FULTON COUNTY

Vision

People *Families* *Neighborhoods*

Mission

To serve, protect and govern in concert with local municipalities

Values

People *Customer Services*
Ethics *Resource Management*
Innovation *Equal Opportunity*

PURCHASING DEPARTMENT
INVITATION TO BID NO. 08ITB59847K-DJ

W027 NORTH FULTON WATER SYSTEM IMPROVEMENTS

Providence Road and Mansell Road Booster Pump Stations

VOLUME 2

For

DEPARTMENT OF PUBLIC WORKS

BID DUE TIME AND DATE: 11:00 A.M., Monday, March 17, 2008
BID ISSUANCE DATE: February 4, 2008
PURCHASING CONTACT: Donna Jenkins at 404-730-4213
E-MAIL: donna.jenkins@fultoncountyga.gov

LOCATION: FULTON COUNTY DEPARTMENT OF PURCHASING & CONTRACT COMPLIANCE
130 PEACHTREE STREET, S.W., SUITE 1168
ATLANTA, GA 30303

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Part 1 General

1.01 Scope

Furnish and install the cast-in-place concrete as shown and indicated on the Drawings and as specified in this Section, complete.

1.02 Submittals

A. Mix designs for all groups and classes of concrete.

B. Strength and slump tests results.

C. Certificates of compliance for each of the following:

1. Cement
2. Aggregates
3. All admixtures

Part 2 Products

2.01 Cement

Cement shall be standard Portland Cement, of American manufacture, conforming to ASTM C 150, Type I Only one brand of commercial Portland cement shall be used in the exposed concrete of the structure. Cement reclaimed by cleaning bags or from leaking containers shall not be used in this work. Each bag shall weigh approximately 94 pounds and contain one cubic foot.

2.02 Concrete Aggregates

A. Fine aggregate shall be sand having clean, hard, durable, uncoated grains and free from deleterious substances and shall conform to ASTM C 33.

B. Coarse aggregate shall be crushed stone having clean, hard, durable, uncoated particles conforming to ASTM C 33

2.03 Water

Water used in mixing concrete shall be clean and free from deleterious amounts of acids, alkalies or organic materials.

2.04 Vapor Barrier

Vapor barrier shall be polyethylene sheeting, minimum 6 mil thickness, conforming to ASTM C 171. Sheeting shall be drilled with 1/2-inch holes at 6 to 10-inch centers each way.

2.05 Admixtures

A. Water reducing admixture shall conform to ASTM C 494, Type A.

B. Water reducing, retarding admixture shall conform to ASTM C 494, Type D.

C. Non-Corrosive, Non-Chloride Accelerator: The admixture shall conform to ASTM C 494, Type C.

D. Air entraining admixture shall conform to ASTM C 260.

E. Calcium Chloride: Calcium chloride or admixtures containing more than 0.1 percent chloride ions are not permitted.

2.06 Curing and Sealing Compounds

A. Curing compound shall be acrylic based, conforming to ASTM C 309.

B. Sealing compound shall be one of the following:

1. Masterseal 340, manufactured by Master Builders

2. Sikaguard 701W, manufactured by Sika Corporation

3. Super Rez Seal, manufactured by Euclid Chemical Company

Part 3 Execution

3.01 Concrete Quality

A. The following class of concrete is required:

Class of Concrete	Compressive Strength @ 28 Days	Slump Range	Maximum W/C Ratio
B	3,000	3" - 5"	0.56

1. Air Content: All concrete shall have an air content of 2.5 to 5.0 percent.

2. Admixture Usage: All concrete placed at air temperatures above 50 degrees F shall contain a water reducing admixture or water reducing-retarding

admixture. All concrete placed at air temperatures below 50 degrees F shall contain the specified non-corrosive non-chloride accelerator.

3.02 Mix Designs

A. Mix design shall be proportioned in accordance with ACI 211.1 making maximum use of the coarse aggregate. The proportioning shall be based on the requirements of a well-graded high density plastic workable mix within the slump range and strengths required. The mix shall contain no less than 1,850 pounds of coarse aggregate per cubic yard of concrete, shall be based on conventional conveying and shall not be altered for use in pumping. Pumping equipment, if used, shall be of sufficient size and design to pump the mix designed for conventional conveyance.

B. Coarse Aggregate

1. Coarse aggregate for all other concrete work shall be Size No. 57.

2. Size No. 467 may be used in lieu of Size No. 57 in concrete members whose minimum size dimension is 8-inches or larger.

C. Submit samples, in adequate quantities for each mix design and verification, of all concrete materials to be used on the project to the designated testing laboratory. Do not use any concrete in this work without acceptance and verification of design mix by the testing laboratory and the approval of the Engineer.

D. If trial batches are used, the testing laboratory shall make strength tests from trial batches in the laboratory using materials and mix designs proposed for use by the Contractor. The testing laboratory shall prepare trial batches in accordance with ACI 211.1.

E. If field experience method is selected, the proposed mix design shall be accompanied by complete standard deviation analysis and at least 30 consecutive strength tests that represent the proposed mix.

F. The proposed mix design and supporting data shall be submitted, in triplicate, to the testing laboratory for their review and comments at least 21 days prior to the expected start of concreting operations. The testing laboratory will forward two copies of the submittal to the Engineer with their comments. The Engineer will review the submittal and return one copy to the Contractor with the Engineer's comments.

G. Compression test specimens made to verify the mixes shall be made in accordance with ASTM C 192. All compression test specimens shall be tested in accordance with ASTM C 39.

3.03 Plant Mixing

A. Proportioning Concrete

1. Proportions shall be in compliance with approved design mix for each class of concrete.

2. The mixing plant shall be provided with adequate equipment and facilities for accurate measurement and control of the quantities of material and water used in the concrete.

3. Concrete materials shall be measured by weight except that admixtures shall be measured by volume.

B. Batching

1. Provide all necessary equipment to accurately determine and control actual amount of materials entering into the concrete mix. Individual ingredients shall be weighted separately for each batch. Accumulative weighing will be allowed if equipment is in acceptable working order as determined by the testing laboratory and approved by the Engineer. Accuracy of all weighing devices shall be such that successive quantities can be measured to within one percent of the desired amount.

2. Completely discharge contents of the mixer before each new batch is loaded. Use of retempered concrete is not permitted.

3. Ready-mixed concrete shall be mixed and delivered in accordance with requirements of ASTM C 94 and the following:

   a. A separate water metering device (not truck tank) shall be used for measuring water added to the original batch.

   b. Use of wash water as a portion of the mixing water is not permitted. Wash water added to empty drums after discharging shall be dumped before a new batch is received.

   c. Centrally mixed concrete shall be mixed for the length of time specified herein, not “shrink-mixed”.

   d. Mixing drums shall be watertight.

   e. Concrete shall be discharged within one hour from the time concrete was mixed, if centrally mixed, or from time the original water was added, if transit-mixed.

   f. Furnish delivery ticket with each load of concrete delivered under these Specifications. Delivery ticket shall show clearly the class and strength of

concrete, size of coarse aggregate, water per cubic yard, its slump, quantities of all admixtures, the date and time of departure from the batching plant, and the time of placement.

3.04 Conveying Equipment

A. If concrete is to be transported in carts or buggies, the carts or buggies shall be equipped with pneumatic tires.

B. Equipment for chuting or other methods of conveying concrete shall be of such size and design as to insure a practically continuous flow of concrete at delivery without segregation of concrete.

3.05 Conveying

A. Concrete shall be conveyed from mixer to place of final placement by methods which will prevent separation or loss of the material.

B. Runway supports shall not bear upon reinforcing steel or fresh concrete.

C. All conveying equipment shall be thoroughly cleaned before each run of concrete is begun.

3.06 Delivery and Protection of Materials

A. Deliver ready-mixed concrete in compliance with requirements of ASTM C 94.

B. The following tests shall be made at the work site prior to placement of concrete:

1. Slump Tests: ASTM C 143.

2. Air Content: ASTM C 173 or C 231

3. Test Cylinders: ASTM C 31

3.07 Severe-Weather Provisions

A. Hot Weather Concreting: Protect in accordance with ACI 305R except as modified herein.

1. Provide adequate methods of lowering temperature of concrete ingredients so that the temperature of concrete when placed does not exceed 90 degrees F.

2. Concrete shall not be placed when the air temperature is expected to exceed 100 degrees F within 12 hours after casting.

3. When the air temperature is 75 degrees F and above, forms and reinforcing shall be thoroughly wetted with water so that the concrete will be placed against wet and cooled surfaces. All excess water shall be removed before casting the concrete.

4. Protection and Curing - Slabs (On Grade and Formed)

   a. Protect slabs from damage due to dry winds and high temperatures.

   b. Protect slabs from direct sun at temperatures of 85 degrees F and above.

   c. Moist curing of all slabs shall start as soon as the surface of the fresh concrete is hard enough to permit curing without damage to the surface of the concrete.

5. Protection and Curing - Formed Surfaces: As soon as the concrete has set, wet the forms and keep the forms wet during the curing period. Provide for keeping the top of the walls, and other top surfaces, moist during the curing period.

B. Cold-Weather Concreting: Protect in accordance with ACI 306R except as modified herein.

1. Provide adequate equipment for heating concrete materials and protecting concrete from damage during freezing or near-freezing weather. No frozen materials, or materials containing ice, shall be used.

2. All concrete materials and all reinforcement, forms, fillers and ground with which concrete is to come into contact shall be free from frost.

3. Whenever the temperature of the surrounding air is below 40 degrees F and falling, all concrete placed in the forms shall have a temperature of between 70 and 80 degrees F, and adequate means shall be provided for maintaining a temperature of not less than 70 degrees F for three days, or 50 degrees F for five days, or for as much more time as is necessary to insure proper curing of the concrete. If high early strength concrete is used, the requirement for maintenance of 50 degrees F may be reduced to three days.

4. Use only the specified non-chloride accelerator. Calcium chloride or admixtures containing more than 0.1 percent chloride ions are not permitted.

5. Housing, covering or other protection used in connection with curing shall remain in place and intact at least 24 hours after the artificial heat is discontinued.

3.08 Construction Joints and Expansion Joints

A. Formed Construction Joints: Prior to placing concrete next to the joint, the joint surface shall be thoroughly cleaned and dampened with water. Remove all free water so that the surface of the joint shows signs of drying before placing the adjacent concrete.

B. Construction Joints in Slabs Where Waterstops are not Specified or Shown to be Installed: These joints shall be located at points of minimum shear and their locations shall be approved by the Engineer before they are bulkheaded. These joints shall be roughened and thoroughly cleaned of all foreign matter and laitance and dampened with water. Remove all free water and slush with a coat of neat cement grout before placing the adjacent concrete. Place the adjacent concrete before the neat cement grout takes its initial set.

3.09 Inspection of Work Before Placing Concrete

A. Inspect the area to receive concrete for any deficiencies which would prevent proper placing of concrete. Do not proceed with placing concrete until such deficiencies are corrected.

B. Do not place in the concrete any item that is not required to be in the concrete by the Drawings and Specifications. Insert all the items shown on the Drawings or specified properly positioned and secured. Openings other than those which are facilitated by sleeves shall be properly formed and positioned.

C. Remove hardened, or partially hardened, concrete on forms or reinforcement before placing concrete.

D. Do not place concrete on earth until the fill or excavation has been prepared as set forth under applicable sections of the Specifications for that work.

E. Give the Engineer at least 48 hours notice before any concrete is to be placed. Concrete shall not be placed until the Resident Inspector has signed a Concrete Preplacement Sign-Off Card completed by the Contractor. The Concrete Preplacement Sign-Off Card certifies that the formwork, reinforcing, and all inserts required for mechanical and electrical work, instrumentation, plumbing, process piping, metal embeds, and any other inserts or miscellaneous specialties required for the work are supported in their proper position; that the formed enclosure is clean, and the surfaces to receive concrete are prepared as specified. A sample of the Concrete Pre-Placement Sign-Off Card is attached to this Section.

3.10 Placing

A. Place concrete as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. Do not place concrete on work that has partially hardened or been contaminated by foreign material, and do not use retempered concrete. In no case shall concrete be placed when the elapsed time after addition of water and cement to batch exceeds one hour.

B. Concrete shall be placed in a manner to avoid the displacement of reinforcing, and coating or spattering the reinforcing steel. The placing of concrete within form work shall be regulated so that the pressure within form work does not exceed the design pressure. In placing concrete each layer shall be placed following the preceding layer to prevent lines of separation or “cold joints” in the work. After the concrete reaches it initial set, jarring the formwork or placing strain or vibration on the ends of projecting reinforcing bars shall be avoided.

C. Concrete shall not be dropped more than four feet.

D. Once concrete placing has started, it shall be carried on as a continuous operation until placing of the concrete between construction joints is completed.

E. Concrete shall be placed in layers not over 12-inches deep and each layer shall be compacted with the aid of mechanical internal-vibrating equipment supplemented by hand spading. Vibrators shall in no case be used to transport concrete. Use of form vibrators are not permitted. Internal vibrators shall maintain a speed of not less than 5,000 impulses per minute when submerged in the concrete. At least one spare working vibrator shall be on the job site as a back-up. Duration of vibrator use shall be limited to that necessary to produce satisfactory consolidation without causing objectionable segregation. Vibrator shall not be lowered into courses that have begun to set. Apply vibrator at uniformly spaced points not further apart than the visible effectiveness of the machine. Type and use of vibrators shall be in accordance with ACI 301.

F. Provide vapor barrier under all slabs on soil, sand or stone. Use largest sheets practicable to reduce number of joints. Lap joints a minimum of 24-inches. Remove torn and punctured sheets and replace with new sheets prior to placing concrete. Placing of concrete shall be done in a manner that will not damage the vapor barrier material. The sub-base material shall be as shown and/or noted on the Drawings.

3.11 Protection

Protect freshly placed concrete from damage or injury due to water, falling objects, persons or anything that may mar or injure finish surface on concrete. Only light use of slabs will be permitted for the first 14 days after placing of the concrete.

3.12 Curing

A. Curing shall conform to ACI 308 except as modified herein.

B. All Slabs on Grade: After placement and finishing, concrete shall be maintained in a moist condition for at least seven successive days during which the temperature of the concrete is 50 degrees F or above. For temperatures of 50 degrees F and below, curing period shall be 14 successive days. Concrete shall be kept moist by any one, or combination, of the following methods:

1. Ponding or Immersion: Continually immerse the concrete in water throughout the curing period. Water shall not be more than 20 degrees F less than the temperature of the concrete.

2. Fog Spraying or Sprinkling: Provide uniform and continuous application of water throughout the curing period.

3. Pervious Sheeting: Completely cover surface and edges of the concrete with two thicknesses of wet sheeting. Overlap sheeting 6-inches over adjacent sheeting. Sheeting shall be at least as long as the width of the surface to be cured. During application, do not drag the sheeting over the finished concrete nor over sheeting already placed. Wet sheeting thoroughly and keep continuously wet throughout the curing period.

4. Impervious Sheeting: Wet the entire exposed surface of the concrete thoroughly with a fine spray of water and cover with impervious sheeting throughout the curing period. Lay sheeting directly on the concrete surface and overlap edges 12-inches minimum. Provide sheeting not less than 18-inches wider than the concrete surface to be cured. Secure edges and transverse laps to form closed joints. Repair torn or damaged sheeting or provide new sheeting. Inspect surface of concrete daily for wetness. The surface shall be kept continuously wet during the curing period.

C. All Other Concrete: After placement, concrete shall be maintained in a moist condition for the same periods as specified above for slabs on grade.

1. Concrete in Formed Surfaces - Slabs and Building Walls: Keep forms and exposed surfaces wet with water during the curing period. If forms are removed before the end of the curing period, apply a curing compound within one hour after form removal.

3.13 Patching

A. As determined by the Engineer, any concrete which is out of alignment or level has a defective surface or has defects which reduce its structural adequacy, shall be considered as not conforming with the Drawings and Specifications and shall be rejected.

B. Do not take any remedial action on concrete with any defect without the permission of the Engineer.

C. Unless the Engineer grants permission to patch the rejected concrete, remove the rejected concrete and replace it with concrete that conforms to the Drawings and Specifications. The location of cut lines and the extent of removal will be determined by the Engineer.

D. If the Engineer grants permission to patch the rejected concrete, it shall be done in accordance with the following:

1. Permission to patch rejected concrete will not be a waiver of the Engineer's right to require complete removal of the rejected concrete if the patching does not, in the Engineer's judgment, restore the concrete to the requirements of the Specifications and Drawings.

2. Patching shall be accomplished after the curing is completed.

3. Defective areas shall be chipped away to a depth of not less than 1-inch, in all cases to sound concrete, with edges perpendicular to the surface. Feather edges will not be permitted. Remove all loose material and thoroughly clean the chipped surfaces with a high pressure air hose delivering air at 100 psi. The area to be patched and an area at least 6-inches wide surrounding it shall be dampened. A bonding grout shall be prepared using a mix of approximately one part cement to one part fine sand passing a No. 30 mesh sieve, mixed to the consistency of thick cream, and then well brushed into the surfaces as noted below in paragraph 5.

4. The patching mixture shall be made of the same materials and of approximately the same portions as used for the original concrete, except that the coarse aggregate shall be omitted and the mortar shall consist of not more than one part cement to two and one-half parts sand by damp, loose volume. White Portland cement shall be substituted for a part of the gray Portland cement to produce a color matching the color of the surrounding concrete, as determined by a trial patch. The quantity of mixing water shall be no more than necessary for handling and placing. The patching mortar shall be mixed in advance and allowed to stand with frequent manipulation with a trowel, without addition of water, until it has reached the stiffest consistency that will permit placing.

5. After surface water has evaporated from the area to be patched, the bond coat shall be well brushed into the surface. When the bond coat begins to lose the water sheen, the premixed patching mortar shall be applied. The mortar shall be thoroughly consolidated into place and struck off so as to leave the patch slightly higher than the surrounding surface. To permit initial shrinkage, it shall be left undisturbed for at least one hour before being finally finished. The patched area shall be kept damp for seven days. Finishing tools that produce a finish matching the surrounding shall be used.

E. Tie holes left by withdrawal of rods or the holes left by removal of ends of wall ties shall be filled solid with mortar after first being wetted. For holes passing through the wall, a plunger-type grout gun shall be used to force the mortar through the wall starting at the back face. A piece of burlap or canvas shall be held over the hole on

the outside and when the hole is filled, the excess mortar shall be struck off with the cloth flush with the surface. Holes not passing through the walls shall be filled with a small tool that will permit packing the hole solid with mortar. Any excess mortar at the surface of the wall shall be struck off flush with a cloth. Mortar shall consist of one part cement, two and one-half parts sand and no more water than necessary for handling and packing.

3.15 Finishes on Formed Surfaces

A. Upon completion of patching, surfaces of concrete shall be finished as follows:

1. Rubbed Stone Finish

   a. Stone rubbed finish shall be applied on a Smooth Form Finish (See Section 03100), and by rubbing the surfaces with carborundum stone and water. The rubbing shall produce an even and smooth finish of uniform color and texture without the addition of any cement to the process, using only the cement paste produced by the rubbing of the concrete.

   b. Areas to receive this finish shall be rubbed after the moist curing has been completed.

   c. The following surfaces shall receive a stone rubbed finish surface coating:

      i. All exterior wall concrete surfaces to levels not less than 6-inches below finish grade.

      ii. All interior wall concrete surfaces within buildings and other such surfaces exposed to view in the finished work (except floor slabs).

      iii. The interior side of liquid containment structure walls to a level not less than 12-inches below normal liquid level, including top of walls.

2. Brushed Finish Surface Coating

   a. The brush finish surface coating shall be applied over a Smooth Form Finish (see Section 03100).

   b. The materials used shall be applied in two separate coats to provide a uniform finish on exposed surfaces that have received the initial rubbed finish. The materials shall be mixed and applied strictly in accordance with the written recommendations of the product manufacturer. The actual application of the material shall be performed by workers who have been instructed in the preparation and application of the material. The final brushing of the material during application shall be performed in such a manner as to present a uniform and attractive appearance, with the final brushing generally being done in one direction. The materials shall be especially manufactured for the purpose of waterproofing exterior concrete surfaces, and enhancing the appearance of the concrete

surface. The final color of the finish shall be pearl gray, or near that of good quality cured natural concrete. Texture of material shall be approved by the Engineer. Material shall be Thorocoat as manufactured by Thoro System Products.

c. The following surfaces shall receive a brushed finish surface coating:

i. All exterior wall concrete surfaces to levels not less than 6-inches below finish grade.

ii. All interior wall concrete surfaces within buildings and other such surfaces exposed to view in the finished work (except floor slabs).

3. Smooth Form Finish is required for all concrete surfaces exposed to view in the completed work. Accomplish the required patching and the following touch-up:

a. Remove all burrs.

b. Remove all form marks.

c. Smooth out lines of indentations.

4. Rough Form Finish shall be produced by filling all tie holes and honeycomb and in other respects leaving the surface as formed. All concrete surfaces which will be covered by earth and which will not be visible in the completed structure may receive a Rough Form Finish.

3.16 Steel Troweled Finish - Floor Slabs

A. Steel troweled finish shall be applied to the surface of all building floor slabs and interior equipment pads.

B. Concrete shall be placed, consolidated, struck-off and leveled to the proper elevation. After the surface has stiffened sufficiently to permit the operation and the water sheen has disappeared, the surface shall be wood floated, by hand or power floated, at least twice, to a uniform sandy texture. Floors shall be leveled such that depressions between high spots do not exceed 1/4-inch under a 10 foot straightedge except where drains occur, in which case the floors shall be pitched to the drains as indicated on the Drawings.

C. After the concrete has received a wood float finish, it shall be troweled at least twice to a smooth dense finish. The drying of the surface moisture before floating or troweling shall not be hastened by the dusting on of dry sand or cement. The first troweling shall be done by a power trowel and shall produce a smooth surface relatively free of defects. Additional troweling shall be done by hand after the surface has hardened sufficiently. The final troweling shall be done when a ringing sound is produced as the trowel is moved over the surface. The surface shall be thoroughly consolidated by the hand troweling operations. The finished surface shall be free of any trowel marks or other imperfections; shall be uniform in texture and appearance, and shall be in true

plane within the tolerance specified. Any deviation from this condition which remains after the troweling is completed shall be corrected by grinding.

