 285 [or 282] or B-Line B2500 [or B3014 and B3014N]. Spot inserts shall allow for lateral adjustment and have means for attachment to forms. Select inserts to suit threaded hanger rod sizes.
2. Continuous concrete inserts shall be used where applicable. Channels shall be 12 gauge, ASTM A1011 SS Grade 33 structural quality carbon steel, complete with styrofoam inserts and end caps with nail holes for attachment to forms. The continuous concrete insert shall have a load rating of 2,000 lbs/ft. in concrete: Anvil AS 349 (1 $\frac{3}{8}$ " x 1 $\frac{5}{8}$ " channel) or AS 449 (1" x 1 $\frac{5}{8}$ " channel), or B-Line B221 (1 $\frac{5}{8}$ " x 1 $\frac{5}{8}$ " channel), 321 (1 $\frac{3}{8}$ " x 1 $\frac{5}{8}$ " channel), or 521 (13/16" x 13/16" channel). Select channel nuts suitable for strut and rod sizes.

2.4 VIBRATION ISOLATION AND SUPPORTS

- A. For refrigeration, air conditioning, hydraulic, pneumatic, and other vibrating system applications, use a clamp that has a vibration dampening insert and a nylon inserted locknut. For copper and steel tubing use B-Line BVT series Vibraclamps, for pipe sizes use BVP series.
- B. For larger tubing or piping subjected to vibration, use neoprene or spring hangers as required.
- C. For base mounted equipment use vibration pads, molded neoprene mounts, or spring mounts as required.
- D. Vibration isolation products as manufactured by B-Line, Vibratrol systems.

2.5 ACCESSORIES

- A. Hanger Rods shall be threaded both ends, or continuous threaded rods of circular cross section. Use adjusting locknuts at upper attachments and hangers. No wire, chain, or perforated straps are allowed.
- B. Shields shall be 180 degree galvanized sheet metal, 12-inch minimum length, 18 gauge minimum thickness, designed to match outside diameter of the insulated pipe; Anvil 167 or B-Line B3151.
- C. Pipe covering protection saddles shall be formed from carbon steel, 1/8-inch minimum thickness, sized for both pipe and insulation thicknesses: Anvil 160 – 165 series or B-Line B3160 – B3165 series. Saddles for pipe sizes greater than 12-inch shall have a center support rib.

2.6 FINISHES

A. Indoor Finishes

- 1. Hangers and clamps for support of bare copper piping shall be coated with fusion-bonded epoxy coating, Scotchcote 134 or Corvel 1660 or copper colored epoxy paint, B-Line Dura-Copper®. Additional PVC coating of the epoxy painted hanger shall be used where necessary.
- 2. Hangers for other than bare copper pipe shall be zinc plated in accordance with ASTM B633 OR shall have an electro-deposited green epoxy finish, B-Line Dura-Green®.
- 3. Strut channels shall be pre-galvanized in accordance with ASTM A653 SS Grade 33 G90 OR have an electro-deposited green epoxy finish, B-Line Dura-Green®.

B. Outdoor and Corrosive Area Finishes

- 1. Hangers and strut located outdoors shall be hot dip galvanized after fabrication in accordance with ASTM A123. All hanger hardware shall be hot dip galvanized or stainless steel. Zinc plated hardware is not acceptable for outdoor or corrosive use.
- 2. Hangers and strut located in corrosive areas shall be type 304 [316] stainless steel with stainless steel hardware

PART 3 - EXECUTION

3.1 PIPE SUPPORTS AND HANGERS

- A. Pipe shall be adequately supported by pipe supports and hangers specified in PART 2 - PRODUCTS. Hangers for insulated pipes shall be sized to accommodate insulation thickness.
- B. Horizontal steel piping shall be supported in accordance with MSS SP-69 Tables 3 and 4, excerpts of which follow below:

Nominal Pipe Size (inches)	Rod Diameter (inches)	Maximum Spacing (feet)
½ to 1¼	3/8	7
1½	3/8	9
2	3/8	10
2½	1/2	11
3	1/2	12
3½	1/2	13
4	5/8	14
5	5/8	16
6	¾	17
8	¾	19
10	7/8	22
12	7/8	23
14	1	25
16	1	27

C. Horizontal copper tubing shall be supported in accordance with MSS SP-69 Tables 3 and 4, excerpts of which follow below:

Nominal Pipe Size (inches)	Rod Diameter (inches)	Maximum Spacing (feet)
½ to ¾	3/8	5
1	3/8	6
1¼	3/8	7
1½	3/8	8
2	3/8	8
2½	1/2	9
3	1/2	10
3½	1/2	11
4	1/2	12
5	1/2	13
6	5/8	14
8	¾	16

- D. Provide means of preventing dissimilar metal contact such as plastic coated hangers, copper colored epoxy paint, or non adhesive isolation tape. Galvanized felt isolators sized for copper tubing may also be used.
- E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
- F. Install hangers to provide a minimum of ½ inch space between finished covering and adjacent work.
- G. Place a hanger within 12 inches of each horizontal elbow.
- H. Support vertical piping independently of connected horizontal piping. Support vertical pipes at every floor. Wherever possible, locate riser clamps directly below pipe couplings or shear lugs.
- I. Where several pipes can be installed in parallel and at the same elevation, provide trapeze hangers as specified in section 2.2 C. Trapeze hangers shall be spaced according to the smallest pipe size, or install intermediate supports according to schedule in section 3.1B.
- J. Do not support piping from other pipes, ductwork or other equipment that is not building structure.

3.2 CONCRETE INSERTS

- A. Provide inserts for placement in formwork before concrete is poured.
- B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Where concrete slabs form finished ceilings, provide inserts to be flush with slab surface.
- D. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inch.

END OF SECTION