3.17 Broom Finish

A. Broom finish shall be applied to:

1. All exterior side walks, walkways and platforms.

B. The surface shall be given a floated finish as specified above, then finished with a flexible bristle broom or burlap belt drawn across the surface. Surface must be hardened sufficiently to retain the scoring or ridges. Scores or ridges shall be transverse to traffic or at right angles to the slope of the slab.

3.18 Surface Preparation for Finish Grout or Topping

The surface shall be given a wood float finish and moist cured. After the curing period, the finish grout or topping shall be applied where indicated and noted on the Drawings.

3.19 Testing Laboratory

A. The testing laboratory shall have access to all places where concrete materials and concretes are manufactured, stored, proportioned, mixed, placed and tested. Duties shall include, but not necessarily be limited to the following:

1. Make, store, transport, cure and test compression specimens made during placing of concrete. Compression test specimens shall be tested in accordance with ASTM C 39. Test reports shall show all pertinent data, such as class of concrete, exact location of pour, air temperature, date of pour, time of pour, truck number for ready-mixed concrete, date on which specimen was broken, age of specimen, compressive strength of specimen, concrete slump test results and air content of concrete from which the specimen was made. One copy each of all tests shall be sent to the Contractor and two copies each to the Engineer.

2. Each strength test requires four standard test cylinders.

3. Samples for strength tests of each class of concrete placed each day shall be taken not less than once a day, nor less than once for each 100 cubic yards of concrete, nor less than once for each 5,000 square feet of surface area for slabs or walls.

4. Each class of concrete shall be tested with at least five strength tests.

5. From each set of four cylinders, two shall be tested at 28 days and shall comprise a strength test under the definition of these Specifications. One cylinder shall be broken at seven days and will be used as an aid in determining the early strength of the concrete and the 28 day strength, and one cylinder retained in reserve for later testing if required.

6. Test for unit weight of concrete when the first load of each class of concrete is delivered and thereafter at the discretion of the testing laboratory.

B. Periodically inspect the batching plant and file a report with the Engineer stating whether the supplier's equipment and methods meet the requirements of these Specifications.

C. Temperature and Placing Record: Temperature record shall be made each day during the concreting operations. Records shall also include location, quantity and starting and finishing time of placement for all concrete work. Copy distribution shall be as specified above for test reports.

3.20 Evaluation of Compression Tests

A. Evaluation of compression test results shall be as follows: For each class of concrete, compression-strength tests for laboratory-cured cylinders shall be considered satisfactory if the averages of the results of all sets of three consecutive compression-strength tests equal or exceed the 28 day design compression-strength specified; and, no individual cylinder strength test falls below the required compression strength by more than 500 psi. Strength tests of specimens cured under field conditions may be required by the Engineer to check the adequacy of curing and protecting of the concrete placed. Specimens shall be molded by the field testing laboratory at the same time and from the same samples as the laboratory-cured specimens.

B. Faulty Concrete: Failure to comply with any of the specified conditions shall constitute faulty concrete. Unless otherwise directed by the Engineer, faulty concrete shall be removed and replaced with concrete as specified, at no expense to the Owner.

C. Additional Test: If permitted by the Engineer, additional tests shall be subject to the approval of the Engineer and at no expense to the Owner. Load tests, if permitted by the Engineer, shall be conducted in accordance with the loading criteria as required by the design of the structure, as determined by the Engineer.

D. Neither the results of laboratory verification tests nor any provision in the Contract Documents shall relieve the Contractor of the obligation to furnish concrete of the class and strength specified.

END OF SECTION

CONCRETE PREPLACEMENT SIGN-OFF CARD

Project:_____

Inspection Date:_____ Concrete Placement Date: _____

Expected Time of Concrete Placement:_____

Estimated Quantity:_____

Mix Design Strength:_____

Location of Structure:_____

Member (walls, beams, etc.):_____

Weather Conditions:_____

Method of Pour: Chute _____ Bucket_____ Pump_____

Conveyor _____ Other _____

	Status			
Work	Ready	N/A	Signature	Date
Formwork				
Reinforcing				
Mechanical				
Electrical				
Instrumentation				
Plumbing				
Process				
Metal Embeds				
Miscellaneous Specialties				
Clean-Up/OK to Place				

The Contractor certifies that the above work to be cast is prepared in accordance with the Contract Documents.

Contractor (Superintendent):_____ Date:_____

Resident Inspector:_____ Date:_____

Part 1 General

1.01 Scope

The work covered by this Section consists of furnishing all labor, equipment and material required to ensure the proper proportioning of materials for masonry mortar and related work as described herein and or shown on the Drawings.

1.02 Storage and Protection

A. Cementitious materials shall be delivered to the site in unbroken bags or other approved containers, plainly marked and labeled with the manufacturer's name and brand.

B. Cementitious materials shall be handled in a manner which will prevent the inclusion of foreign materials and damage by water or dampness.

1.03 Quality Assurance

A. Materials shall conform to the current editions of the following standards:

1. Masonry Cement: ASTM C91.

2. Aggregate for Masonry Mortar: ASTM C 144.

3. Portland Cement: ASTM C 150, Type I.

4. Hydrated Lime for Masonry Purposes: ASTM C 207, Type S.

5. Mortar for Unit Masonry: ASTM C 270.

B. The Contractor shall submit to the Engineer written evidence that the cement, lime and aggregate is in conformance with the material and mechanical requirements specified herein. Certified copies of independent laboratory test results or mill test results from the cement, lime and/or aggregate supplier may be considered evidence of compliance provided such tests are performed in accordance with the appropriate ASTM 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 cement, lime and/or aggregate.

C. In addition to these submittals, the Contractor shall submit to the Engineer test results in compliance with ASTM C 270, Section 9 for each type of mortar to be used in the work. The test report shall also include the average compressive strength of three 2-inch cubes of laboratory prepared mortar. Mortar mix ingredients and proportions shall not be changed during the course of the work without the Engineer's approval. Extreme care shall be taken to assure that the same proportion of each ingredient is

used in each batch. Mortar color shall be proportioned by weight in individual containers prior to mixing. Measuring mortar color by volume during mixing shall not be allowed.

Part 2 Products

2.01 Materials

A. Masonry Cement

1. Masonry cement shall be a mixture of Portland cement and Type S hydrated lime. The mix shall not contain inert or noncementitious mineral fillers. If package mix is used, other hydraulic cements may be substituted for a part of the Portland cement. However, the Portland cement shall not be less than 30 percent of the total. Packaged mixes shall conform to the requirements of ASTM C 91.

2. The composition of the masonry cement shall be printed on each bag in terms that show compliance with these requirements.

3. If a packaged mix is not used, the Portland cement shall conform to ASTM C 150, Portland Cement, Type I and hydrated lime shall conform to ASTM C 207, Type S. The hydrated lime may be used in dry or paste form.

B. Sand: Aggregate for use in masonry mortar shall be clean, free from salt or other deleterious materials and conform to ASTM C 144, Aggregate for Masonry Mortar.

C. Water: Water for mixing shall be potable, clean and free from oil, acids, salts and other deleterious matter.

D. Pigments for Colored Mortar: Iron oxides and chromium oxides with demonstrated record of satisfactory performance in mortar mixes.

1. Products: The following products, provided they comply with requirements of the contract documents, will be among those considered acceptable:

a. "SGS Mortar Colors"; Solomon Grind-Chem Services, Inc.

b. "True Tone Mortar"; Frank D. Davis Company.

E. Water: Potable.

F. Accelerating Admixture: Nonchloride type for cold weather mortar mixes, in proportion recommended by manufacturer.

G. Color

1. Masonry cement used in load bearing and non-load bearing CMU wall construction shall be grey.

2. Masonry cement used in the brick and split faced CMU veneer shall be colored. Colors shall be selected by the Engineer in conjunction with the selection of the brick and CMU veneers.

2.07 Masonry Cleaner

A. Detergent Solution: Job-mixed solution of 1/2 cup trisodium phosphate and 1/2 cup laundry detergent per gallon of water.

2.08 Mortar and Grout Mixes

A. General: Do not use admixtures unless indicated as acceptable in the contract documents.

1. Do not use calcium chloride in mortar or grout mixture.

B. Mixing: Use mechanical batch mixer and comply with referenced ASTM standards.

C. Mortar for Unit Masonry: ASTM C 270, Proportion Specification.

1. Masonry below grade and in contact with earth: Type M.

2. Reinforced masonry: Type S.

3. Locations indicated on the Drawings: Type S.

4. Applications as follows: Type N.

a. Exterior, above-grade walls.

b. Locations for which another mortar type has not been specifically indicated.

D. Mortar Colored with Aggregates: Produce required mortar color by use of colored aggregates in combination with selected cementitious materials.

1. Mix to match the Architect's sample.

E. Mortar Colored with Pigments: Proportion selected pigments with other ingredients to produce required color. Do not exceed ratio of pigment-to-cement recommended by pigment manufacturer.

F. Grout: ASTM C 476; provide consistency required at time of placement to fill completely all spaces indicated to be grouted.

Part 3 Execution

3.01 Installation

A. Mixing and Placing

1. All mortar materials shall be accurately measured by volume and thoroughly mixed until they are evenly distributed throughout the batch. Mix mortar as follows: first, add approximately 3/4 of required water, 1/2 the sand and all the cement and lime; mix and add remainder of sand. Mix briefly; then add remainder of water in small quantities until workability of batch is satisfactory to masons. Mortar color when used shall be added to the 3/4 of required water prior to adding sand. After all materials have been added, mix for a minimum of five minutes. Completely empty drum before recharging for next batch.

2. All mortar shall be mixed in a powered, batch-type mechanical mixer. This requirement will not waived except for minor jobs and then only upon the approval of the Engineer.

3. Mortars mixed for more than one hour shall not be used. A mortar which shows a tendency to become dry before this time shall have water added to it and shall be re-mixed. The use of a continuous mixer or retempered mortar shall not be permitted.

4. Mortar for pointing shall have integral waterproofing added in accordance with the manufacturer's instructions.

? 5. Mortar for exterior brick paving shall have a bond coat between the concrete slab and mortar setting bed. Bond coats consist of Portland cement mixed to a creamy consistency with latex additive. The bond coat is used to create improved bond between the concrete slab and the mortar setting bed. It is installed as the setting bed and pavers are laid and should not exceed 1/16 in. (2mm).

B. Mix Proportions: All mortar shall conform to the requirements of ASTM C 270. Mix proportions by volume. Allowable error is two percent.

1. Mortar Mixes

Types	Mix by Parts Description	A	B
M	Portland Cement	1	1
M	Masonry Cement	0	1
M	Hydrate Lime	1/4	0
M	Damp Loose Aggregate	3 - 3-1/2	4-1/2 - 6

Types	Mix by Parts Description	A	B
N	Portland Cement	1	0
N	Masonry Cement	0	1
N	Hydrate Lime	1	0
N	Damp Loose Aggregate	4-1/2 - 6	2-1/4 - 3
S	Portland Cement	1	1/2
S	Masonry Cement	0	1
S	Hydrate Lime	1/2	0
S	Damp Loose Aggregate	4-1/2	4-1/2

END OF SECTION

Part 1 General

1.01 Scope

A. The work covered by this Section consists of furnishing all labor, equipment and material required for the correct placement and construction of concrete masonry units and related work as described herein and/or shown on the Drawings.

B. Work for Other Trades: Bolts, anchors and shelf angles shall be the responsibility of the Contractor. However, the subcontractors requiring such work are responsible for furnishing complete information to the Contractor.

C. Furnish and install all precast concrete sills, lintels and parking bumpers as described herein and/or shown on the Drawings.

1.02 Submittals

A. Samples: Submit two full-size concrete masonry units of each type required, including special shapes, to show range of colors, texture, finishes and dimensions.

B. Certification: Furnish manufacturer's written certification accompanied by suitable laboratory or mill test reports that masonry units furnished meet or exceed the requirements of these Specifications.

C. Shop Drawings: Contractor shall submit detail drawings of precast sills, coping and lintels for approval by the Engineer before proceeding with fabrication.

1.03 Storage and Protection

Store masonry units above ground on level platforms which allow air circulation under stacked units. Cover and protect against wetting prior to use. Handle units on pallets or flat bed barrows. Do not permit free discharge from conveyor units or transporting in mortar trays.

Part 2 Products

2.01 Concrete Masonry Units

A. Concrete block shall have 8 x 16-inch face with 4, 6, 8, 10 or 12-inch nominal width, as required.

B. Hollow masonry units shall comply with “Specification for Hollow Load-Bearing Concrete Masonry Units”, ASTM C 90, Grade N. Hollow masonry units shall be one of the following:

1. Medium weight, 105 to 125 pcf concrete. Minimum net compressive strength of 1,900 psi.

2. Light weight, concrete weighing less than 105 pcf. Minimum net compressive strength of 1,900 psi.

2.02 Concrete Brick

Concrete brick shall comply with “Specifications for Concrete Building Brick”, ASTM C 55, Grade N.

2.03 Reinforcement

A. Block wall reinforcement shall be of the prefabricated type for use in masonry mortar joints. Wall reinforcement shall be of ladder design for composite wall construction with No. 9 gauge deformed galvanized side rods and No. 9 gauge galvanized cross rods. Joint reinforcement shall comply with “Standard Specification for Cold Drawn Steel Wire for Concrete Reinforcement”, ASTM A 82.

B. Dovetail anchors shall be galvanized steel. Lengths, spacings and locations shall be in accordance with standard construction practice, where required.

2.04 Precast Sills and Lintels

A. Precast Sills and Lintels: Precast concrete sills, coping, trim and lintels shall be provided as shown on the Drawings. All exterior sills, coping and trim shall be constructed of white Portland cement and light granite aggregate. Interior lintels shall be constructed of gray Portland cement and marble aggregate. All exposed surface shall be ground and treated with a water-repellent material.

B. Finished precast units shall be thoroughly protected against chipping and in no case will chipped surfaces or corners be permitted to remain in walls or copings.

Part 3 Execution

3.01 Erection and Workmanship

A. Scaffolding shall be provided, as required. Scaffolding shall not be overloaded and shall be inspected regularly by the Contractor to verify that it is amply strong, well braced and securely positioned. The Contractor shall be unconditionally responsible for the safety of the scaffolding at all times.

B. Masonry shall not be laid when the temperature is below 40 degrees F. Walls shall be carried up level and plumb all around. Unfinished work shall be stepped face for joining with new work; toothing shall not be permitted. Heights of masonry shall be checked by the Contractor with an instrument at each floor and at sills and heads of openings to maintain the level of the walls.

C. Masonry units shall be handled with care to avoid chipping, cracking and spalling of faces and edges. Drilling, cutting, fitting and patching to accommodate the work of others shall be performed by qualified masons. Masonry shall be cut with a masonry saw outside of buildings. Chipping or breaking with a hammer will not be permitted.

D. Door and window openings, louvered openings, anchors, pipes, ducts and conduits shall be built in carefully as the work progresses. Ties and anchors shall be placed accurately. Metal work specified elsewhere shall be placed in position as the work progresses. Grouting of ties and anchors into hardened mortar or grout shall not be permitted.

E. Masonry units shall be laid in running bond. The first course of masonry shall be laid in a full bed of mortar; and the succeeding courses shall be shoved (not laid) in beds of mortar to fill the joints full without subsequent flushing and filling. Unless shown or specified otherwise, all joints shall be 3/8-inch thick. Where ties, anchors and bolts occur within the cells of the units, such cells shall be filled with mortar or grout as the work progresses.

F. Concrete masonry units shall be dry when laid. Each unit shall be adjusted to final position in the wall while the mortar is still soft and plastic. Any unit disturbed after mortar has stiffened shall be removed and relaid with fresh mortar. Vertical cells to be filled with grout shall be aligned to provide a continuous unobstructed opening of the dimensions shown. Chases shall be plumb and shall be minimum one unit length from jambs of opening.

G. Exterior or exposed masonry joints shall be finished with smooth concave contour. Procedure used in striking joints shall be as follows: first strike the bed joints; next strike the head joints; then strike bed joints as required to remove any spots, etc., from intersection of bed and head joints. After mortar has initial set but before mortar is hard, restrike the head joints to provide clean, smooth intersection of the head and bed joints. Interior and exterior joints to receive masonry coating shall be tooled flush.

H. At the end of each day's work, the tops of exposed masonry walls shall be covered with a strong, nonstaining waterproof membrane well secured in place. Surfaces not being worked on shall be properly protected at all times. Unfinished work shall be stepped for joining with new work. Before new work is started, all loose mortar shall be removed and the exposed joint thoroughly wetted, not less than 30 minutes before laying new work.

I. Control joints shall be installed where concrete masonry units abut dissimilar materials and shall be installed vertically in exterior walls at 30 feet on center, unless shown otherwise on the Drawings. Control joints shall be constructed by omitting joint mortar and installing a back-up rod and sealant at both faces of the concrete masonry unit.

3.02 Wall Reinforcement

A. Place wall reinforcement in first masonry bed joint above finished floor and in alternate bed joints (16-inches on center) thereafter.

B. Masonry joint reinforcement shall be placed so that longitudinal wires are located over face shell mortar beds and are fully embedded in mortar for their entire length with minimum mortar cover of 5/8-inch of exterior side of walls and 1/2-inch at other locations. Reinforcement shall be placed in first and second bed joint above and below openings. Reinforcement in the first bed joint immediately above and below openings shall be continuous. In the second bed joint it shall extend two feet beyond each side of the opening.

C. Reinforcing shall be lapped a minimum of 6-inches at splices. Corner and abutting wall reinforcement shall be prefabricated corner and tee sections.

3.03 Weep Holes

Provide weep holes in head joints of first masonry course immediately above concealed flashings. Weep holes shall be spaced 24-inches on center, unless shown otherwise on the Drawings.

3.04 Cleaning

A. During construction, care shall be taken to keep exposed face of masonry clean of mortar and other stains. Joints shall be raked as they reach thumbprint hardness. The exposed work shall then be brushed with a soft fiber brush to remove adhering mortar. A wooden paddle shall be used to remove more tenacious material. Bases of walls shall be protected from splash stains by covering the adjacent floor or ground with sand, sawdust or polyethylene film.

B. At completion of work, holes in exposed masonry shall be pointed and defective joints shall be cut out and tuck pointed solidly with mortar.

C. If necessary, exposed masonry surfaces shall be scrubbed with warm water and soap and fiber brush and thoroughly rinsed with clear water. Work which may be damaged, discolored or stained shall be protected during the cleaning process. The use of sapolio or wire brushes or acid for washing down walls shall not be permitted.

D. Protect all finished work against freezing, for a period of not less than 48 hours, by means of enclosures, temporary heat or such other protective methods as may be required and directed by the Engineer.

END OF SECTION

Part 1 General

1.01 Scope

The work covered by this Section consists of furnishing all labor, equipment, and materials required for the correct placement and construction of reinforced masonry units and related work as described herein and/or shown on the Drawings.

1.02 Additional Requirements

Requirements of Section 03200 of these Specifications apply to work of this Section.

1.03 Submittals

A. Mill Certificates: Submit steel producer's certificates of mill analysis, tensile and bend tests for reinforcement steel required for the Project.

B. Shop Drawings: Submit shop drawings for fabrication, bending and placement of reinforcement bars. Comply with ACI 315 “Manual of Standard Practice for Detailing Reinforced Concrete Structures”. Show bar schedules, diagrams of bent bars, stirrup spacing, lateral ties and other arrangements and assemblies as required for fabrication and placement of reinforcement for unit masonry work.

1.04 Product Delivery, Storage and Handling

Store masonry units above ground on level platforms which allow air circulation under stacked units. Cover and protect against wetting prior to use. Handle units on pallets or flat bed barrows. Do not permit free discharge from conveyor units or transporting in mortar trays.

Part 2 Products

2.01 Materials

A. General: Refer to Section 04220 of these Specifications for masonry accessories not included in this Section.

B. Reinforcement: Provide deformed bars of following grades complying with ASTM A 615, except as otherwise indicated.

C. Shop fabricate reinforcement bars which are shown to be bent or hooked.

Part 3 Execution

3.01 Placing Reinforcement

A. Clean reinforcement of loose rust, mill scale, earth, ice or other materials which will reduce bond to mortar or grout. Do not use reinforcement bars with kinks or bends not shown on the Drawings or final shop drawings, or bars with reduced cross-section due to excessive rusting or other causes.

B. Position reinforcement accurately at the spacing indicated. Support and secure vertical bars against displacement. Horizontal reinforcement may be placed as the masonry work progresses. Where vertical bars are shown in close proximity, provide a clear distance between bars of not less than the nominal bar diameter or 1-inch, whichever is greater.

C. Splice reinforcement bars where shown. Do not splice at other points unless acceptable to the Engineer. Provide lapped splices, unless otherwise indicated. In splicing vertical bars or attaching to dowels, lap ends, place in contact and wire tie. Provide not less than the minimum lap indicated, or if not indicated, as required by governing code.

D. Anchoring: Anchor reinforced masonry work to supporting structure as indicated. Anchor reinforced masonry walls to non-reinforced masonry where they intersect.

3.02 Installation, General

A. Refer to Section 04220 of these Specifications for general installation requirements of unit masonry.

B. Temporary Formwork: Provide formwork and shores as required for temporary support of reinforced masonry elements.

C. Construct formwork to conform to shape, line and dimensions shown. Make sufficiently tight to prevent leakage of mortar, grout or concrete, if any. Brace, tie and support as required to maintain position and shape during construction and curing of reinforced masonry.

D. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and all other reasonable temporary loads that may be placed on them during construction. Allow not less than the following minimum time to elapse after completion of members before removing shores or forms, provided suitable curing conditions have been obtained during the curing period.

1. Ten days for girders and beams.

2. Seven days for slabs.

3. Seven days for reinforced masonry soffits.

3.03 Installation of Reinforced Concrete Unit Masonry

A. General: Do not wet concrete masonry units (CMU). Lay CMU units with full-face shell mortar beds. Fill vertical head joints (end joints between units) solidly with mortar from face of unit to a distance behind face equal to not less than the thickness of longitudinal face shells. Solidly bed cross-webs of starting courses in mortar. Maintain head and bed joint widths shown, or if not shown, provide 3/8-inch joints.

B. Walls

1. Pattern Bond: Lay CMU wall units in 1/2 running bond with vertical joints in each course centered on units in courses above and below, unless otherwise indicated. Bond and interlock each course at corners and intersections. Use special-shaped units where shown, and as required for corners, jambs, sash, control joints, lintels, bond beams and other special conditions.

2. Maintain vertical continuity of core or cell cavities, which are to be reinforced and grouted, to provide minimum clear dimension indicated and to provide minimum clearance and grout coverage for vertical reinforcement bars. Keep cavities free of mortar. Solidly bed webs in mortar where adjacent to reinforced cores or cells.

3. Where horizontal reinforced beams (bond beams) are shown, use special units or modify regular units to allow for placement of continuous horizontal reinforcement bars. Place small mesh expanded metal lath or wire screening in mortar joints under bond beam courses over cores or cells or cells of non-reinforced vertical cells, or provide units with solid bottoms.

4. Brace walls against wind and other forces during construction. Allow sufficient time between lifts to preclude displacement of solid masonry units or cracking of face shells of hollow masonry units. If blowouts, misalignment or cracking of face shells should occur during construction, tear down and re-build the wall.

5. Option: Where all vertical cores are not shown to be grouted, the Contractor may elect to fill all vertical cores with grout. In which case, requirements for mortar bedding of cross-webs and closing or core spaces below bond beams do not apply.

C. Columns and Pilasters: Use CMU units of the size, shape and number of vertical core spaces shown. If not shown, use units which provide minimum clearances and grout coverage for number and size of vertical reinforcement bars shown. Provide pattern bond shown, or if not shown, alternate head joints in vertical alignment.

D. Grouting

1. Use “Fine Grout” per ASTM C 476 for filling spaces less than 4-inches in one or both horizontal directions.

2. Use “Coarse Grout” per ASTM C 476 for filling 4-inch spaces or larger in both horizontal directions.

3. Grouting Technique: At the Contractor's option, use either low-lift or high-lift grouting techniques subject to requirements which follow:

   a. Low-Lift Grouting

      i. Provide minimum clear dimension of 2-inches and clear area of 8 square inches in vertical cores to be grouted.

      ii. Place vertical reinforcement prior to laying of CMU. Extend above elevation of maximum pour height as required for splicing. Support in position at vertical intervals not exceeding 192 bar diameters nor 10 feet.

      iii. Lay CMU to maximum pour height. Do not exceed five foot height, or if bond beam occurs below five foot height, stop pour at course below bond beam.

      iv. Pour grout using chute or container with spout. Rod or vibrate grout during placing. Place grout continuously; do not interrupt pouring of grout for more than one hour. Terminate grout pours 1-1/2-inches below top course of pour.

      v. Bond Beams: Stop grout in vertical cells 1-1/2-inches below bond beam course. Place horizontal reinforcement in bond beams; lap at corners and intersections as shown. Place grout in bond beam course before filling vertical cores above bond beam.

   b. High-Lift Grouting

      i. Do not use high-lift grouting technique for grouting of CMU unless minimum cavity dimension and area is 3-inches and 10 square inches, respectively.

      ii. Provide cleanout holes in first course at all vertical cells which are to be filled with grout. Use units with one face shell removed and provide temporary supports for units above, or use header units with concrete brick supports, or cut openings in one face shell.

      iii. Construct masonry to full height of maximum grout pour specified, prior to placing grout. Limit grout lifts to a maximum height of five feet and grout pour to a maximum height of 12 feet for single wythe hollow concrete masonry walls, unless otherwise indicated.

      iv. Place vertical reinforcement before grouting. Place before or after laying masonry units, as required by job conditions. Tie vertical reinforcement to dowels at base of masonry where shown and

thread CMU over or around reinforcement. Support vertical reinforcement at intervals not exceeding 192 bar diameters nor 10 feet. Where individual bars are placed after laying masonry, place wire loops extending into cells as masonry is laid and loosen before mortar sets. After insertion of reinforcement bar, pull loops and bar to proper position and tie free ends.

v. Place horizontal beam reinforcement as the masonry units are laid.

vi. Prior to grouting, inspect and clean grout spaces. Remove dust, dirt, mortar droppings, loose pieces of masonry and other foreign materials from grout spaces. Clean reinforcement and adjust to proper position. Clean top surfaces of structural members supporting masonry to ensure bond. After final cleaning and inspection, close cleanout holes and brace closures to resist grout pressures.

vii. Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist displacement of masonry units and breaking of mortar bond. Install shores and bracing, if required, before starting grouting operations.

viii. Place grout by pumping into grout spaces unless alternate methods are acceptable to the Engineer.

ix. Limit grout pours to sections which can be completed in one working day with not more than one hour interruption of pouring operation. Place grout in lifts which do not exceed five feet. Allow not less than 30 minutes nor more than one hour between lifts of a given pour. Rod or vibrate each grout lift during pouring operation.

x. Place grout in lintels or beams over openings in one continuous pour.

xi. Where bond beam occurs more than one course below top of pour, fill bond beam course to within 1-inch of vertically reinforced cavities, during construction of masonry.

xii. When more than one pour is required to complete a given section of masonry as required for splicing. Pour grout to within 1-1/2-inches of top course of first pour. After grouted masonry is cured, lay masonry units and place reinforcement for second pour section before grouting. Repeat sequence if more pours are required.

END OF SECTION

Part 1 General

1.01 Scope

A. This Section covers all items fabricated from metal shapes, plates, sheets, rods, bars or castings and all other wrought or cast metal except component parts of equipment and items covered by other sections.

B. Fabricated metal items, which are detailed on the Drawings but not mentioned specifically therein, shall be fabricated in accordance with the applicable requirements of this Section.

1.02 Factory Testing

A. Prior to delivery, all basic materials specified herein shall be tested and inspected by an approved independent commercial testing laboratory. Payment for such services will be made by the Contractor. If approved by the Engineer, certified tests performed by the manufacturer's testing laboratory at no cost to the Owner will be acceptable.

B. If so desired by the Engineer, inspection of the fabrication shall be made at the place of manufacture. Access shall be permitted to all places where the work is being done.

1.03 Submittals

Detailed shop drawings, product data sheets and erection and installation details for miscellaneous metal items shall be submitted in accordance with Section 01340 of these Specifications. Submittals shall indicate thickness, type, grade, class of metal, dimensions and shall show construction details, reinforcement, anchorage, welds, fasteners and installation with relation to other construction.

1.04 Storage and Protection

A. Store structural metals above ground on platforms or other supports and protect from weather with suitable covering. Do not permit water ponding or moisture collection on stored items.

B. Handle steelwork to prevent damage to members and to shop paint coat and to prevent accumulation of mud, dirt or other foreign materials capable of interfering with field paint application.

1.05 Quality Assurance

Structural steel manufacturers shall provide written certification to the Engineer that all materials furnished comply with all applicable requirements of these Specifications.

Part 2 Products

2.01 Materials and Construction

A. All materials shall be new and undamaged and shall conform to pertinent AISC, ANSI, ASTM or other industry standards. Unless specified otherwise in other Sections, all materials in fabricated metal items shall conform to the following requirements:

1. Structural steel shapes, plates and bars shall conform to Specifications of Structural Steel ASTM A 36.

2. Structural steel tubing shall conform to ASTM A 501.

3. Stainless steel shall conform to the following AISI Type 304 for sheets and plates; AISI Type 316 for bolts and stainless steel items in corrosive areas.

4. Galvanizing shall be hot dipped in accordance with Specifications for Zinc (Hot Galvanized) Coatings on Products Fabricated from Rolled, Pressed and Forged Steel Shapes, Plate, Bars and Strip ASTM A 123.

5. Gray cast iron shall conform to ASTM A 48, Class 30B.

6. Ductile iron shall conform to ASTM A 536, Grade 65-40-18.

7. Aluminum alloy shall conform to the following Aluminum Association Specifications and designations:

   6061-T6 Structural Shapes, Tubes and Pipes in Corrosive Areas, Sheets, Plates, Wire, Rods, Bars, Bolts and Screws

   6063-T6 Tubes and Pipes in Non-Corrosive Areas

   6066-T6 Weldings and Extrusions

   6151-T6 Forgings and Forging Stock

8. High strength steel bolts, nuts and washers shall conform to ASTM A 325.

9. All embedded anchor bolts or anchor bolt materials shall be ASTM A 193, Grade B8; ASTM A 276, Type 304; or IFI-104, Grade 304 stainless steel, threaded per ANSI B1.1. Nuts shall be heavy hex nuts, ANSI B18.2, semifinished pattern and shall be ASTM A 194, Grade 8 or IFI-104, Grade 304 stainless steel. Flat washers shall be 18-8 stainless steel and shall conform to ANSI B27.2.

10. Electrodes for welding structural steel shall conform to “Specification for Mild-Steel Covered Arc-Welding Electrodes”, AWS A5.1, E-70 series. Electrodes for welding aluminum shall conform to AWS A5.10.

B. Stairs and Platforms: Stairs and platforms shall be fabricated from steel conforming to ASTM A 36 and shall be hot dipped galvanized after fabrication, unless noted otherwise. Stair and platform design, fabrication and installation shall conform to OSHA regulations.

C. Checkered Floor Plates: Unless otherwise shown, checkered floor plates shall be 6061-T6 aluminum alloy with raised diamond pattern on the upper surface. Floor plate shall have a minimum thickness of 1/4-inch and shall be designed for a deflection of not more than 1/300 of span under a uniform load of 100 pounds per square foot. However, in no case shall the thickness of the floor plates be less than that shown on the Drawings for the specified clear span.

D. Welding and Brazing - General

1. All welds shall be sound and free from embedded scale and slag. All butt welds shall be continuous and where exposed to view shall be ground smooth. All continuous welds shall be gas and liquid-tight. Intermittent welds shall have an effective length of at least 2-inches and shall be spaced not more than 6-inches apart.

2. All welding of steel and aluminum, including materials, welding techniques, general safety practices, appearance and quality of welds and methods of correcting defective work, shall conform to the latest requirements of AWS Specifications. Structural steel welding shall conform to the requirements of the AWS Structural Welding Code. The general recommendations and requirements of the AWS Structural Welding Code shall also apply to welded aluminum structures. The welding process and welding operators shall meet qualification tests and welding performance tests in accordance with the latest provisions of ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications. Welding process and qualification procedures for welding of pipe shall conform to the latest requirements of ANSI B31.1, Section 327, Welding and Section 328, Brazing and Soldering. All costs associated with the qualification or testing of welders and welding operators shall be borne by the Contractor.

3. The Owner may inspect any weld by radiographic or other means. Welds not in accordance with the requirements specified herein shall be repaired or replaced at the Contractor's expense. Excessive porosity, non-metallic inclusions, lack of fusion, incomplete penetration and cracking shall constitute grounds for rejection of welds.

E. Shop Fabrication

1. Structural steel shall be fabricated in conformity with dimensions, arrangement, sizes and weights or thicknesses shown on the Drawings or stipulated in the Specifications.

2. All members and parts, as delivered and erected, shall be free of winds, warps, local deformations or unauthorized bends. Holes and other provisions for field connections shall be accurate and shop checked, so that proper fit will result when the units are assembled in the field.

F. Galvanizing

1. All galvanizing shall be done by the hot-dip process, after fabrication in conformity with requirements of ASTM A 123, A 153, A 384 and A 385. Articles to be galvanized shall be pickled before galvanizing.

2. Areas of galvanizing damaged by welding or burning or otherwise damaged shall be thoroughly stripped and cleaned and recoated with zinc to the required thickness by the hot-dip process.

3. Galvanized articles shall be free from uncoated spots, blisters, flux, black spots, dross, projections and other defects not consistent with acceptable galvanizing practice.

4. Zinc and cadmium plating shall be subject to visual examination to determine uniformity of coating. The Engineer may require that the coating uniformity be tested in accordance with ASTM A 239.

Part 3 Execution

3.01 Installation

A. Structural Steel

1. General: Except as otherwise specifically noted on the Drawings, or specified herein, all materials and work for structural steel and miscellaneous metal work shall be in conformity with applicable provisions of the latest edition of the AISC "Steel Construction Manual" and AISC "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings".

2. Connections

a. Connections not specifically detailed on the Drawings shall be as defined in Tables I and III, Framed Beam Connections, in the seventh edition of the AISC manual. The shop fabricated portion of structural connections may be bolted or welded. Except for connections detailed on the Drawings or specified otherwise, field connections shall be made with ASTM A 325 high strength bolts.

b. Connections for miscellaneous metal work not included in the AISC definition of structural steel may be made with ASTM A 307 bolts. Bolts shall be equipped with self-locking nuts or lock washers.

c. High strength bolts shall be installed 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. A platform or other means of access shall be provided at each field connection and shall be left in place until the connection has been inspected by the Engineer.

d. 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.

e. Field Erection: Before assembly, surfaces to be in contact with each other shall be thoroughly cleaned. All parts shall be assembly accurately as shown on the Drawings. Light drifting to match unfair holes will not be permitted. Any enlargement of holes necessary to make connections in the field shall be done by reaming with twist drills. Enlarging holes by burning is absolutely prohibited.

B. Structural Aluminum

1. General Except as specifically noted on the Drawings, or specified herein, all materials and work for structural aluminum shall conform with the applicable provisions of the latest edition of “Specifications for Aluminum Structures”, published by the Aluminum Association, Inc., New York, New York.

2. Lay Out: Hole centers may be center punched and cutoff lines may be punched or scribed. Center punching and scribing shall not be used where such marks would remain on fabricated material. A temperature correction shall be applied where necessary in the layout of critical dimensions. The coefficient of expansion shall be taken as 0.000013 per degree F.

3. Cutting: Material 1/2-inch thick or less shall be sheared, sawed, or cut with a router. Material more than 1/2-inch thick shall be sawed or routed. Cut edges shall be true and smooth, and free from excessive burrs or ragged breaks. Edges or plates carrying calculated stresses shall be planed to a depth of 1/4-inch, except in the case of sawed or routed edges of a quality equivalent to a planed edge. Re-entrant cuts shall be avoided wherever possible. If used, they shall be filleted by drilling prior to cutting. Flame cutting of aluminum alloys is not permitted.

4. Heating: Structural material shall not be heated except as provided herein. Material may be heated to a temperature not exceeding 400 degrees F for a period not exceeding 30 minutes to facilitate bending. Such heating shall be done only when proper temperature controls and supervision are provided to

ensure that the limitations on temperature and time are carefully observed. The Engineer shall be so informed if this method is to be used.

5. Punching, Drilling and Reaming: Rivet or bolt holes may be punched or drilled to finished size before assembly. The finished diameter of holes for unfurnished bolts shall be not more than 1/6-inch larger than the nominal bolt diameter. All holes shall be cylindrical and perpendicular to the principal surface. Holes shall not be drifted in such a manner as to distort the metal. All chips lodged between contacting surfaces shall be removed before assembly.

6. Bolting: All bolts for bolting aluminum shall be Type 304 or 316 stainless steel as specified herein.

7. Welding

   a. Dirt, grease, forming or machining lubricants or any organic materials shall be removed from the areas to be welded by cleaning with a suitable solvent or by vapor degreasing. Additional operations to remove the oxide coating just prior to welding are required when the inert gas tungsten arc welding method is used. This may be done by etching or scratch brushing. The oxide coating need not be removed if the welding is done with the automatic or semi-automatic inert gas shielding metal arc. Suitable edge preparation to assure 100 percent penetration in butt welds shall be used. Oxygen cutting shall not be used. Sawing, chipping, machining or shearing may be used.

   b. Any welding of aluminum shall be done using a non-consumable tungsten electrode with filler metal in an inert gas atmosphere (TIG) or using a consumable filler metal electrode in an inert gas atmosphere (MIG). No welding process that requires the use of a welding flux shall be used unless prior approval has been obtained from the Engineer. Preheating for welding is permissible provided the temperature does not exceed 400 degrees F for a total time of 30 minutes. Welding of any structure which is to be anodized shall be done using filler alloy rods which will not discolor when anodized.

   c. The welding process and welding operators shall both meet a qualification test conforming to the qualification methods described in the ASME Boiler and Pressure Vessel Code, Section IX, Welding Qualifications.

3.02 Field Painting

Structural and miscellaneous metals shall be cleaned, shop primed and painted in accordance with the requirements of Section 09900 of these Specifications.

3.03 Inspection and Testing

Materials or workmanship not conforming to the provisions of these Specifications shall be rejected at anytime defects are found during the progress of the work.

3.04 Cleaning

Prior to the acceptance of the work under this Section, thoroughly clean all installed materials, equipment and related areas in accordance with the requirements of Section 01710 of these Specifications.

END OF SECTION

Part 1 General

1.01 Scope

Furnish and install all the steel joists and accessories as shown and indicated on the Drawings and as specified in this Section, complete.

1.02 Applicable Publications

A. The publications listed below form a part of these Specifications.

1. Steel Joist Institute (SJI) Publications

   Standard Specifications, Load Tables, and Weight Tables for Steel Joists and Joist Girders (1986)

   Recommended Code of Standard Practice for Steel Joists and Joist Girders (1985)

2. Steel Structures Painting Council (SSPC) Specification

   PS 14.01-82 - Steel Joist Shop Painting System

3. American Welding Society (AWS) Publication

   D1.1-86 - Structural Welding Code-Steel

1.03 Qualifications

Manufacturer: For purposes of designating type and quality for the work under this Section, Drawings and Specifications are based on products manufactured by a member firm of the Steel Joist Institute.

1.04 Submittals

A. Shop Drawings: Shop drawings shall show all details and dimensions necessary for checking, fabrication and installation of joists.

B. Certification: Submit certification from the Steel Joist Institute on membership and class of joists approved for manufacture.

C. Mill Certification: The Contractor shall furnish to the Engineer two certified copies of all mill reports or certified laboratory reports covering the chemical and physical properties of the steel used in the work.

D. The Contractor shall provide to the Engineer a certification by a structural engineer (registered in the state where this Project is located) stating that the steel joists for this Project are designed in accordance with these Specifications.

Part 2 Products

2.01 Steel Joists

A. Joists shall be steel joists (open-web) meeting the requirements of the SJI Specifications for the series indicated on the Drawings.

1. Configurations: Steel joists shall have parallel chord, underslung configuration, unless otherwise shown or noted on the Drawings.

2. End Support: Ends of steel joists shall be bolted to the supporting structure.

3. Primer: Steel joists shall be given a shop coat of paint after fabrication conforming to SSPC Specification PS14.01 Type I, Red or Grey Oxide Primer. Primer shall be applied in accordance with manufacturer's recommendations to provide a minimum dry film thickness of 2 mils.

2.02 Bridging

A. Type: Bridging shall consist of "X" bracing where shown on the Drawings.

B. Spacing: Spacing of bridging shall be per manufacturer’s recommendation.

Part 3 Execution

3.01 Product Handling

A. Handling: Care shall be exercised at all times to avoid damage during unloading, storing and erecting. Dropping of joists will not be permitted.

B. Joists damaged beyond repair, as determined by the Engineer, shall be removed from the construction site by the Contractor. The Contractor shall replace all such damaged joists at no cost to the Owner.

C. Storage: Contractor shall provide on-site storage for joists before erection. Joists and accessories shall be kept free from dirt, grease and other foreign matter and shall be protected from corrosion.

3.02 Erection

A. Spacing: The spacing of steel joists shall be as indicated on the Drawings.

B. Connections: Connections of joists to supporting members shall be bolted unless otherwise noted or shown on the Drawings.

3.03 Field Painting

Field Touch-up: Abraded shop coats shall be touched-up after erection with the same primer material as used for the shop coats.

3.04 Source Quality Control

A. The material to be furnished shall be subject to inspection and tests in the shop and field. Inspection and tests in the shop and field will be conducted by a testing laboratory employed by the Owner.

B. Joists with cracked or improper welds or joists otherwise damaged so as to affect their structural properties shall not be used in the work. Field repair of such damaged joists will be allowed only by special permission and subject to approval of the Engineer. The method of repairs shall be in accordance with the manufacturer's recommendations and shall be subject to the approval of the Engineer.

END OF SECTION

Part 1 General

1.01 Scope

Completely furnish and install the steel roof decking and accessories as shown and indicated on the Drawings and as specified in this Section.

1.02 Qualifications

For purposes of designating type and quality for work under this Section, Drawings and Specifications are based on products manufactured or furnished by a member firm of the Steel Deck Institute with design properties determined in accordance with the "Light Gauge Cold-Formed Steel Design Manual of the AISI".

1.03 Design Requirements

A. The publications listed below form a part of these Specifications:

1. Steel Deck Institute (SCI)

   SDI-82 Design Manual for Composite Decks, Form Decks and Roof Decks

   SDI-Jan 81 Diaphragm Design Manual, First Edition

2. American Society for Testing and Materials (ASTM)

   A 525-81 General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process

3. American Welding Society (AWS)

   D1.1-82 Structural Welding Code, Steel

   D1.3-80 Welding Sheet Steel in Structures

4. Military Specification (Mil. Spec.)

   DOD-P-21035A Paint, High Zinc Dust Content, Galvanizing Repair (Metric)

5. American Iron and Steel Institute (AISI)

   Specification for the Design of Cold-Formed Steel Structural Members (1980 Edition)

1.04 Submittals

A. Shop Drawings: Shop drawings shall be submitted for approval and shall include deck types, locations and necessary details of decking units, accessories and

supporting members, required section properties, sizes and locations of holes to be cut and reinforcement to be provided, location and sequence of welded and fastener connections and the manufacturer's erection instructions. Shop drawings shall show all steel roof decking support framing.

B. Manufacturer's Data: Submit for review by the Engineer three copies of manufacturer's data on deck system to be furnished for the Project.

1.05 Storage and Protection

A. The Contractor shall coordinate delivery of materials. Care shall be exercised at all times to avoid damage through handling during unloading, storing and erection.

B. The Contractor shall provide on-site storage for deck sheets and accessories in accordance with the requirements of Section 01640 of these Specifications. Steel decking not promptly erected shall be stored off the ground with one end elevated for drainage and shall be protected from the weather by waterproof covering.

1.06 Quality Assurance

A. The material to be furnished shall be subject to inspection and tests in the field. Inspection and tests in the field will be conducted by a testing laboratory employed by the Owner.

B. The manufacturer shall provide written certification that all materials furnished comply with all applicable requirements of these Specifications.

Part 2 Products

2.01 Acceptable Manufacturers

All steel roof decking shall be manufactured by Consolidated Systems, Rollform Products, Mac-Fab Products, Epic Metals Corporation, Inryco Inc. or United States Steel Corporation.

2.02 Materials and Construction

A. General: Galvanized steel sheets shall conform to ASTM A 525 and AISI Specifications, with a minimum yield point of 33,000 psi. Galvanizing shall be not less than 0.40 ounce per square foot.

B. Fabrication

1. Design: Roof decking shall be deep-rib, nestable side-lap type deck, of sizes and gauges shown on the Drawings to span three or more supports with flush ends.

2. Deck units shall be factory-cut square ends with field skew saw cutting to match diagonal framing.

2.03 Accessories

A. The manufacturer's standard type accessories shall be furnished as necessary to complete the roof deck installation. Metal accessories shall be of the same material as the decking and have minimum gauge as follows:

1. Saddles: 18 gauge.

2. Welding Washers: 16 gauge.

3. Sump Pans at Drains: 14 gauge.

4. Cant Strip: 22 gauge.

5. Other Metal Accessories: 20 gauge, unless otherwise indicated.

Part 3 Execution

3.01 Installation

A. Decking shall be placed in accordance with approved shop drawings.

B. Erection of decking and accessories shall be in accordance with the SDI "Steel Roof Deck Design Manual" and the approved shop drawings. Damaged decking and accessories and units with burned holes shall not be installed. The deck units shall be placed on secured supports, properly adjusted and aligned at right angles to supports before being permanently secured in place. Locate end laps only over supports, with a minimum lap of 2-inches. The deck shall not be used for storage or as a working platform until the units have been secured in position. The maximum uniform distributed storage load shall not exceed 10 pounds per square foot.

C. The deck units shall be welded to the steel framework at ends of units and at intermediate supports by fusion welds not less than 1/2-inch diameter, spaced not more than 8-inches across width of deck units and at least one weld in each flute joined to form a continuous diaphragm. Holes and similar defects will not be acceptable. Side laps of adjacent units shall be fastened between supports by screws at intervals not exceeding 18-inches. For beams parallel to deck spans, the maximum spacing of welds shall not be greater than 16-inches. Where two units abut, each unit shall be welded to the steel framing. Welding pattern for the deck diaphragm shall be as indicated on the Drawings.

D. Perform all welding in accordance with AWS D1.3 using methods and electrodes as recommended by the manufacturer of the base metal alloys being used. Welds shall be made only by operators previously qualified by test prescribed in AWS D1.3 to perform the type of Work required. Location, size and spacing of welds shall be as specified above.

E. Holes and other openings required shall be drilled or cut, adequately reinforced and framed as necessary for rigidity and sufficient load-carrying capacity as approved by the Engineer.

3.02 Field Painting

All welds, weld scars and abraded shop coats shall be cleaned by chipping and wire brushing and touched-up, after erection, with a galvanized repair coating conforming to Mil. Spec. DOD P-21035A.

3.03 Protection of Deck

Areas of high traffic volume shall be protected by plywood flooring over the metal deck. The metal deck shall be protected against undue abuse during construction when the metal deck is used as a platform. The Contractor shall insure that the metal deck configuration and structural integrity is maintained until the work is completed. Damaged deck must be replaced at no additional cost to the Owner.

END OF SECTION

Part 1 General

1.01 Scope

The work under this Section includes, but is not necessarily limited to, the furnishing and installation of all miscellaneous metals and related items as indicated on the Drawings, herein specified and as necessary for the proper and complete performance of this work.

1.02 Submittals

A. Make all submittals in accordance with Section 01340 of these Specifications.

B. Shop Drawings: For each fabricated item, show the following:

1. 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.

2. Plans and elevations.

3. Jointing and connections.

   a. Indicate welded connections using standard AWS symbols; indicate net weld length.

4. Profiles of sections and reinforcing.

5. Fasteners and anchors.

6. Accessories.

7. Location of each finish.

C. Product Data: Manufacturer's specifications and installation instructions. Submit for:

1. Product data for nonslip aggregates and nonslip aggregate surface finishes, prefabricated building columns, cast nosings, treads and thresholds, steel floor plate, paint products, and grout.

2. All manufactured products used in fabrications.

D. Samples of products and materials when requested.

1. Samples representative of materials and finished products as may be requested by Architect.

1.03 Performance Requirements

A. Structural Performance Requirements: Where complete sizes or dimensions of structural members, connections, or fasteners of any item are not indicated, design the item to produce strength appropriate to the use intended.

B. Handrails: Design to resist the loads specified by applicable building code(s).

C. Guardrails: Design to resist loads specified by applicable building code(s).

D. Toeboards: Where toeboards are indicated as required, but are not detailed, design toeboards to conform to the requirements of 29 CFR 1910.23.

1.04 Division of Work

A. General: The following list of items to be furnished under this Section is placed here to aid the various trades in estimating their portion of the Work. It is not a full and complete list and does not relieve the Contractor from providing a totally complete Project including all miscellaneous items.

B. Miscellaneous Metal Items

1. Loose angle and wide flange lintels.

2. Stairs and landings including posts, bearing plates, and integral support beams.

3. Beams, angles and other supporting grating over pipe trenches including embedded connections.

4. Embedded connections and plates in masonry and cast-in-place concrete for precast plank and tees.

5. Bumper posts and sleeves.

6. Bearing plates for other items specified herein.

7. Railings.

8. Edge angles cast-in-concrete.

1.05 Quality Assurance

A. Qualifications: For fabrication and erection of the work of this Section, use only personnel completely trained and experienced in the type of work being performed and thoroughly familiar with the original design and the approved shop drawings.

B. Codes and Standards: In addition to complying with all pertinent codes and regulations, comply with applicable standards for materials design and construction of the following:

1. American Society for Testing Materials

2. American Institute of Steel Construction

3. American Iron and Steel Institutes "Specifications for the Design of Light Gage Cold Formed Steel Structural Members"

4. Occupational Safety and Health Act

5. American Welding Society

6. National Association of Architectural Metal Manufacturers

C. Conflicting Requirements: In the event of conflict between pertinent codes and regulations and the requirements of the referenced standards or these Specifications, the provisions of the more stringent shall govern.

Part 2 Products

2.01 Materials

A. General: Materials shall be new, top quality of their respective kinds, standard sizes and fabricated in a shop whose principal business is manufacturing the items specified in this Section. Materials shall be free of defect impairing strength, durability or appearance. Miscellaneous anchors, plates, clips, bolts, nuts and the like shall be provided as necessary to complete the work, whether or not they appear on the Drawings or in the Specifications.

B. Steel shall conform to ASTM A 36.

C. Cast iron shall be soft, gray iron, true to pattern, smooth and straight, free from defects impairing strength, durability or appearance.

D. Malleable iron shall be high grade white iron castings, fully annealed and of uniform ductile structure throughout.

E. Use genuine wrought iron conforming to ASTM A 41 for bolts, rods, and bars; ASTM A 42 for plates, and ASTM A 162 for sheets.

F. Aluminum alloys shall be of uniform quality and free from injurious defects and meet the properties and applicable specifications of the Aluminum Company of America.

G. Bird screen shall be No. 2 mesh, brass or copper wire cloth, minimum wire diameter 0.063-inch.

H. All other materials not specifically described but required for a complete and proper installation of the work of this Section, shall be new, first quality of their respective kinds and as selected by the Contractor subject to approval of the Engineer.

2.02 Fabrication

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 deg F (55.5 deg C).

D. Shear and punch metals cleanly and accurately. Remove burrs.

E. Ease exposed edges to a radius of approximately 1/32 inch (1 mm), 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 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 secure metal fabrications rigidly in place and to support indicated loads.

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 metal fabrications 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.

2.06 Rough Hardware

A. Furnish bent, or otherwise custom-fabricated, bolts, plates, anchors, hangers, dowels, and other miscellaneous steel and iron shapes as required for framing and supporting woodwork, and for anchoring or securing woodwork to concrete or other structures. Straight bolts and other stock rough hardware items are specified in Division 6 Sections.

B. Fabricate items to sizes, shapes, and dimensions required. Furnish malleable-iron washers for heads and nuts that bear on wood structural connections, and furnish steel washers elsewhere.

C. Fabricate and shop-assemble in largest practical sections for delivery to site.

1. Prepare and reinforce fabrications as required to receive applied items.

2. Fabricate items with joints tightly fitted and secured.

3. Make exposed joints tight, flush, and hairline.

D. Fasteners: Use concealed fasteners if possible.

1. Exposed fasteners: Flathead, countersunk type unless otherwise indicated.

E. Anchors: Fabricate to suit conditions indicated; use anchors of same material and finish as item except where specifically indicated otherwise.

F. Welding:

1. Welding of steel: Comply with AWS D1.1 recommendations.

2. Provide continuous welds at welded corners and seams.

3. Exposed welds: Grind flush and smooth.

G. Joints Exposed to Weather: Fabricate to keep water out, or provide adequate drainage of water that penetrates.

2.07 Fabrication - Railings

A. Railings - General: Construct as indicated.

1. Preassemble in shop to maximum extent practicable.

2. Bending of members: Use jigs to make each similar configuration the same; make neat bends without other deformation.

3. Close exposed open ends of members using same material as used in member.

4. Expansion joints: Slip joints located not more than 6 inches from posts and at not more than 40 feet on center; provide an internal sleeve at least 4 inches longer than width of joint, fastened to one side of joint.

5. Toeboards: 4 inch by 1/8 inch thick plate; provide for railings around floor openings and at open-sided floors.

6. Provide all components necessary for assembly of railings and for attachment to other work.

   a. For attachment to concrete or masonry: Provide inserts for installation into concrete or masonry, or provide other type of anchorage.

      i. Provide matching metal flange, welded to post, to cover grouted joint.

   b. For anchoring to solid masonry: Use fittings fastened to masonry with bolts and expansion shields unless otherwise indicated.

   c. For anchoring to hollow masonry: Use fittings fastened to masonry with toggle bolts unless otherwise indicated.

   d. Fasten fittings to railings in same manner as railing connections.

7. Exterior railings:

   a. Provide weep holes or other means for evacuation of water trapped in hollow members.

8. Wall mounted handrails: Return railing to wall at ends except where otherwise indicated.

B. Removable Railing Sections: Provide sockets to receive posts; provide removable tamperproof socket covers.

2.08 Fabrication - Gratings

A. Gratings - General:

1. Provide toeboards at open sides of elevated gratings when curb is not otherwise indicated.

B. Expanded Metal Mesh Gratings:

1. Provide framing and supports indicated.

a. Where grating and supports are of the same material, weld non removable units to supports at 6 inches on center.

b. Bolt removable units to supports at 6 inches on center.

2. Divide grating into fewest possible sections.

a. Run long dimension of diamonds parallel to span.

b. Cut edges to be welded together so that bond points of adjacent pieces are butted, not lapped.

c. Weld adjacent pieces at every other bond point.

2.09 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 1 inch per foot (85 mm per meter) of clear span but not less than 8 inches (200 mm) bearing at each side of openings, unless otherwise indicated.

D. Galvanize loose steel lintels located in exterior walls.

2.10 Shelf and Relieving Angles

A. Fabricate shelf and relieving angles from steel angles of sizes indicated and for attachment to concrete framing. Provide slotted holes to receive 3/4-inch (19-mm) bolts, spaced not more than 6 inches (150 mm) from ends and not more than 24 inches (600 mm) o.c., unless otherwise indicated.

B. For cavity walls, provide vertical channel brackets to support shelf/relieving angles from back-up masonry and concrete. Align expansion joints in angles with indicated control and expansion joints in cavity wall exterior wythe.

C. Galvanize shelf angles to be installed on exterior concrete framing.

D. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.11 Miscellaneous Steel Trim

A. Unless otherwise indicated, fabricate units from structural steel shapes, plates, and bars of profiles shown with continuously welded joints, and smooth exposed edges. Miter corners and use concealed field splices wherever possible.

B. Provide cutouts, fittings, and anchorages as required to coordinate assembly and installation with other work. Provide anchors, welded to trim, for embedding in concrete or masonry construction, spaced not more than 6 inches (150 mm) from each end, 6 inches (150 mm) from corners, and 24 inches (600 mm) o.c., unless otherwise indicated.

C. Galvanize miscellaneous steel trim in the following locations:

1. Exterior locations.

2. All interior locations unless otherwise indicated.

2.12 Cast Nosings, Treads and Thresholds

A. Fabricate units of material, sizes, and configurations indicated. If not indicated, provide cast-iron units with an integral abrasive finish. Furnish in lengths as required to accurately fit each opening or conditions.

B. Cast units with an integral abrasive grit consisting of aluminum oxide, silicon carbide, or a combination of both.

C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Safety Tread Co., Inc.

2. Amstep Products.

3. Armstrong Products, Inc.

4. Balco/Metalines, Inc.

5. Safe-T-Metal Co.

6. Wooster Products Inc.

D. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with the manufacturer.

E. Drill for mechanical anchors with countersunk holes located not more than 4 inches (100 mm) from ends and not more than 12 inches (300mm) o.c., evenly spaced between ends, unless otherwise indicated. Provide closer spacing if recommended by the manufacturer.

F. Provide 2 rows of holes for units over 5 inches (125 mm) wide, with 2 holes aligned at ends and intermediate holes staggered.

G. Apply black asphaltic coating to concealed bottoms, sides, and edges of cast-iron units set into concrete.

H. Provide a plain surface texture, except where fluted or cross-hatched surfaces are indicated.

2.13 Pipe Bollards

A. Fabricate pipe bollards from Schedule 80 steel pipe. Cap bollards with 1/4-inch (6.4-mm) minimum steel plate.

B. Fabricate sleeves for bollard anchorage from steel pipe with 1/4-inch- (6.4-mm-) thick steel plate welded to bottom of sleeve.

2.14 Fabrication - Shop Coatings

A. Hot-dip galvanize steel and iron assemblies set in concrete and masonry.

B. Shop prime all iron and steel fabrications, except:

1. Fabrications embedded in concrete or mortar.

C. Prepare surfaces to be coated as follows:

1. Solvent-clean in accordance with SSPC-SP 1.

2. Exterior fabrications: Clean in accordance with SSPC-SP 5, SSPC-SP 6, SSPC-SP 8, or SSPC-SP 10.

3. Interior fabrications: Clean in accordance with SSPC-SP 3, SSPC-SP 5, SSPC-SP 6, SSPC-SP 8, or SSPC-SP 10.

D. Shop Priming: Comply with SSPC-PA 1.

1. Apply primer immediately following surface preparation.

2. Do not prime surfaces to be welded.

3. Do not prime surfaces in direct contact bond with concrete.

4. Apply extra coat to corners, welds, edges, and fasteners.

E. Shop Painting: Comply with SSPC-PA 1.

F. Aluminum Ladder: Meet OSHA requirements.

Part 3 Execution

3.01 General

A. Workmanship: Install items square and level, accurately fitted and free from distortion and defects.

B. Coordination: Supply to appropriate trades, items requiring to be cast into concrete, embedded in masonry, complete with necessary setting templates.

C. Touch-Up: After installation, touch-up field welds and scratched and damaged surfaces.

D. Protection: Where required, provide approved protection against galvanic action between contacts of dissimilar metals or situations that will cause deterioration of metals in contact or associated in any way.

3.02 Painting

Painting shall be in accordance with Section 09900 of these Specifications.

3.03 Cleaning

Prior to acceptance of the work of this Section, thoroughly clean all installed materials and related areas in accordance with Section 01710 of these Specifications.

END OF SECTION

Part 1 General

1.01 Scope

A. Adhesive anchor bolts shall be provided for mechanical equipment where indicated on the Drawings or as required by equipment manufacturer's anchor bolt setting plan.

B. Expansion bolts shall be provided where indicated on the Drawings and as required to attach anchor ladders, handrails, stairs, ship's ladders and structural steel shapes to hardened concrete or masonry.

C. Embedded anchor bolts shall be provided where indicated on the Drawings or in the Specifications or where recommended by equipment manufacturers.

1.02 Material Storage

All material shall be stored in manner which will protect it from deterioration and damage.

Part 2 Products

2.01 Adhesive Anchor Bolts

A. Adhesive anchor bolts shall consist of a stainless steel threaded rod meeting the requirements of ASTM F 593 (AISI 304). Installation shall be in conformance with the manufacturer's instructions and under the supervision of a manufacturer's field representative to ensure for maximum pullout and shear strength will be attained.

B. All nuts shall be of stainless steel meeting requirements of ASTM F 594 Alloy Group I, Condition CW.

C. All washers shall meet dimensional requirements of ASTM F 436. Material for washers shall be stainless steel, Type 304, 305, 384 or MX7.

D. Adhesive anchor bolts shall be Epcon System Ceramic 6 Epoxy Adhesive by ITW Ramset/Red Head or HIT HY 150 Injection Adhesive by Hilti Fastening Systems.

2.02 Expansion Anchor Bolts

A. Expansion anchor bolts shall be stainless steel, AISI Type 304 or 316 and shall be of the wedge or self-drilling type. Expansion anchors shall conform to the applicable requirements of Federal Specifications FF-S-325. Installation methods shall be in conformance with the manufacturer's recommendations. For maximum pullout and shear strength, but in no case shall the depth of the hole be less than five bolt diameters. The minimum distance between the center of the expansion anchor and an edge or exterior corner shall not be less than 6 times the diameter of the hole in which it is installed.

B. All nuts shall be of stainless steel meeting requirements of ASTM F 594 Alloy Group I, Condition CW.

C. All washers shall meet dimensional requirements of ASTM F 436. Material for washers shall be stainless steel, Type 304, 305, 384 or MX7.

D. Expansion anchors shall be "Trubolt " by ITW Ramset/Red Head, or "KWIKBOLT II" by Hilti Fastening Systems.

2.03 Embedded Anchor Bolts

A. Embedded anchor bolts, except those used for equipment anchoring, shall be carbon steel unless stainless steel is required on the Drawings or Specifications. Embedded anchor bolts used for anchoring equipment shall be stainless steel.

B. Carbon steel anchor bolts shall meet the requirements of ASTM A 307 or ASTM A 193, Grade B8. Bolts shall be threaded per ANSI B1.1.

C. Stainless steel anchor bolts shall meet the requirements of ASTM A 276, Type 304.

D. All nuts shall be heavy hex nuts, ANSI B18.2, semi-finished pattern. Nuts for carbon steel bolts shall meet the requirements of ASTM A 194, Grade 8. Nuts for stainless steel bolts shall meet the requirements of ASTM A 276, Type 304.

E. All washers shall conform to ANSI B27.2 and shall be 18-8 stainless steel.

Part 3 Execution

3.01 Adhesive Anchor Bolt Installation

A. Drilled Holes: Holes for adhesive anchors shall be drilled with a rotary percussion hammer drill with a carbide tipped masonry drill bit conforming to ANSI B94.12-77. Hole diameter and depth shall be as specified by the manufacturer.

B. Hole Cleaning and Preparation: After drilling, dust and fragments shall be cleared out using a water jet, circular wire brush and oil-free compressed air. The hole may be damp but all water must be blown out.

C. Curing: Anchor shall be unloaded and allowed to cure for manufacturer's recommended curing time.

3.02 Expansion Bolt Installation

A. Drill expansion bolt holes into concrete through item being supported or locate by a template. Drill all holes by a tool designed by or approved by manufacturer of expansion anchors.

B. Installation of expansion anchors shall be in compliance with manufacturer's recommendations for maximum holding power, but in no case shall depth of hole be less than four bolt diameters. Minimum distance between center of any expansion anchor and an edge or exterior corner of concrete shall not be less than 4-1/2 times diameter of hole in which it is installed.

3.03 Embedded Anchor Bolt Installation

Anchor bolts shall be properly located and built into connecting work. Bolts shall be preset by the use of templates or such other methods as may be required to locate the anchor bolts accurately. All base plate anchor bolt nuts shall be turned down tight.

END OF SECTION

Part 1 General

1.01 Scope

A. The work covered by this Section includes furnishing all labor, materials and equipment required to fabricate and install all rough carpentry work as described herein, shown on the Drawings or necessary for proper completion of the work.

B. The Contractor shall properly coordinate the work of other trades to ensure accurate placement of anchors, inserts, receptacles, cutouts and other items.

1.02 Storage and Protection

A. All lumber shall be protected and kept under cover, both in transit and at the job site. Material shall not be delivered unduly long before it is required for proper performance of the work.

B. All materials, when delivered to the job site, shall be stacked to ensure ventilation and protection from the weather. Lumber shall not be stored within a structure during the process of any wet work being done or until the wet work is reasonably dry.

1.03 Quality Assurance

A. The following grading rules and standards, latest editions, shall 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 the grading rules of the American Plywood Association.

7. Southern Pine Plywood - U.S. Product Standard PS-1 and the grading rules of the American Plywood Association.

8. Hardwood Plywood - U.S. Product Standard PS-51 or U.S. Commercial Standard CS-35.

B. Each piece of lumber or plywood shall bear the grade and trademark of the appropriate lumber inspection agency and a mark of mill identification. Plywood shall bear the DFPA grade and trademark of the American Plywood Association.

Part 2 Products

2.01 Framing and Rough Lumber

A. Wood for furring, blocking and framing for all permanent work, unless specified otherwise, shall be construction grade Douglas fir of full and square dimensions, free of large or loose knots, shakes, wains or saps. Maximum moisture content shall not exceed 19 percent.

B. All framing, blocking, etc., in contact with concrete or masonry construction shall be pressure treated with a water soluble salt conforming to AWPA Standard P-5 using a process conforming to AWPA Standard C2 and shall bear the AWPB LP-2 or LP-22 quality mark. Pressure treated wood shall be paintable, stainable, oil free and odorless. Pressure treated plywood shall conform to AWPA Standard C9.

C. Where fire retardant treated wood is specified or shown on the Drawings, lumber and plywood shall be impregnated with a special fire retardant chemical. Fire retardant treated wood shall have a fire hazard classification of less than 25 for flame spread, fuel contributed and smoke generated in accordance with ASTM E 84 and shall be UL designated as FR-S. For exterior grade fire retardant treated wood, there shall be no change in classification following exposure to the standard rain test in accordance with ASTM D 2898. Wood shingles and shakes shall, in addition, meet the requirements of ASTM E 108 for Class C roof construction. Following treatment, fire retardant treated wood shall be kiln dried to a moisture content of not more than 19 percent for exterior grade and 15 percent for interior grade. Each piece of lumber or plywood and each bundle of shingles or shakes shall bear the approved UL and Factory Mutual labels for fire performance rating. Allowable design stresses of fire retardant treated wood shall not exceed 90 percent of those published by NFPA.

2.02 Wood Treatment By Pressure Process

A. Aboveground Lumber: AWPB LP-2 (waterborne preservatives).

1. Kiln dried after treatment to 19 percent maximum moisture content.

2. Treat the following:

a. Wood in contact with roofing, flashing, or waterproofing.

b. Wood in contact with masonry or concrete.

c. Wood within 18 inches of grade.

d. Tree stakes

e. Other members indicated.

B. Ground Contact Treatment: AWPB LP-22.

1. Treat the following:

a. Wood in contact with ground.

C. Fasteners for Preservative Treated Wood: Hot-dip galvanized steel (ASTM A153).

D. Fire-Retardant Treatment:

1. Fire-retardant treated lumber: AWPA C20.

2. Fire-retardant treated plywood: AWPA C27.

3. Provide treatment classified for use as Exterior Type.

Part 3 Execution

3.01 Installation

A. All materials shall be installed by an erector of proven experience and shall be accomplished in a first class manner. Any damages to exposed members shall be repaired to the satisfaction of the Engineer or damaged members shall be replaced. All installation work shall conform to AITC Standard 105.

B. Furnish dressed wood nailing strips and wood blocking of the sizes indicated or required and install on or in concrete or masonry as required for the attachment of carpentry and the work of other trades. All grounds and nailing strips shall be anchored to the masonry with countersunk 1/4-inch toggle bolts or other type anchors not over 24-inches on center. Grounds shall be set rigid in perfect alignment and shall be trued with a long straight edge. Wood plates shall be anchored to concrete slabs using concrete nails or power actuated fasteners.

C. Framing lumber and other rough work shall be properly framed, closely fitted, accurately set to required lines and levels and rigidly secured in place. Special framing or construction not explicitly shown or specified shall be provided as required to complete the work in the best and most workmanlike manner. Nailing and spiking shall be done in a thoroughly workmanlike manner, with nails of ample size, using spikes larger than 12 penny where practical. Members shall be framed for the passage of pipes and ducts to avoid cutting structural members.

D. Brush cut surfaces of pressure treated lumber with a heavy coat of preservative (same preservative used in original application).

3.02 Cleaning

Prior to acceptance of the work of this Section, thoroughly clean all installed materials and related areas in accordance with Section 01710 of these Specifications.

END OF SECTION

Part 1 General

1.01 Scope

A. The work covered by this Section includes furnishing all labor, materials and equipment required to fabricate and install filter bed media and appurtenances as described herein, shown on the Drawings, or necessary for proper completion of the Work.

B. Description of Operation

Batch quantities of sludge, mixed with polyelectrolyte (polymer), are directed over the drying beds. Immediate separation of water drains through the filter bed media. Dried sludge is collected off the media.

C. System Design Data

Sludge shall be dried to a liftable state when loaded on the sludge filter trench. Trench covers shall allow up to four feet of sludge to be loaded on top of the trench without deformation of the cover. Trench covers shall allow rolling equipment such as a loaded “Bob Cat” to traverse the cover without deformation.

1.02 Submittals

A. Submit complete shop drawings and engineering data in accordance with the requirements of Section 01340 of these Specifications.

B. Shop drawings shall indicate the materials, arrangement, thickness, size of sections, construction, fastenings, clearances, assembly and erection details, built-in hardware and necessary connections to work of other trades. Only the general dimensions and elevations are shown on the Drawings. The manufacturer/supplier shall provide detailed layout, dimensions, assembly and detailed connections in the shop drawings.

C. Submit complete engineering design calculations for all trough assemblies. Calculations shall clearly illustrate the profile, layout, and loads considered. Calculations shall bear the seal and registration number of a professional engineer registered in the State of Georgia. Submit calculations concurrently with the shop drawings.

1.03 Storage and Protection

A. Store trough assemblies on level flat planes such that twisting and bending stresses shall not be imposed during storage.

B. Follow the manufacturer's recommendations for stacking and storage.

C. Maintain all troughs covered.

Part 2 Products

2.01 Acceptable Manufacturers

A. The filter bed media shall be as furnished by Gravity Flow Systems Southwest, Seguin, Texas.

1. The individual filter media modules shall measure 12-inches from one flat side to the opposite flat side in both directions, within a ± 1/32-inch tolerance, for reasons of manufacturing consistency, replacement, and interchangeability. Media failing to meet these dimensional requirements shall be unacceptable.

2.02 Materials and Construction

A. Media

The filter media modules shall be constructed of high strength polyurethane having shore Durometer hardness readings of no less than 65. The modules shall measure 2-inches high x 12-inches x 12-inches and have incorporated within sufficient structural design to be able to support the weight of sludge removal equipment weighing up to 4,000 pounds GVW. The filter modules shall have a solid area of 88% formed by the molding of triangular cross-sections measuring .105” wide x .170” high tapered at 13 degrees per side. These triangular sections are separated by an open area of .015” wide x 1.00” long slots. The polyurethane shall be protected against UV deterioration. The modules shall have two male dovetails on two sides and two female dovetails on two sides to allow for interlocking. The interlocking shall be designed to allow any module to be removed without disturbing any other modules.

B. Perimeter Sealing

The filter media shall be sealed on all perimeter edges by a minimum 1/8-inch thick x 1-inch x 2-inch T304 stainless steel angle. The angle shall be complete with 1/16-inch thick x 1-inch wide neoprene rubber strips adhered to each leg of the angle. The angle shall be placed in such a manner that one rubber strip rests tightly against the media and one rests against the concrete sidewall. The angle shall be held in place by 1/2-inch x 3-1/2-inch stainless steel wedge anchors located on maximum 18-inch centers. After the angles are installed, any gaps that may occur should be caulked with a suitable weatherproof silicon caulking, furnished by the General Contractor.

C. Anchorage

All anchorage for the filter media and its appurtenances shall be Type 18-8 stainless steel. Anchor bolts, nuts, and washers shall be placed in position by the Contractor according to certified dimension prints furnished by the equipment manufacturer.

Part 3 Execution

3.01 Installation

A. Manufacturer's Service Representative

1. The manufacturer shall furnish the services of a competent service technician to inspect the installation and to place the equipment into operation.

   a. The Contractor shall include in his Bid the services of a factory representative for a period of 1 day and one trip to the Project location.

   b. Checkout of final installation, start-up, calibration, and instruction of operation personnel shall be performed by an authorized representative of the manufacturer.

B. Sealants

The Contractor shall furnish and apply all waterproofing caulking compound for sealing of the media modules.

END OF SECTION

Part 1 General

1.01 Scope

A. The work under this Section includes, but is not necessarily limited to, the furnishing and installation of all dampproofing as indicated on the Drawings, herein specified and as necessary for the proper and complete performance of this work.

B. The bituminous dampproofing materials specified herein shall be surface applied as follows:

1. Apply to the entire face of all exterior building walls below grade. Do not apply to the outside of concrete tanks which contain water.

2. Apply to block behind brick as indicated on the Drawings.

C. The penetrating cementitious dampproofing materials specified herein shall be of the surface applied, capillary action type, capable of providing the dampproofing qualities as stated under 1.02 of this Section for all applications, at locations shown on the Drawings.

D. Provide all labor, materials, equipment and appliances as required for the proper installation of dampproofing as follows:

1. Prepare all surfaces as specified herein to receive dampproofing.

2. Provide dampproofing at all vertical and horizontal surfaces shown on the Drawings.

3. The manufacturer shall provide all certifications, test data, affidavits or samples requested by the Engineer.

4. Perform all installations to comply with local rules, ordinances and regulations, OSHA Requirements and EPA Statutes complying with environmental protection.

5. Perform all installations in accordance with the approved construction progress schedule or at such times necessary for the orderly and expeditious completion of the Project.

6. Upon completion of dampproofing, remove all waste or rubbish resulting from dampproofing operations and all equipment used for same.

1.02 Submittals

Submit approved manufacturer's product literature for dampproofing materials including all special details and recommended application procedures in accordance with the requirements of Section 01340 of these Specifications.

1.03 Product Handling

A. Protection: Use all means necessary to protect dampproofing materials before, during and after installation and to protect the installed work and materials of all other trades, contiguous to the dampproofed surfaces. Packaged containers shall be stored on wood skids, 6-inches off the ground and covered with heavy plastic sheeting which shall remain in place at all times.

B. Replacement: All broken containers and their contents shall be removed from the premises, discarded in a legal fashion and replaced with new materials at no additional cost to the Owner.

1.04 Coordination

A. Review all Drawings and details of installations of other adjoining materials and cooperate with the respective trades.

B. The applicator's particular attention is directed to the requirement to properly prepare surfaces for the attachment of other materials and to chip out and repack surfaces at all attachments.

1.05 Quality Assurance

A. Qualifications of Installers

1. The applicators performing this work must have a minimum of five years experience in this type of dampproofing and be able to show that they have successfully carried out contracts of a similar nature, size and scope.

2. Provide at least one person who shall be present during execution of this portion of the work and who shall be thoroughly experienced in installation of the specified products and shall direct all work performed under this Section.

B. Manufacturer's Certification: Prior to start of installation of the work of this Section, arrange a visit to the job site by a representative of the manufacturer of the dampproofing materials used, who shall inspect and certify:

1. That the surfaces to which dampproofing is to be applied are in condition suitable to receive dampproofing.

2. That the materials to be installed comply in all respects with the requirements of this Section.

3. That the applicator has the experience to install said materials in complete accordance with the manufacturer's current recommendations.

1.06 Warranty

Furnish a written warranty, warranting materials and workmanship for a period of five years after acceptance of the work of this Section and binding the Contractor to repair and make good, at no additional cost to the Owner, all defects which appear during this period.

Part 2 Products

2.01 Acceptable Manufacturers

Bituminous dampproofing shall be equal to Sonneborn or W.R. Meadows.

2.02 Materials

A. The penetrating cementitious dampproofing shall be factory formulated in a designed mix to be applied in a slurry paste mixed to the proper consistency with the addition of water in quantities recommended by the manufacturer.

B. Premixed factory formulation shall be warranted not to contain additives such as chlorides, sulphates, iron oxides or similar deleterious substances.

C. All materials used in the formulation shall comply with standards set forth herein, as follows: Penetrating cementitious dampproofing compound shall be composed of specially prepared Portland cement, fine oven dried quartz aggregates and moisture active, chemically treated ingredients equal to Permquick Super 200, Vandex Super or Penetron.

Part 3 Execution

3.01 Installation

A. Apply all dampproofing materials in strict accordance with manufacturer's instructions and recommendations and this Section.

B. Before backfilling against dampproofing, repair all damaged surfaces.

3.02 Preparation

A. Prior to commencing dampproofing operations inspect all containers for rips, tears or holes. Any damaged containers shall be rejected and replaced with new materials.

B. Make sure that surfaces to be treated are free of laitance and other materials which will inhibit the bonding and penetration capabilities of the dampproofing systems. Floor hardeners or curing agents should not be used prior to the application.

C. Do not apply systems when the ambient temperature falls below 35 degrees F. The temperature should be above 35 degrees F for 24 hours before and 48 hours after the coating application.

D. Surfaces to receive slurry applications shall have a wood float or rough finish and have open capillaries. Construction joints and visible cracks exceeding 0.01-inch in size should be routed out 3/4-inch. Remove all laitance, dirt, dust and rinse all concrete slabs and cracks with water. The surfaces shall have a dark appearance at the time when the slurry coating is applied. Remove form oil, form release agents and other foreign materials which will inhibit the bond and penetration of the system. Steam clean, acid etch, or brush blast when necessary. Leave tie holes 1-inch back. Segregated areas and faulty construction joints shall be routed out to sound concrete. Construction joints and visible cracks in concrete surfaces exceeding hairline size (larger than 0.01-inch) should be routed out 3/4-inch deep.

E. Clean surfaces to be dampproofed with water. Dampness should be present in the concrete strata to achieve maximum initial penetration of the penetrating cementitious dampproofing compound.

3.03 Mixing Procedures

A. Slurry Mix: Use separate containers to measure powder and water. Water must be potable. Add one part water to three parts powder; mix thoroughly. Stir the slurry mixture frequently during the application and prepare only as much as can be applied within a 30 minute period.

B. Mortar Mix: Add water to powder. Work with trowel until medium stiff consistency is reached. Prepare only as much mix as can be applied within a 30 minute period.

3.04 Safety Measures

For maximum safety, hands should be protected with rubber gloves whenever penetrating cementitious dampproofing materials are being used for an extended period of time. During spray or overhead applications, goggles should be worn.

3.05 Application Procedures

A. Penetrating cementitious dampproofing coatings shall be applied with a stiff masonry brush/broom or with normal hopper fed spray equipment.

1. Horizontal Concrete Surfaces

a. Dry Shake and Power Trowel, Wood Float or Bull Float Application: Dry shake when horizontal concrete slab is in the plastic state. Apply 1.0 pound per square yard. Trowel or float surface to specified finish.

b. Slurry Mix: Construction joints and pour joints should be treated with 2.5 to 3.0 pounds per square yard in slurry consistency immediately prior to placing of concrete. Install mortar strip 3/4 x 1-1/4-inch at all construction joints. Installation of reglets and cant strips at time of forming is recommended.

2. Vertical Concrete Surfaces

a. Honeycombed areas, faulty construction joints, cracks, and tie holes, apply 2.0 pounds per square yard and fill.

b. Coat interior/exterior surfaces of concrete walls 2.5 to 3.0 pounds per square yard using slurry mix.

c. Fill reglets, construction joints, junction walls and slab.

3.06 Protection and Curing

A. Protect the freshly treated surfaces from rain for a minimum period of 24 hours. Maintain above 35 degrees F for 48 hours.

B. Moisture cure all treated areas for a minimum period of two days, starting with a fine water fog spraying the day following completion of the application, or apply Penecure curing compound after the set of the coating.

3.07 Neutralization

A. Treated surfaces to receive paints or other protective coatings should be neutralized with a vinegar salt water solution or muriatic acid/water solution 1:10. Rinse all treated surfaces thoroughly with water. The neutralization procedures should follow direction of product labels.

B. For application to cisterns and drinking water reservoirs, follow EPA requirements.

3.08 Cleaning

Prior to acceptance of the work of this Section, thoroughly clean all installed materials and related areas in accordance with the requirements of Section 01710 of these Specifications.

END OF SECTION

Part 1 General

1.01 Scope

A. The work covered by this Section includes furnishing all labor, materials and equipment required to furnish and install all building insulation as specified herein and/or shown on the Drawings.

B. Roof insulation shall be furnished and installed under applicable roofing section(s) of these Specifications.

1.02 Submittals

Complete shop drawings and engineering data shall be submitted to the Engineer.

1.03 Storage and Protection

Insulation shall be stored indoors in a dry location in accordance with the manufacturer's instructions.

1.04 Quality Assurance

A. All insulation shall be delivered to the site in unopened packages. Packages shall be clearly marked with the manufacturer's name, type, quantity of insulation and "R" value (where applicable).

B. "R" values shall be determined in accordance with the standards of the National Mineral Wool Insulation Association.

C. The Contractor shall submit a certificate to the Engineer stating that all loose fill insulation conforms to the latest applicable specifications of the Perlite Institute.

Part 2 Products

2.01 Loose Fill Insulation

A. Loose fill insulation shall be loose, expanded Perlite conforming to ASTM C 549 and Federal Specification HH-1-574b.

B. Loose fill insulation shall be a product of a member of the Perlite Institute and shall be approved for use in FHA construction.

2.02 Perimeter Insulation

A. Perimeter insulation shall be 1-inch thick rigid, closed cell, urethane board insulation conforming to Federal Specification HH-1-530A, Type III, Grade 2, Class 1, equal to that manufactured by the Upjohn Company or Owens Corning.

B. Urethane perimeter insulation shall have a density of not less than 2.0 pcf in accordance with ASTM C 303. Thermal conductivity of not less than 0.14 Btu/inch/square foot-hour- degree F in accordance with ASTM C 578, and a water absorption not to exceed 0.1 percent in accordance with ASTM C 272.

C. Perimeter insulation shall be approved for use in FHA construction.

D. Adhesive shall be as recommended by insulation manufacturer.

2.03 Rigid Wall Insulation

A. Unless noted otherwise, rigid wall insulation shall be 3/4-inch thick, rigid, closed cell, expanded polystyrene board insulation conforming to ASTM C 578.

B. Polystyrene wall insulation shall have a density of not less than 1.0 pcf in accordance with ASTM C 303, a thermal conductivity not to exceed 0.26 Btu/inch/square foot/ hour/degree F in accordance with ASTM C 518, and a water absorption not to exceed two percent in accordance with ASTM C 272. Flame spread and fuel contributed shall not exceed 25 and smoke generated shall not exceed 50 in accordance with ASTM E 84 for 1-inch thickness.

2.04 Batt Insulation

Batt insulation shall be nominal 24-inch wide Kraft paper faced fiberglass Batts with an R-value as shown on the Drawings.

2.05 Vapor Barrier

Vapor barrier shall be 0.006-inch thick polyethylene film membrane in a width as wide as practical.

Part 3 Execution

3.01 Installation of Loose Fill Insulation

A. Loose fill insulation shall be installed in the cores of all hollow masonry units in exterior walls.

B. The insulation shall be poured directly into the wall at any convenient interval. Wall sections under doors and windows shall be filled before sills or lintels are placed.

C. All holes and openings in the wall through which insulation can escape shall be permanently sealed or caulked prior to installation of the insulation. Copper, galvanized steel or fiberglass screening shall be used in all weep holes.

3.02 Installation of Perimeter Insulation

A. At all heated areas, provide a 24-inch wide horizontal layer of insulation under all slabs on grade, the exterior edge of which shall abut the inside face of the foundation wall.

B. Place insulation directly on level, well-tamped fill before concrete floor slab is poured. Place insulation carefully and bed in a manner to keep top surfaces level and in same plane. Cement sections together tightly.

3.03 Installation of Vapor Barrier

Install vapor barrier directly over fill and perimeter insulation. Where joints in membrane occur, lap a minimum of 18-inches. Exercise care not to puncture the membrane. Where punctures occur, patch so as to maintain a continuous membrane. Install concrete slab floor directly over the vapor barrier.

3.04 Cleaning

Prior to acceptance of the work of this Section, thoroughly clean all installed materials and related areas.

END OF SECTION

Part 1 General

1.01 Summary

A. Section includes:

1. Manufactured metal roofing system:

a. Manufactured metal roof panels.

b. Manufactured metal wall panels.

c. Installation accessories including miscellaneous trim, flashing, closures, drip flashing and accessories..

2. Manufactured metal panel soffit system.

B. Related Sections:

1. Metal structural systems: Division 5.

2. Sheet metal flashing: Elsewhere in Division 7.

3. Roof accessories: Elsewhere in Division 7; Section includes:

a. Pipe penetration seals.

b. Expansion joint covers.

4. Gutters and downspouts: Division 7.

1.02 References

A. Section 05100: Structural Steel Framing.

B. Section 05500: Miscellaneous metal fabrication.

C. Section 07900: Sealants.

D. American Iron & Steel Institute (AISI) Specification for the Design of Coldformed Steel Structural Members SG02-1:2001.

E. ASTM A-653-03 Steel Sheet, Zinc-Coated (Galvanized)

F. ASTM E-1680-95 (2003) Air Leakagae

G. ASTM E-331-86

H. UL 580 Uplift

I. SMACNA - Architectural Sheet Metal Manual - 5th Addition.

J. Building Materials Directory - Underwriter's Laboratories, Test Procedure 580.

1.03 System Description

A. The roofing assembly includes preformed sheet metal panels, related accessories, valleys, hips, ridges, eaves, corners, rakes, miscellaneous flashing and attaching devices.

B. Structural Requirements: Design roof and wall systems to safely withstand dead load and live loads prescribed by the governing building code.

C. Environmental Requirements:

1. Provide for expansion and contraction of system components due to ambient temperature and solar heat gain. Accommodate movement due to temperature change without buckling, undue stress on structural elements, reduction of performance, or other damaging effects.

a. Anticipated ambient temperature range: Minus 20 to plus 120 degrees F.

D. Wind Uplift: Provide metal roof panel systems which have been tested in accordance with UL 580 and listed in the UL "Roofing Materials and Systems Directory" for the following rating:

1. Class 90.

1.04 Submittals

A. Product Data: Manufacturer's written technical information, including performance data, details, and installation recommendations, which demonstrate that metal panel assembly components comply with contract documents.

B. Shop Drawings: Drawings which show arrangement and orientation of panels and details of panel joints, corners, custom profiles, supporting devices, and closure trim and flashing. Show panel system in relation to adjacent construction.

C. Samples for Selection of Coated Finishes: Coating manufacturer's full range of color selection data.

D. Submit calculations with registered engineer seal, verifying roof panel and attachment method resists windpressures imposed on it pursuant to applicable building codes.

1.05 Quality Assurance

A. Manufacturer Qualifications: A company with a minimum of 10 years' successful experience in the design, fabrication, and installation of metal panel systems comparable in size and nature to those required for this Project.

B. Field Measurements: Measure in-place construction on which panel system will be installed if possible, before fabrication of panels. If not feasible, fabricate material to allow in-field trimming of panels to assure proper fit.

1. Coordinate field measurements and shop drawings with shop fabrication to minimize field adjustments, splicing, and mechanical joints.

1.06 Delivery, Storage and Handling

A. Upon receipt of panels and other materials, installer shall examine the shipment for damage and completeness.

B. Panels should be stored in a clean, dry place. One end should be elevated to allow moisture to run off.

C. Panels with strippable film must not be stored in the open, exposed to the sun.

D. Stack all materials to prevent damage and to allow for adequate ventilation.

1.07 Warranty

A. Warrant coated finish against cracking, peeling, blistering, chalk in excess of 8 units, and fade in excess of 5 NBS points, for a period of 20 years, without reducing or otherwise limiting any other rights to correction which the owner may have under the contract documents.

B. Applicator shall furnish guarantee covering watertightness of the roofing system for the period of two (2) years from the date of substantial completion.

Part 2 Products

2.01 Manufacturers

A. Manufactured Metal Panel Systems: Furnish basic materials, including panels, accessories, and fasteners, from a single source manufacturer. Furnish other products integral with panel system from the same manufacturer as basic materials, or from a manufacturer approved or recommended by the basic materials manufacturer.

1. Provide products complying with requirements of the contract documents and made by one of the following:

a. Atas Inernatioal, Inc.(System: MRD150)

b. IMETCO Innovative Metals Company Inc.

c. Zip-Rib

d. Berridge Manufacturing Company. (System: Cee-Lock)

e. McElroy

2.02 Sheet Materials

A. Prefinished Metal shall be Hot-Dipped Galvanized - ASTM A446-85 Grade C G90 Coating A525-86 24 gauge core steel .

B. Unfinished Metal shall be Grade C Galvalume ASTM 792-86, AZ 55, "Satin Finish".

C. Finish shall be full strength Kynar 500 Fluoropolymer coating, applied by the manufacturer on a continuous coil coating line, with a top side dry film thickness of 0.70 to 0.90 mil over 0.25 to 0.35 mil prime coat, to provide a total dry film thickness of 0.95 to 1.25 mil. Bottom side shall be coated with primer with a dry film thickness of 0.25 mil. Finish shall conform to all tests for adhesion, flexibility, and longevity as specified by the Kynar 500 finish supplier.

D. Strippable film shall be applied to the top side of the painted coil to protect the finish during fabrication, shipping and field handling. This strippable film must be removed immediately before installation.

2.03 Accessory Materials

A. Fasteners: Stainless Steel with washers where required.

B. Sealant: As specified in Section 07900.

C. Vinyl Weatherseal Insert.

D. Galvanized Steel Sheet: ASTM A 446, with minimum G90 zinc coating.

2.04 Fabrication

A. All exposed adjacent flashing shall be of the same material and finish as the roof panels.

B. Hem all exposed edges of flashing on underside, 1/2 inch.

2.05 Roof System

A. System Type: Uninsulated system consisting of roof panels with concealed attachment clips in panel seams and purlins, or similar secondary structural system to attach roof system to primary building structure.

1. Panels shall have 1.5" high vertical legs, spaced 15 to 16" on center and shall have no exposed fasteners.

2. Standing seam to be of an interlocking, "snap-lock" design.

3. When required, Panel assembly to bear Underwriter's Laboratories Label UL90, pursuant to Construction Number 334 and applicable Fire Ratings.

4. Certification shall be submitted, based on independent testing laboratory, indicating no measurable water penetration or air leakage through the system when tested in accordance with ASTM E-331-86 and E-283 84.

5. Seam type: Factory-formed for self-interlocking without field crimping.

6. Exterior finish: Fluoropolymer.

7. Interior (underside) finish: Same as exterior finish.

8. Panel profile: Similar to "Berridge Cee-Lock-Snap Lock Standing Seam System"; Berridge Manufacturing Company.

B. Fasteners:

1. Threaded fasteners - general: Provide manufacturer's standard corrosion-resistant fasteners of size and type required for intended application.

   a. Use of cadmium-plated fasteners is not allowed.

2. Rivets: Noncorrosive metal, compatible with metals to be fastened.

   a. Exposed-to-view rivets are not allowed.

C. Accessories:

1. Sheet metal closures, flashing, and trim: Fabricate from same type of sheet metal, and with same finish, as adjacent roof panel.

2. Flexible sheet flashing: Neoprene or EPDM sheet, minimum 0.060 inch thickness.

3. Concealed sealants and gaskets: Manufacturer's standard.

4. Exposed joint sealant: As specified elsewhere in Division 7.

2.06 Soffitt Panels

A. Soffit Panel System: Metal panels with attachment clips or fasteners concealed in panel seams and light-gage metal framing system to attach soffit panels to primary building structure.

1. Metal panels: Galvanized sheet steel, minimum 24 gage (0.028 inch thick).

2. Exterior finish: Fluoropolymer.

3. Interior finish: Same as exterior finish.

4. Panel width (nominal coverage): 12 inches.

5. Panel profile: Similar to Berridge Vee-Panel Soffit system; Berridge Manufacturing Co.

B. Concealed Panel Clips:

1. Fabricate from galvanized steel.

2. Provide panel system manufacturer's standard clips to suit project requirements, including but not limited to the following:

a. Live loads.

b. Thermal movement; accommodate expansion and contraction without introducing stress into wall system.

c. Special conditions at transitions, penetrations, and terminations.

C. Fasteners:

1. Threaded fasteners - general: Provide manufacturer's standard corrosion-resistant fasteners of size and type required for intended application.

2. Rivets: Noncorrosive metal, compatible with metals to be fastened.

a. Exposed-to-view rivets are not allowed.

D. Accessories:

1. Sheet metal closures, flashing, and trim: Fabricate from same type of sheet metal, and with same finish, as adjacent metal panels.

2. Concealed sealants and gaskets: Manufacturer's standard.

3. Exposed joint sealant: As specified elsewhere in Division 7.

2.07 Finishes

A. Fluoropolymer Finish:

1. Pretreatment: Caustic etch and conversion coating, each followed by water rinse.

2. Primer: Modified epoxy primer, minimum 0.2 mil thick; bake to cure.

3. Finish coat: 70 percent "Kynar 500" or "Hylar 5000" resin finish coat, minimum 0.8 mil thick; bake to cure.

a. Color: Selected by J. W. Robinson & Associates, Inc, after contract award, from manufacturer's standard color selection.

4. Protective film: Provide strippable plastic film, applied to finish of coil stock before forming.

Part 3 Execution

3.01 Examination

A. Verify that substrate or structural system to receive work of this section is complete, properly sized, and is laid out correctly in plan and elevations.

B. Correct unacceptable substrate installations before start of metal panel erection.

C. Examine plywood or metal deck to ensure proper attachment to framing.

[] D. Inspect roof deck to verify deck is clean and smooth, free of depressions, waves or projections, level to ¬" in 20', and properly sloped to [valleys] (or) [eaves].

E. Verify roof openings, curbs, pipes, sleeves, ducts or vents through roof are solidly set, cant strips and reglets in place, and nailing strips located.

F. Verify deck is dry and free of snow or ice. [Flutes in steel deck to be clean and dry] or [joints in wood deck to be solidly supported and nailed].

G. Coordinate work with other adjacent elements of building envelope to ensure watertight construction.

3.02 Installation

A. General: Install manufactured metal panels in accordance with panel manufacturer's recommended practices.

1. Fasten panels to structure as necessary to comply with performance criteria, allowing for expansion and contraction due to temperature variations and building movement.

2. Install gaskets, sealants, closures, and trim as the work progresses to ensure airtight and watertight performance of the completed installation.

B. Roof System Installation:

1. Comply with manufacturers standard instructions and conform to standards set forth in the Architectural Sheet Metal Manual published by SMACNA, in order to achieve a watertight installation.

2. Install panels in such a manner that horizontal lines are true and level and vertical lines are plumb.

3. Install starter and edge trim before installing roof panels.

4. Remove protective strippable film prior to installation of roof panels.

5. Attach panels using manufacturer's standard clips and fasteners, spaced in accordance with approved shop drawings.

6. Install sealants for preformed roofing panels as approved on shop drawings.

7. Do not allow panels or trim to come into contact with dissimilar materials.

8. Do not allow traffic on completed roof. If required, provide cushioned walk boards.

9. Install roof panels in single, continuous piece from eaves to ridge.

10. Protect installed roof panels and trim from damage caused by adjacent construction until completion of installation.

11. Remove and replace any panels or components which are damaged beyond successful repair.

12. Coordinate installation of roof accessories specified elsewhere.

C. Wall System Installation:

1. Secondary structure: Install panel supports, taking care to align members correctly for proper engagement of panel attachment system.

2. Concealed-fastener wall panel system installation: Install wall panels using clips or fasteners concealed in joint lap.

   a. Use of exposed fasteners is not permitted unless specifically approved by the J. W. Robinson & Associates, Inc.

3. Coordinate wall panel work with installation of doors, windows, and other elements of the wall to ensure continuous weathertight enclosure.

3.03 Installation Tolerances

A. Roof Systems:

1. Alignment: 1/4 inch in 20 feet for conformity to lines of roof slope and seam locations.

3.04 Cleaning and Protection

A. Remove protective coverings from prefinished metal surfaces after each panel is installed.

B. Touch up or refinish marred or abraded surfaces. Replace damaged units and units which cannot be refinished to the J. W. Robinson & Associates, Inc.'s satisfaction.

C. Clean finished surfaces using techniques and materials recommended by panel manufacturer. Protect cleaned surfaces until project completion.

END OF SECTION

Part 1 General

1.01 Summary

A. Section Includes:

1. Sheet metal flashing and trim.
2. Flexible flashings.
3. Downspouts and conductor heads.
4. Gutters
5. Fasteners and attachment devices.
6. Coatings and slip sheets to isolate sheet metal from dissimilar materials.

B. Flashings which are integral with membrane roofing or waterproofing systems (base flashings) are not included in this Section.

C. Wood blocking, nailers, edge strips, and battens are not specified in this Section.

1.02 Submittals

A. Product Data: Manufacturer's technical information and installation instructions, in sufficient detail to demonstrate products comply with contract documents.

B. Shop Drawings: Detailed drawings clearly indicating component profiles, joints, transitions, fastening methods, and relationship of flashing materials to adjacent construction.

1. Shop drawings showing layout, profiles, methods of joining, and anchorages details, including major counterflashings, trim/fascia units, gutters, downspouts, scuppers, and expansion joint systems. Provide layouts at 1/4-inch scale and details at 3-inch scale.

C. Samples: Submit samples of each type of metal and finish required.

1. 8-inch-square samples of specified sheet materials to be exposed as finished surfaces.
2. 12-inch-long samples of factory-fabricated products exposed as finished work. Provide complete with specified factory finish.

1.03 Quality Assurance

A. Installer: A company familiar with installing products included in this section and which has completed at least 20 installations similar in scope to work included in this Section.

B. Quality Standard:

1. Fabricate and install sheet metal work in accordance with Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA) "Architectural Sheet Metal Manual," unless specifically indicated otherwise.

C. Wind Resistance:

1. Fabricate and install flashings at edges of roof in accordance with Factory Mutual (FM) Loss Prevention Data 1-49 for specified wind zone. Ensure that substrate construction also is in compliance.

Part 2 Products

2.01 Materials

A. Prefinished Galvanized Steel Sheet: Coil coated, commercial quality steel sheet, ASTM A 526 or ASTM A 527, G90 hot-dip galvanized.

1. Finish: 70 percent "Kynar 500" or "Hylar 5000" resin finish over epoxy primer; minimum system thickness 1.0 mil. Provide manufacturer's standard prime coat on underside.

a. Color: Selected by DESIGN PROFESSIONAL, after Contract award, from manufacturer's standard color selection.

2. Provide strippable plastic protective film on prefinished surface.

3. Manufacturer: Provide products complying with requirements of the contract documents and made by one of the following:

a. Atas Aluminum Corporation.

b. Copper Sales, Inc.

c. MM Systems Corporation.

d. Petersen Aluminum Corporation.

e. Vincent Metals Division/Rio Algom, Inc.

B. Copper Sheet: ASTM B 370, of temper appropriate for use.

C. Bonded Copper: 3 ounces per square foot bonded on both sides by asphalt to heavy waterproofed, reinforced creped kraft paper.

D. EPDM Flashing: Uncured EPDM sheet; minimum 60-mil thickness; minimum properties as follows:

1. Tensile strength (ASTM D 412): 1,305 pounds per square inch.

2. Elongation (ASTM D 412): 300 percent.

3. Maximum brittleness temperature (ASTM D 746): Minus 49 degrees F.

4. Resistance to heat aging (ASTM D 573): Minimum properties (ASTM D 412) after aging at 240 degrees F for 672 hours:

   a. Tensile strength: 1,205 pounds per square inch.

   b. Elongation: 200 percent.

   c. Tear resistance: 125 pounds per inch.

5. Products: Provide one of the following:

   a. "Sure-Seal Elastoform Flashing"; Carlisle Syntec Systems.

   b. "SPM Flashing"; Manville Roofing Systems, a Division of Schuller International, Inc.

E. Foam Backing For Flexible Flashings: Closed-cell foam rubber; polyethylene, neoprene, or similar soft, compatible material.

2.02 Accessory Materials

A. Fasteners: Corrosion-resistant metal of same material as the material being fastened, or other material recommended by sheet metal manufacturer. Match finish and color of exposed fastener heads to finish and color of sheet material being fastened.

B. Solder: ASTM B 32, 50/50 tin-lead, rosin flux unless recommended otherwise by sheet metal manufacturer.

C. Installation Accessories, Flexible Flashings: Provide joint tape, adhesives, sealers, and fasteners as recommended by flexible flashing manufacturer for indicated applications.

D. Sealant: As specified in Division 7.

   1. Use noncuring type for concealed joints.

   2. Use nonsag elastomeric type for exposed joints.

E. Joint Adhesive: Two-component noncorrosive epoxy adhesive, recommended by metal manufacturer for sealing of nonmoving joints.

F. Bituminous Coating: Heavy bodied, sulfur-free, asphalt-based paint; FS TT-C-494.

G. Gutter and Conductor-Head Guards: 20-gage bronze or nonmagnetic stainless steel mesh or fabricated units, with selvaged edges and noncorrosive fasteners. Select materials for compatibility with gutters and downspouts.

2.03 Preformed Reglet Flashing Systems

A. General: Fabricate reglet flashing system from 16-oz. copper sheet formed to provide secure interlocking of separate reglet and counterflashing pieces.

B. Types Required:

1. Surface-mounted type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.

2.04 Fabrication - General

A. Form sheet metal to match profiles indicated, substantially free from oil-canning, fish-mouths, and other defects.

B. Comply with SMACNA "Architectural Sheet Metal Manual" for applications indicated.

C. Provide for thermal expansion of exposed sheet metal work exceeding 15 feet running length.

1. Flashing and trim: Provide movement joints at maximum spacing of 10 feet; no joints allowed within 2 feet of corner or intersection.

D. Conceal fasteners and expansion provisions wherever possible.

1. Exposed fasteners are not allowed on faces of sheet metal exposed to public view.

E. Form a 1/2-inch hem on underside of exposed edges.

F. Fabricate cleats and attachment devices from same material as sheet metal component being anchored or from compatible, noncorrosive metal recommended by sheet metal manufacturer.

1. Gage: As recommended by SMACNA or metal manufacturer for application, but in no case less than gage of metal being secured.

2.05 Sheet Metal Fabrications

A. General: As a minimum, fabricate flashings using materials in the thickness listed for each flashing application.

B. Exposed Flashings - Low Slope Roofs or Waterproofing:

1. Scuppers:

a. Prefinished Galvanized sheet steel: 24 gage (0.0239 inch).

C. Semiconcealed Flashings - Low Slope Roofs or Waterproofing:

1. Counter flashing:

a. Stainless sheet steel: 24 gage (0.0239 inch).

D. Concealed Wall Flashings:

1. Masonry through-wall flashing:

a. Bonded Copper: 3 ounces per square foot bonded on both sides by asphalt to heavy waterproofed, reinforced creped kraft paper.

E. Miscellaneous Flashings:

1. Ledge flashing:

a. Stainless steel sheet: 24 gage (0.0239 inch).

2.06 Gutters, Downspouts and Conductor Heads

A. Fabricate from same material and finish used for adjacent exposed flashings.

B. Form sheet metal to profile dimensions indicated, free from distortions and defects detrimental to water-tight system.

C. Provide precast concrete splash blocks at downspout discharge.

D. Provide formed metal splash pans fabricated from same type of sheet metal used for downspouts. Locate where downspout discharges onto lower roof.

E. Downspout Supports: Brackets.

F. Back-paint concealed metal surfaces with bituminous coating to a minimum of 15 mils dry film thickness.

G. Shop Finish, Rain Drainage: Provide manufacturer's standard baked-on acrylic shop finish on sheet metal rain drainage units (gutters, downspouts, and similar exposed units); 1.0-mil dry film thickness.

H. Splash Pads: Precast concrete type, of size and profiles indicated; minimum 3,000 psi at 28 days, with minimum 5 percent air entrainment.

1. Downspout Boots: Steel.

2. Seal metal joints.

I. Splash Pads: Precast concrete type, of size and profiles indicated; minimum 3,000 psi at 28 days, with minimum 5 percent air entrainment.

Part 3 Execution

3.01 Examination

A. Examine substrates and conditions under which products of this section are to be installed and verify that work may properly commence. Do not proceed with the work until unsatisfactory conditions have been fully resolved.

1. Verify that nailers, blocking, and other attachment provisions for sheet metal work are properly located and securely fastened to resist effects of wind and thermal stresses.

3.02 Preparation

A. Deliver the following items to entities performing work, for incorporation into their work:

1. Masonry through-wall flashings: Division 4.

B. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

C. Isolate dissimilar metals by means of a heavy bituminous coating, approved paint coating, adhered polyethylene sheet, or other means approved by the Architect/Engineer.

3.03 Installation

A. General: Comply with sheet metal manufacturer's installation methods and recommendations in the SMACNA "Architectural Sheet Metal Manual."

B. Sealed Joints: Form minimum 1-inch hooked joints and embed flange into sealant or adhesive. Form metal to completely conceal sealant or adhesive.

1. Use joint adhesive for nonmoving joints specified not to be soldered.

2. Moving joints: When ambient temperature is moderate (40-70 degrees F) at time of installation, set joined members for 50 percent movement either way. Adjust setting position of joined members proportionally for temperatures above 70

degrees F. Do not install sealant at temperatures below 40 degrees F. Refer to section on sealants elsewhere in Division 7 for handling and installation requirements for joint sealers.

C. Soldered Joints:

1. Do not solder prefinished galvanized steel sheets.

2. Clean surfaces to be soldered, removing oils and foreign matter.

3. Pretin edges of sheets to be soldered to a width of 1-1/2 inches, except where pretinned surface would show in the finished work.

4. Do not use torches for soldering.

5. Heat surfaces to receive solder and flow solder into joint. Fill joint completely.

6. Completely remove flux and spatter from exposed surfaces.

D. Roof Edge Flashings: Secure metal flashings at roof edges to comply with Factory Mutual Loss Prevention Data 1-49 for Zone 1 wind exposure.

E. Surface-Mounted Reglets: Attach reglets securely to substrate, at locations indicated. Install elastomeric sealant at top edge. Refer to Section on sealants elsewhere in Division 7 for handling and installation requirements for joint sealers.

F. Counterflashings: Coordinate installation of counterflashings with installation of assemblies to be protected by counterflashing. Install counterflashings in reglet or receiver of other sheet metal fabrication. Secure in a waterproof manner by means of snap-in installation and sealant, lead wedges and sealant, interlocking folded seam, or blind rivets and sealant. Lap counterflashing joints a minimum of 2 inches and bed with sealant.

G. Flexible Flashing Installation:

1. Comply with flashing manufacturer's instructions regarding surface preparation, handling, use of adhesives, and use of fasteners.

2. Take care during and after installation to avoid puncture or rupture of flexible flashing.

3. Secure flexible flashing to vertical surfaces using adhesive or combination of adhesive and fasteners.

4. Form continuous watertight seams between pieces of material using seam adhesive as recommended by flashing manufacturer.

5. Install continuous gutter guards on gutters, arranged as hinged units to swing open for cleaning gutters. Install "beehive"-type strainer-guard at conductor heads, removable for cleaning downspouts.

6. Do not stretch flexible flashing sheets tight between points of anchorage. At moving joints or where Drawings indicate slack or loop in flashing, form to approximate profile indicated and adhere foam rubber filler to back of flexible flashing. Anchor edges in a bed of sealant.

3.04 Cleaning and Protection

A. Remove protective film from prefinished sheet metal immediately after installation.

B. Repair or replace work which is damaged or defaced, as directed by the Architect/Engineer.

1. Refinish marred and abraded areas of prefinished sheet using finish manufacturer's recommended methods and materials. Replace units which, in the opinion of the Architect/Engineer cannot satisfactorily be refinished in place.

C. Remove from sheet metal surfaces any debris or substances which will inhibit uniform weathering.

D. Protect sheet metal work as recommended by the installer so that completed work will be clean, secured, and without damage at substantial completion.

END OF SECTION

Part 1 General

1.01 Scope

A. Firestopping materials.

B. Firestopping of all non-metallic pipe penetrations of fire rated assemblies, whether indicated on Drawings or not. See Sheet A-2 for locations of fire rated walls.

1.02 References

A. ASTM E 814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops; 2002.

B. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

1.03 Submittals

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on product characteristics.

1.04 Quality Assurance

Fire Testing: Provide firestopping assemblies of designs which provide the specified fire ratings when tested in accordance with methods indicated.

1.05 Environmental Requirements

A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation. Maintain minimum temperature before, during, and for 3 days after installation of materials.

B. Provide ventilation in areas where solvent-cured materials are being installed.

Part 2 Products

2.01 Firestopping Assemblies

A. Firestopping: Any material meeting requirements.

1. Fire Ratings: Use any system listed by UL or tested in accordance with ASTM E 814 that has F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and that meets all other specified requirements.

2.02 Materials

A. Firestop Devices - Wrap Type: Mechanical device with incombustible filler and sheet stainless steel jacket, collar, and flanged stops, intended to be installed after penetrating item has been installed; conforming to the following:

1. Durability and Longevity: Permanent.

2. Manufacturers:

a. Grace Construction Products: www.na.graceconstruction.com.

b. 3M Fire Protection Products; Product RC-1 Restricting Collar: www.3m.com/firestop.

c. Specified Technologies, Inc: www.stifirestop.com.

d. FPT, Inc; Product 100 WS, 100 WC: www.fpt-flammadur.com.

B. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Type required for tested assembly design.

Part 3 Execution

3.01 Examination

A. Verify openings are ready to receive the work of this Section.

3.01 Preparation

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter which may affect bond of firestopping material.

B. Remove incompatible materials which may affect bond.

3.03 Installation

A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.

B. Do not cover installed firestopping until inspected by authority having jurisdiction.

3.04 Cleaning and Protection

A. Clean adjacent surfaces of firestopping materials.

B. Protect adjacent surfaces from damage by material installation.

END OF SECTION

Part 1 General

1.01 Scope

The work covered by this Section consists of furnishing all labor, equipment and material required to apply all sealants and related work as described herein and/or shown on the Drawings.

1.02 Submittals

Complete engineering and product data shall be submitted to the Engineer in accordance with the requirements of Section 01340 of these Specifications. Color samples shall be submitted for approval by the Owner.

1.03 Storage and Delivery

A. Materials shall be stored in strict conformance with the manufacturer's instructions and in accordance with the requirements of Section 01611 of these Specifications.

B. Materials shall be delivered to the job site in sealed containers, with the manufacturer's original labels attached and accompanied by written certification indicating compliance with the requirements of these Specifications.

1.04 Quality Assurance

The manufacturer shall provide the Engineer with written certification that all products furnished comply with all applicable requirements of these Specifications.

1.05 Warranty

A. Provide a warranty against defective materials and workmanship in accordance with the requirements of Section 01740 of these Specifications.

B. The following types of failures will be considered defective work requiring replacement: leakage, hardening, cracking, crumbling, melting, shrinking or running of caulking compound or staining of adjacent work by caulking compound.

Part 2 Products

2.01 Materials

A. All caulking shall be a two component polysulfide sealant containing 100 percent solids and conforming to ANSI A116.1 and Federal Specification TT-S-00227E, Type II, Class A or B. Sealant shall be "Thiokol Sealant" by the Euclid Chemical Company, "Sikaflex 411/412" by the Sika Chemical Corporation or "Synthacaulk GC-5" as manufactured by Pecora Chemical Corporation. Use Class B for gun Grade and

Class A for pour grade. The caulking shall be nonbleeding and shall not stain any material to which it is applied.

B. Joint backing, where indicated or required, shall be equal to "Tremco Joint Backing" by Tremco Mfg. Company or "Ethafoam SB" backer rod by Dow Chemical Company. Application shall be in accordance with sizes listed below:

Joint Size, inches	Rod Diameter, inches
3/16	1/4
1/4	3/8
3/8	1/2
1/2	5/8
5/8	3/4
3/4	1

C. Color of sealant or caulking shall be as selected by the Engineer.

D. Caulking shall have a minimum life expectancy of 20 years and shall be resistant to the effects of sunlight, abrasion, oils, mild chemicals, cleaning agents and immersion in water.

Part 3 Execution

3.01 Preparation

A. All joints or channels shall be cleaned and free of dirt, oil, grease, moisture, old paint, loose mortar and other foreign matter.

B. Metal surfaces shall be wiped with material equal to Zylol or Mek and then dried.

C. Masonry surfaces shall be cleaned with a wire brush and then blown clean. Any waterproofing treatments contaminating the joint must be completely removed.

D. Where joints are 1/2-inch wide, they should be backed to 1/2-inch of the surface. All 3/4-inch wide joints shall be backed to 1/4-inch of the surface. Size of joint backing shall be large enough so that it can be compressed by at least 30 percent before inserting into the joint.

E. Surface of concrete or masonry shall be primed in accordance with the manufacturer's printed instructions.

3.02 Application

A. The Contractor shall caulk all joints (both inside and outside of jambs, heads and sills) between the metal doors, windows, louvers, etc. and masonry throughout the

buildings, as indicated on the Drawings, or otherwise required, so as to leave the building weathertight.

B. Apply sealant with hand or air gun under sufficient pressure and through nozzle openings of such a diameter so that a full bead of sealant is run into the joint and fills the opening completely.

C. Apply joint backer with a blunt rounded tool in accordance with manufacturer's instructions so it will not stain the sealant.

D. All beads should be tooled immediately after application to insure firm and full contact with the interface of the joint.

E. Work shall be of highest quality and in accordance with the manufacturer's current printed instructions.

3.03 Cleaning

Remove all excess material and smears adjacent to joint as work progresses.

END OF SECTION

Part 1 General

1.01 Scope

The work covered by this Section consists of furnishing all labor, equipment and material required to furnish and install all steel doors, frames and related work as described herein and/or shown on the Drawings.

1.02 Submittals

A. Submit complete shop drawings and engineering data in accordance with the requirements of Section 01340 of these Specifications.

B. Shop drawings shall indicate elevations of each door type, details of each frame type, location in the building for each item, conditions and special details of construction, methods of assembling sections, locations and installation requirements for hardware, size, shape and thickness of materials, joints and connections and finishing system.

1.03 Transportation and Handling

Shipment: For welded type frames, provide temporary steel spreaders fastened across bottom of frames where construction will permit concealment; leave spreaders in place after installation, otherwise remove spreaders after frames are set and anchored. In place of spreaders, frames may be strapped or in packages. Before shipping, label each frame and door with metal or plastic tags to show their location, size, door swing and other pertinent information.

1.04 Storage and Protection

Protect doors and frames from damage during transportation and at the job site. Store doors and frames at the site, under cover, on wood blocking or on suitable floors. After installation, protect doors and frame from damage during subsequent construction activity. Damaged work will be rejected and shall be replaced with new work.

1.05 Quality Assurance

The manufacturer shall provide written certification to the Engineer that all products furnished comply with all applicable requirements of these Specifications.

Part 2 Products

2.01 Materials and Construction

All hollow steel doors and frames shall be the product of a member of the Steel Door Institute. Doors and frames shall conform to the requirements of Steel Door Institute SDI-100 and SDI-112 for Type III extra heavy-duty doors.

2.02 Metal Frames

A. Location and Type: All metal frames for doors, mullions, interior glazed panels and interior louvered panels shall be formed of steel to sizes and shapes indicated. Frames shall be combination type with integral trim and fabricated with full welded unit and shall be the double rabbet design.

B. Type and Gauges of Metal: Metal for frames shall be cold-rolled, steel sheets with clean, smooth surfaces complying with ASTM A 366. Except where other gauges are indicated or specified, frames shall be fabricated from steel, not lighter than 16 gauge. Provide concealed metal reinforcement for hardware as required. The gauges of metal for reinforcement shall be in accordance with the manufacturer's recommendations for the type of hardware, and the thickness and width of doors to be hung in the frame, provided that the gauges used are not lighter than 7 gauge for hinges, 12 gauge for closers and 14 gauge for lock strikes and rod strikes.

C. Workmanship and Design: The finished work shall be strong and rigid, neat in appearance and free from defects. Fabricate moulded members straight and true with corner joints well formed, in true alignment and fastenings concealed where practicable. Where exterior frames are set in masonry, provide a caulking groove 1/4-inch wide by 5/8-inch deep, with a closed back to receive the caulking compound. Metal frames for use in interior exposed masonry partitions shall be trim and neat at masonry to receive caulking compound. Frames shall be manufactured and machined to within ±1/32-inch of required dimensions.

D. Forming Corner Joints: Joints for welded frames shall be mitered, mechanically interlocked, and arc-welded for full width of frame and trim. All contact edges shall be closed tight and all welds on exposed surfaces dressed smooth and flush.

E. All frames shall be of the rigid welded type.

F. Provisions for Hardware: Frames shall be prepared at the factory for the installation of hardware in accordance with the requirements of Section 08710 of these Specifications. Welding of hinges to frames will not be permitted. Frames shall be mortised, reinforced, drilled and trapped to templates to receive all mortised hardware. Frames to receive surface applied hardware shall be provided with reinforcing plates only. Provide cover boxes in back of all hardware cut-outs. Door frames shall be punched to receive rubber or vinyl door silencers. Provide three silencers on lock sides of single doors and two silencers for each leaf in heads of double door frames. Furnish the required number and type of silencers with the frames. Lock strikes shall be set out and adjusted to provide clearance for silencers. All hardware preparation and reinforcement shall be in accordance with Steel Door Institute SDI 107.

G. Mullions and Transom Bars: Mullions and transom bars shall be closed or tubular construction and shall member with heads and jambs and be secured thereto. Use butt welded joints for all construction. Provide adjustable floor anchors and spreader connections at bottom of mullions.

H. Structural Reinforcing Members: Where structural steel members are indicated at mullions, transoms or other locations and are required to be built into the hollow metal frames, the structural steel shapes shall be provided as part of the frame assembly.

I. Wall Anchors: Provide metal anchors of shapes and sizes required for the adjoining type of wall construction. Fabricate jamb anchors of steel, not lighter than the gauge used for frame. Then locate anchors on jambs near the top and bottom of each frame and at intermediate points not over 24-inches apart.

1. For frames set in masonry, provide 10-inch long corrugated or other deformed type adjustable anchors at jambs. Provide mortar guard at lock. Anchors shall be galvanized.

2. For frames set in wood or metal stud partitions, weld or otherwise securely fasten anchors to back of frames at jambs, make provisions for securing anchors to wood studs with No. 12 round head wood screws, or by nailing. Make provisions for securing anchors to steel studs with 1/4 round head machine screws, nuts and washers or by welding.

J. Floor Anchors: Provide floor clips of not less than 16 gauge steel and fasten to bottom of each jamb member for anchoring frame to floor construction. Clips shall be adjustable and drilled for 3/8-inch diameter anchor bolts. Anchors shall be galvanized.

K. Extension Clips: Where floor fill occurs, the bottom of frames shall terminate at the indicated finished floor levels and be supported by an adjustable extension clip angle resting on and anchored to the structural slab.

L. Frame Prime Coat: All surfaces of all frames that will be concealed after the installation shall receive a field application of an approved coat of asphaltic bituminous primer paint.

M. The manufacturer shall use extreme care in preparing the frames for contact with the concrete grout required in the jamb portion of all frames. Frames that rust out or become defective by rusting action shall be removed, new frames installed and refinished, all by the Contractor at no additional cost to the Owner.

N. Grouting: All hollow metal frames set in masonry shall have the head and jambs grouted full.

O. Labeled Frames: Where a UL-labeled fire door is specified or shown, metal frame and anchorage hardware shall be UL listed and labeled. Do not remove label from frame.

P. Frames shall be prime painted at the factory in accordance with 3.02 of this Section.

2.03 Flush Hollow Metal Doors

A. General Requirements: Doors indicated on Drawings as flush hollow metal and including flush hollow metal doors with glazed and/or louvered openings shall comply with the type, or types, or construction as specified. Doors shall be furnished as a package unit complete with frames as specified herein before and prepared to receive the hardware in accordance with the requirements of Section 08710 of these Specifications.

B. Construction: Hollow metal doors shall be of the flush, seamless, extra heavy-duty type for high use, industrial applications. Doors shall be constructed using 16 gauge sheet steel face panels either welded to a reinforced steel core or chemically bonded to a composite core. Core shall be constructed of rigid urethane foam, rigid polystyrene foam, phenolic resin impregnated hexagonal honeycomb, or a metal grid fabricated from 16 gauge steel channels. Doors constructed using metal spacers or a metal grid shall be filled with glass fiber insulation. Top and bottom edges of door shall be formed with continuous, minimum 16 gauge steel channels. Top and bottom edges shall be finished flush and sealed against water penetration. Hinge edge shall be reinforced with a continuous, minimum 14 gauge steel channel built up to additional thickness at hinges. Lock edge shall be reinforced with a continuous 14 gauge steel channel or bar. Internal reinforcement for lock and exit hardware shall be box type, minimum 16 gauge, with reinforcing plates on both sides of door. Internal reinforcement for closers and overhead holders shall be 12 gauge, located on both sides of door. Edge seams formed by face sheets at hinge and lock stiles shall be continuously arc welded top to bottom and ground smooth.

C. Type and Gauges of Metal: Metal for doors shall be cold-rolled sheets with clean smooth surfaces. The gauges of metal shall be as herein specified. Metal shall be phosphate treated prior to painting.

D. Workmanship: The finished work shall be rigid, neat in appearance and free from defects. Form moulded members shall be straight and true, with joints coped or mitered, well formed and in true alignment. All welded joints on exposed surfaces shall be dressed smooth so they are invisible after finishing.

E. Door Sizes and Clearances: Doors shall be of type, sizes and design indicated, 1-3/4-inch thick. The clearances for doors shall be 1/8-inch maximum at jambs and heads, 1/8-inch maximum at meeting stiles of pairs of doors, 3/4-inch maximum at sills without thresholds and 1/4-inch maximum between threshold and door.

F. Stile Edges: The lock edges of stiles shall be rounded for double-acting doors and beveled 1/8-inch in 2-inches for other hollow metal doors. Double beveled and straight edge doors are acceptable, providing they will swing free under all operating conditions. Pairs of hollow metal doors shall have rebated edges at stiles. Pairs of doors, except for pairs of doors with vertical rod panic hardware, shall have a steel astragal attached to the inactive leaf for inswinging doors and attached to the active leaf for outswinging doors.

G. Weatherstripping: Weatherstripping shall be furnished in accordance with the requirements of Section 08735 of these Specifications.

H. Provisions for Hardware: Mortise, reinforce, drill and tap doors at factory to receive all hardware in accordance with the requirements of Section 08710 of these Specifications. Doors shall be field drilled and tapped for surface hardware. Provide metal reinforcing plates for locks and all mortised hardware as required. The gauges of metal for reinforcing plates shall comply with the manufacturer's recommendations for the type of hardware used and the size required by commercial standard. All hardware preparation and reinforcement shall be in accordance with Steel Door Institute SDI 107.

I. Location of Hardware: The location of hardware in connection with hinged and other swing type hollow metal doors and frames shall be in accordance with the manufacturer's current printed specifications.

J. Louvers for Doors: Louvers indicated for interior doors shall be stationary sight-proof type with a minimum of 60 percent of free air area. Make louvers for exterior doors weatherproof. Construct louvers of 18 gauge steel for interior doors and 16 gauge steel for exterior doors. Louvers for exterior doors shall be provided with aluminum insect screen. Louvers shall be of fixed type of standard design and construction as produced by the door manufacturer. Louvers on UL-listed fire doors shall be UL approved, fusible link type designed to automatically lock closed at 135 degrees F.

K. Labeled Doors: Where shown or specified, flush metal doors shall be furnished with UL fire door label. Label shall not be removed from door. UL-labeled doors shall be furnished with UL approved automatic closers and shall be self-latching on closure. All labeled pairs of doors, except pairs of doors with vertical rod panic devices, shall have overlapping, surface mounted, steel astragals.

L. Thermal and Sound Rated Doors: All exterior flush metal doors and doors to unheated garage areas shall have an apparent U factor not to exceed 0.10 Btu/square foot/hour/degree F. Cores of interior doors on equipment rooms containing noisy equipment such as compressors or elevator machinery shall have a sound transmission class rating of not less than STC 34 in accordance with ASTM E 90 and ASTM E 413. Sponge neoprene seals and automatic door bottoms shall comply with the requirements of Section 08735 as applicable.

2.04 Stick Assemblies

A. Stick assemblies shall be fabricated from 16 gauge, cold rolled steel, accurately cut and welded together at the factory into a rigid frame. Frame assembly shall be phosphatized and finished as specified herein for metal frames. Steel glazing heads shall be provided for glazed areas. Mullion sections shall have identical face dimensions and jab depths as open sections. Transom bar and sill sections shall be flush with faces of adjacent vertical members. Section shall be of double rabbet design.

B. Where shown, transom panels shall be hollow metal type panels, 1-3/4-inch in thickness, with 20 gauge steel face sheets. Transom panels shall be bounded on bottom with transom bar. Transom panels shall be finished as specified herein for metal doors and frames.

Part 3 Execution

3.01 Installation

A. Installation of Metal Frames: Set frames in position, plumb, align and brace securely until permanent anchors are set. Anchor bottom of frames to floors with expansion bolts, or with power fasteners. Build wall anchors into walls, or secure to adjoining construction as indicated or specified. Grout frames and transoms full in masonry walls. Where frames require ceiling struts or other structural overhead bracing, they shall be anchored securely to ceilings, or structural framing above. All methods shall be in conformance with the manufacturer's recommendations and Steel Door Institute SDI 105. Metal frames shall be field painted after installation to match door panels.

B. Installation of Metal Doors: Hang doors after frames are securely in place in conformity with the manufacturer's recommendations. Make necessary adjustments after door is installed so that it operates with maximum ease and efficiency. The manufacturer shall provide one pint of each finish color to the field for touch-up of all nicks, mars and other imperfections.

C. Installation of Prefinished Doors: Prefinished doors shall not be hung until all related construction and installation work which could result in damage to door finish is completed. Protective coverings shall remain in place until all other trades have completed their work.

3.02 Surface Preparation and Shop Painting

A. Primed Finish: Apply a primer finish to all ferrous metal surfaces furnished under this Section. Clean and phosphatize metal surfaces to assure maximum paint adherence, follow with a dip or spray coat of rust-inhibitive primer on all exposed surfaces. Primer shall be oven-baked for maximum hardness and durability. Primer shall be capable of passing a 200 hour salt spray test in accordance with ASTM B 117.

B. Factory Finish: After cleaning and application of the prime coat, apply one coat of baked enamel to the primed surface. Finished surfaces shall be smooth and free from irregularities and rough spots. The time and temperature for drying shall be in accordance with manufacturer recommendations for developing maximum hardness and resistance to abrasion. Colors shall be selected by the Engineer from the manufacturer's standard color chart. Painting should be protected with a plastic covering to be removed after installation and when all other trades have completed their work.

C. Finish paint shall be capable of passing a 250 hour salt spray test in accordance with ASTM B 117, a 1,000 hour humidity test in accordance with ASTM D 1735, and a 1,000 hour weather exposure test in accordance with ASTM D 822. Finished paint shall have a dry film thickness of not less than 1.5 mils.

3.03 Cleaning

Upon completion, metal surfaces of doors and frames that are factory finished shall be thoroughly cleaned and touched-up as recommended by the door manufacturer.

END OF SECTION

Part 1 General

1.01 Scope

Provide fiberglass reinforced polyester exterior flush doors in exterior, hollow steel frames at locations shown on the Drawings.

1.02 Design Requirements

A. Provide flush type FRP doors 1-3/4-inches thick.

B. Provide tubular frame members, fabricated in accordance with the manufacturer's standard fabrication methods.

C. Provide insulated openings in doors as indicated, with the manufacturer's standard aluminum moldings and stops with removable stops on the inside. Glazing materials and installation shall be in accordance with Section 08810 of these Specifications.

1.03 System Performance

Provide exterior door assemblies that have been designed and fabricated to comply with requirements for system performance characteristics listed below as demonstrated by the testing manufacturer's corresponding stock systems according to test methods designated: Thermal Transmittance (exterior doors) - U-value of not more than 0.09 BTU/per AAMA 1503.1.

1.04 Submittals

A. Submit manufacturer's specifications, standard details and installation recommendations for components of fiberglass reinforced polyester doors required for the Project, including test reports certifying that products have been tested and comply with performance requirements.

B. Submit shop drawings and engineering data for fabrication and installation of fiberglass reinforced polyester doors, including elevations, detail sections of typical composite members, hardware mounting heights, anchorages, reinforcement, expansion provisions and glazing.

C. Submit 6-inch samples of each type and color of fiberglass reinforced polyester finish and 12-inch long sections of extrusions or formed shapes. Where normal color and texture variations are to be expected, include two or more units in each set of samples showing limits of such variations.

D. Furnish templates, diagrams and other data to fabricators and installer of related work, as needed for coordination of operators, doors, frames, hardware, concrete work, electrical work, air supply, etc.

1.05 Storage and Protection

A. All materials supplied shall be delivered to the site in their original, unopened packages with labels intact. All materials supplied shall be packages in individual corrugated cartons. Doors shall "float" within cartons, with no portion of door in contact with outer shell. Materials shall be inspected for damage and the manufacturer informed of any discrepancies. Unsatisfactory materials shall not be used.

B. All materials shall be stored in accordance with the requirements of Section 01730 of these Specifications.

1.06 Quality Assurance

The manufacturer shall provide the Engineer with written certification that all products furnished comply with all applicable requirements of these Specifications.

Part 2 Products

2.01 Acceptable Manufacturers

A. FRP doors as manufactured by Special-Lite, Inc. of Decatur, Michigan have been used for design standard. The following manufacturers are acceptable, subject to compliance with these Specifications: Tubelite, Vistawall.

B. Take field measurements prior to fabrication to ensure proper fitting of work.

2.02 General Fabrication

A. Complete fabrication, assembly, finishing and other work before shipment to the Project site. Disassemble components only as necessary for shipment and installation. The manufacturer shall provide fasteners for surface mounted door closers.

B. Perform fabrication operations, including cutting, fitting, forming, drilling and grinding of material in a manner which prevents damage to exposed finish surfaces.

C. Complete cutting, fitting, forming, drilling and grinding prior to cleaning, finishing and surface treatment. Remove arises from cut edges and ease edges and corners to a radius of approximately 1/64-inch.

D. Install reinforcing as necessary for high-traffic performance; separate dissimilar metals with bituminous paint or other separator which will prevent corrosion.

E. Maintain accurate relation of planes and angles, with hairline fit of contacting members.

F. Fasteners: Conceal fasteners wherever possible.

2.03 Aluminum Members

A. Alloy and temper recommended by the manufacturer for strength, corrosion resistance and application of required finish shall be in accordance with ASTM B 221 for extrusions, ASTM B 209 for sheet/plate, minimum wall thickness shall be 1/8-inch.

B. Dark bronze anodized aluminum finish shall be AAM12C22A42, (Class 1 anodized), 0.7 mils or greater thickness.

2.04 Fasteners

Fasteners shall be aluminum or other materials warranted by the manufacturer to be non-corrosive and compatible with aluminum components.

2.05 Brackets and Reinforcements

A. Provide non-magnetic stainless steel or hot-dip galvanized steel complying with ASTM A 386.

B. Provide the manufacturer's standard reinforcement for each type of hardware required, not less than 0.125-inch thick.

C. Provide the manufacturer's recommended fasteners reinforcement.

2.06 Core Material

High density foam of five pounds per cubic foot of density. Core shall not contain any chlorofluorocarbons (CFSs) nor shall CFCs be used in the core foaming process.

2.07 Face Material

A. General: FRP, 0.120-inch minimum thickness, with pebble- like embossed finish. Color of both sides of the doors shall be "dark brown".

B. Impact Strength of Face Sheets: ASTM D 1242, Izod Impact Strength, 13.5 foot-pounds per inch of notch.

C. Abrasion Resistance of Face Sheets: ASTM D 1242, 1,000 cycles of Model 503 Taber Abraser with a 1,000 gram load, not to exceed 0.23 percent of weight loss.

D. Hardness of Face Sheets: ASTM D 2583, Barcol Meter Hardness Test, not more than 50.

E. Humidity Resistance of Face Sheets: ASTM D 570, water absorption not greater than 0.40 percent after 24 hour immersion.

2.08 Hardware

A. All hardware shall conform to the requirements of Section 08710 of these Specifications.

B. Hardware shall be installed by the door manufacturer.

2.09 Door Weatherstripping

The manufacturer shall install "brush" type weatherstripping insert into tubular rails and stiles. Weatherstripping shall be mounted to the bottom rail of all doors, to the meeting stile of double doors, and to the top rails of doors located directly under other doors.

2.10 Door Grilles

Door grilles shall be fabricated from extrusions of 6063T5 aluminum alloy with Class 1 dark bronze anodized finish and integral, bronze-colored insect screen. Grilles shall seal weathertight to the door without exposed sealant and shall be designed to prevent blowing rain passing through the grille. Grilles shall be of a size as shown on the Door Schedule, have a minimum of 33 percent free area, and include only stainless steel fasteners.

2.11 Door Frames

Door frames shall be one-piece tubular extrusions of 6063T5 aluminum alloy with a minimum 1/8-inch wall thickness and a 2-inch x 6-inch overall dimension. Joints shall be reinforced with internal anchors to physically interlock frame members. Frames shall be internally reinforced at hardware attachment points and shall be mortised, reinforced, drilled and tapped to receive all mortised hardware. Frames shall have a dark bronze anodized finish. Door frames shall have thick pile weatherstripping at both jambs and head.

Part 3 Execution

3.01 Installation

A. Inspect all surfaces to receive work. Notify the Engineer in writing of conditions detrimental to the proper and timely completion of the work. Commencement of work shall signify acceptance of conditions and subsequent adjustments shall be the responsibility of the Contractor.

B. Install doors and frames complete with necessary hardware, jamb and head mold stops and anchors in accordance with the shop drawings, manufacturer's instructions, and as specified herein.

C. Doors shall be installed with proper clearances and shall operate smoothly and easily.

3.02 Field Painting

Field painting shall be in accordance with the requirements of Section 09900 of these Specifications.

3.03 Inspection and Testing

Following installation, doors will be inspected and tested for proper installation and function. The Contractor shall make, at the Contractor's own expense, all necessary changes, modifications, and/or adjustments required to ensure a satisfactory installation.

3.04 Cleaning

A. Upon completion of installation, leave areas of work in a neat, clean condition. Remove all debris caused by work of this Section from the premises.

B. Upon completion of installation, including work by other trades, lubricate, test, and adjust doors to operate easily, free from warp, twist or distortion and fitting weathertight for the entire perimeter.

END OF SECTION

Part 1 General

1.01 Scope

The work covered by this Section consists of furnishing all labor, equipment and material required to fabricate and install all aluminum windows, including screens, hardware and related work, as described herein and/or shown on the Drawings.

1.02 Submittals

A. Shop drawings and engineering data shall be submitted in accordance with the requirements of Section 01340 of these Specifications.

B. Shop drawings shall indicate elevations of windows, full size sections, thickness, fastenings, proposed method of anchoring, the size and spacing of anchors, details of construction, method of glazing, mullion details, method and materials for weatherstripping and details of installation.

C. Where metal sub-frames, stools, castings, sills, trim, window cleaners, bolts and other related items are required, shop drawings shall show the assemblage and connections of windows and adjacent work.

1.03 Storage and Protection

Protection and care shall be used in handling windows during transportation and at the job site. Store windows upright on pieces of lumber in a dry location and under cover. After installation, protect windows from damage during subsequent construction activities.

1.04 General Requirements for Windows

A. Sizes and Combinations: Furnish windows of sizes and combinations indicated, and locate fixed sections as detailed. The standard commercial tolerances for overall sizes and for thickness of metal as defined in AAMA Specifications shall apply where applicable.

B. Construction and Workmanship: Construct windows to produce results specified and to assure neat appearance. Make permanent joints by welding, or by mechanical fastenings. Joints shall be of strength to maintain the structural value of members connected. Welded joints shall be solid, have excess metal removed, and dressed smooth on exposed and contact surfaces. The dressing shall be done so that no discoloration or roughness will show after finishing. When welding flux is used, it shall be completely removed immediately after the welding is completed. Joints formed with mechanical fastenings shall be closely fitted, sealed with mastic and made permanently watertight. Except as designated otherwise, frames and sash shall be assembled at the plant and shipped as a unit with hardware unattached.

C. Accessories: Furnish all necessary hardware, fastenings, clips, fins, anchors and other appurtenances necessary for complete installation of windows. Except as specified otherwise, anchors and fastenings shall be aluminum or non-magnetic stainless steel.

D. Hardware: The items, type and function of hardware required shall be as specified under each individual window type. Hardware shall be of suitable design and have sufficient strength to perform the function for which it is used. It shall be attached securely to the windows with non-corrosive bolts or self-tapping screws.

E. Provisions for Glazing: Sash shall be designed for securing glass with beads or glazing clips and glazing compound as indicated or specified for each basic window type. Where insulating glass is specified, rabbets shall be of adequate depth to receive the glass and glazing accessories. Where vinyl, neoprene or synthetic rubber gaskets are used in connection with glazing beads, the color of gaskets shall be black. Glazing beads shall be of the extruded snap-in type and shall have no exposed screws. Glazing legs shall be minimum 0.75-inch in length.

F. Performance: Unless otherwise specified or required by AAMA Specifications, windows shall meet the following performance criteria:

1. Air Infiltration: Air infiltration shall not exceed 0.15 cfm per liner foot of operating sash perimeter at a pressure differential of 6.24 psf in accordance with ASTM E 283.

2. Water Infiltration: Water infiltration shall be zero at a pressure differential of 6.24 psf in accordance with ASTM E 331.

3. Deflection: Deflection under design load shall not exceed L/175 of unsupported span in accordance with ASTM E 330. No permanent deformation shall occur.

1.05 Quality Assurance

A. All aluminum windows shall conform with Specification C-A3-HP, VP-A3-HP, P-A3 HP, DH-A3-HP, or TH-A3, as applicable, in ANSI A134.1 (AAMA 302.8). All aluminum windows shall be labeled with the AAMA "QUALITY CERTIFIED" label and shall be of the sizes and types shown on the Drawings. The window manufacturer shall submit to the Engineer, through the Contractor, copies of certified test reports demonstrating compliance with the above referenced standards.

B. If requested by the Engineer, the Contractor shall submit samples of extruded frame, sash and trim members and hardware used in fabricating windows and screens.

1.06 Warranty

Warrant windows against failure of materials or workmanship to include excessive leakage or air infiltration, excessive deflections, faulty operation of sash, deterioration of finish or metal in excess of normal weathering, and defects in hardware and weatherstripping.

Part 2 Products

2.01 Acceptable Manufacturers

Aluminum windows shall be manufactured by Kawneer Company, Inc., Disco Aluminum Products, Winco Ventilator Company or Ware Aluminum Windows.

2.02 Materials and Construction

A. All windows shall be of the types and sizes shown on the Drawings and shall be constructed of extruded aluminum sections. All windows shall be of monumental construction with minimum 2-inch deep sections.

B. All principal window members, including muntins, shall be of Alloy 6063-T5, having a tensile strength of not less than 22,000 psi. Sections shall not be less than 0.062-inch thick, true to details and with clean, well defined profiles.

C. The corners of the window frames shall be coped, double mortise and tenon construction providing rigid and secure connection. All mechanically connected joints shall be factory sealed using a non-hardening elastomeric compound conforming with AAMA 803.2.

D. The alloys for aluminum and the construction of windows and accessories shall be in accordance with the current published specifications of the manufacturer for the type, model or series specified, and with modifications and other specific requirements as described herein.

E. All screws, nuts, washers, bolts, rivets and other miscellaneous fastening devices incorporated in the product shall be of aluminum or nonmagnetic stainless steel and shall be of sufficient strength to perform the functions for which they are used. Fasteners which are concealed when the window is installed and closed may be of magnetic stainless steel having a chromium content of not less than 16 percent.

F. Hardware having exposed component parts shall be of aluminum, bronze, or nonmagnetic stainless steel and shall be of sufficient strength to perform the functions for which it is used. All locking hardware shall be white bronze with U.S. 25-D as standard finish. Hardware shall be applied to sash members by means of screws and/or stainless steel inserts. Stainless steel inserts shall be used where hardware applies a reverse pressure. Projected and drop-head in-swing windows shall be provided with 4-bar stainless steel Anderberg hinges. Exposed counter-

balancing-mechanism housings, roto-operator arms and guide-follower hardware may be of cadmium- or zinc-plated steel in accordance with ASTM B 633 or B 766. Nickel- or chrome-plated steel, where used, shall be in accordance with ASTM B 456, Type KS.

G. The entire periphery of all operating ventilators shall be continuously weatherstripped. Weatherstrip shall be of resilient material compatible with aluminum and resistant to weathering. Flexible vinyl weatherstrip, where used, shall be equal to Commercial Standard CS 230-60. Weatherstripping shall effect a minimum air infiltration as required by AAMA. Weatherstripping shall engage so as not to require locking to pass air infiltration tests. Weatherstripping shall be replaceable without removing ventilator from frame.

H. Anchoring devices used in the erection of windows shall be of aluminum, nonmagnetic stainless steel or other noncorrosive material compatible with aluminum.

I. Unless otherwise shown or specified, all aluminum windows shall have a 0.4 mil, clear, anodized finish conforming to AA-M10C22A31 (Alcoa 204R1). Where dark bronze or black anodizing is specified, windows shall be etched and coated with a 0.7-mil, integral color anodized finish conforming to AA-M10C22A42.

2.02 Protective Coating

Where aluminum windows contact dissimilar metals, concrete, or masonry, the contacting surfaces shall be given two heavy coats of alkali-resistant bituminous paint conforming to Federal Specification TT-C-494.

Part 3 Execution

3.01 Installation of Windows

A. General: Windows shall be installed and adjusted by experienced and qualified window erectors and using only skilled window mechanics. Aluminum windows shall be installed, without forcing, into prepared openings, in accordance with the shop or setting Drawings. Set windows at the proper elevation and location, plumb, level and in alignment; properly brace frames to prevent distortion and misalignment. Protect aluminum from dissimilar materials as hereinbefore specified. Lubricate hinges and hardware for smooth and quiet operation.

B. Sealant: The entire perimeter of the windows shall be caulked with a sealant conforming to AAMA 808.1 and in conformance with the requirements of Section 07900 of these Specifications. Remove excess sealant before it hardens.

C. Anchors and Fastenings: Anchor window units to masonry, or to other adjoining or adjacent construction as shown on details and approved shop drawings. Where windows are set in prepared masonry openings, place the necessary anchorage during progress of wall construction. Anchors and fastening shall be built into, anchored or bolted to the jambs of openings and shall be fastened securely to the windows or frames, and to the adjoining construction. Unless otherwise detailed,

anchors shall be spaced not more than 18-inches apart on heads, jambs and sills. All anchors shall have sufficient strength to hold the member firmly in position.

D. Glazing: Glazing shall be performed in accordance with the requirements of Section 08810 of these Specifications. The glazing contractor shall furnish an approved glazing compound for glazing aluminum windows. The glazing compound shall have a composition particularly adapted for use with aluminum windows and shall not require painting to protect it from drying out or deterioration. The glazing contractor shall remove from the glazing surfaces of the sash any materials to which the glazing compound will not readily adhere.

3.02 Cleaning

Metal surfaces of windows shall be cleaned on both the inside and outside of all mortar, plaster, paint and other foreign matter to present a neat appearance and prevent fouling of weathering surfaces, weatherstripping or the operation of hardware. In addition, windows shall be washed off with a stiff fiber brush, soap and water and thoroughly rinsed with clear water. Where aluminum windows have become stained or discolored, they shall be cleaned or have finish restored in accordance with recommendations of the Architectural Aluminum Manufacturer's Association. Stained, discolored or abraded windows that cannot be satisfactorily repaired shall be replaced with new windows, at no additional cost to the Owner.

END OF SECTION

Part 1 General

1.01 Scope

The work covered by this Section consists of furnishing all labor, equipment and material required to construct and install all finishing hardware and related work as described herein and/or shown on the Drawings.

1.02 Qualifications

The hardware supplier must be an established firm dealing in contract finishing builder's hardware, with a sample room and adequate inventory. This supplier must be prepared to provide a competent representative to service hardware on the jobs as may be required. This hardware supplier shall be a regular franchised distributor for all hardware, materials and equipment required in this Section.

1.03 Submittals

A. Shop drawings and engineering data submittals shall be made in accordance with the requirements of Section 01340 of these Specifications. A complete schedule of each item of hardware required for each door or item of equipment shall be submitted. List hardware item number, manufacturer, manufacturer's number or symbol and finish.

B. Submit complete manufacturing data as follows:

1. Specifications and installation data on door hardware of all types.

2. With shop drawings, a brochure showing and describing each type of hardware that is being supplied to the Project.

C. Templates: Supply all necessary templates and template information to door and frame manufacturers in ample time to prevent delay to progress of Project.

1.04 Storage and Protection

A. Provide adequate locked storage space for hardware before distribution and installation.

B. Properly tag, index and file all keys as directed prior to turning over to Owner.

C. Hardware shall be checked after delivery to the Project by the hardware supplier before it is installed.

D. Package each item of hardware and each lock set separately in individual containers, complete with necessary screws, keys, instructions and installation template for spotting mortising tools. Match each container with item number corresponding to number shown on the Contractor's hardware schedule.

1.05 Quality Assurance

The manufacturer shall provide written certification to the Engineer that all products furnished comply with all applicable requirements of these Specifications.

Part 2 Products

2.01 Acceptable Manufacturers

A. The hardware manufacturer shall be an experienced, reputable firm with a full line of door hardware.

B. Mortise locksets shall be UL listed and shall be Sargeant "7800 Line", Yale "Series 8000" or Schlage L9000 "Series 064".

C. Cylindrical locksets shall be Sargeant "7-Line" or Yale "Series 5400".

D. Exit devices on doors with mullions shall be Sargeant "9863 Series" or Yale "Series 1500/2540".

E. Exit devices on doors without mullions shall be Sargeant "9728 Series" or Yale "Series 1520/2520".

F. Butt hinges shall be manufactured by Hager, Stanley, Yale or Lawrence Brothers.

G. Door closers shall be LCN 4010 Series, Sargeant 150 Series or Yale 3500 Series.

H. Combination door closer/door holder releases shall be Yale "4800 Series" or Norton "Series 7800".

2.02 Materials and Construction

A. Keys and Keying: All locksets shall be masterkeyed to all existing locksets with the master key. Five master keys shall be provided to the Owner, with five copies of each key required for the work.

B. Construction Keying: Furnish all locks and cylinders construction keyed. Furnish Contractor with six construction master keys. At completion of job, the insertion of permanent key shall void the construction master key.

C. Mortise Locksets: Unless otherwise shown or specified, mortise locksets shall be heavy duty, mortise type conforming to Federal Specification FF-H-106, Type 86 and ANSI A156.2, Series 1000, Grade 1. Lockset shall have spherical knobs, escutcheon, 2-piece, 5/8-inch throw antifriction latch bolt, 1-inch throw deadbolt, 6-pin brass tumbler lock mechanism, and curved lip strike conforming to ANSI A115.1. Lockset shall be UL listed.

D. Cylindrical Locksets: Unless otherwise shown or specified, cylindrical locksets shall be heavy duty, bored cylindrical type conforming to Federal Specification FF-H-106, Type 161 and ANSI A156.2, Series 4000, Grade 1. Lockset shall have spherical knobs with recessed opening for key and/or turn mechanism, standard backset, and curved lip strike conforming to ANSI A115.3. Lockset shall be UL listed.

E. Panic and Fire Exit Devices: Where shown or specified, UL labeled panic and/or fire exit devices shall be furnished. Panic and fire exit devices on single doors and on pairs of doors with mullions shall be heavy duty, mortise type with 6-pin tumbler locking mechanism, 1-inch diameter crossbar, bar lockdown device, pull-side handle with thumbpiece and escutcheon. Bar lockdown device shall be allen key operated and shall retract latch bolt when in the locked position. Exit devices shall be UL listed.

1. Panic and fire exit devices on pairs of doors without mullions shall be heavy duty, concealed, vertical rod type. Exit device shall have 1-inch diameter crossbar, bar lockdown device, pull-side handle with thumbpiece and escutcheon. Bar lockdown device shall be allen key operated and shall retract vertical rod bolts when in the locked position. Exit device shall be UL listed.

2. Fire-rated pairs of doors with vertical rod exit devices on both leaves shall not have astragals.

F. Butt Hinges: Unless otherwise specified, doors 60-inches high and not over 90-inches high shall receive three full mortise butt hinges. Doors over 90-inches and not over 120-inches high shall receive four full mortise butt hinges. Hinges shall be of the stainless steel, 2 race ball bearing type. Out-swinging exterior doors shall have nonremovable pins. Minimum gauge of all hinges shall be 0.134-inch, unless indicated otherwise, with minimum size of 4-1/2-inches by 4-1/2-inches. Hinges shall be of a type and size to allow for proper door swing and clearance.

G. Door Closers: Automatic door closers shall have full rack and pinion construction with heat treated steel rack and pinion and cast iron or bronze hydraulic case. Close shall have separate valves for adjustment of latching speed and closing speed, 50 percent closing power spring adjustment, separate valve for adjustment of backcheck cushioning and tamperproof, rectangular, full metal cover. Backcheck shall be effective at approximately 70 degrees for both regular and parallel arm applications. Closers shall be surface mounted and through bolted on the door and, whenever possible, shall be mounted on the room or interior side. Closers with parallel arms on exterior doors shall be the next larger size than normally used with the door. Closers on exterior doors, cross-corridor doors and stairwell doors shall have hold-open devices adjustable from 85 through 180 degrees. All door closers shall be furnished with a five year warranty from the manufacturer. Closers shall have finish to match other door hardware. Door closers shall be UL listed.

H. Combination Door Closer/Door Holder-Release: All fire-rated exterior doors, cross-corridor doors and stairwell doors shall be equipped with a combination door closer and door closer-release device. The closer/holder shall be a UL approved, electromechanical device designed to automatically release the door from a hold-open position and close it in the event of a fire. The device shall feature a

solenoid-operated plunger valve to seal the hydraulic diameter and hold the door and a ball-check valve to allow the door to open. The closer/holder shall have a built-in, ionization-type smoke detector mechanism to trip the release mechanism and cause the door to close. On pairs of doors, only one of the closer/holder devices shall be equipped with a smoke detector, but both doors shall be released simultaneously by the action of the single detector. In the event of a power failure, the doors shall be released and the closer shall function as a standard automatic, hydraulic door closer. The release mechanism shall be automatically reset when power is restored or when the products of combustion have cleared. The closer/holder shall be capable of holding the door at any desired angle between 85 and 145 degrees and shall be top-jamb mounted on the stop side of the door. The closer/holder shall operate on 120 volt, 60 Hz, single phase power with concealed wiring.

I. Latch Bolts: On pairs of doors without panic or fire exit devices, the active leaf shall have lockset and automatic door closer as specified herein. The inactive leaf shall have independent, manually operated, stile-mounted latch bolts at top and bottom. No lockset or closer hardware shall be provided on the inactive leaf with latch bolts. Latch bolts shall be of the flush-mounted, lever arm type and shall have US 26D or US 32D satin finish. Door leaves shall be furnished with an overlapping steel astragal attached to the inactive leaf for in-swinging doors and attached to the active leaf for out-swinging doors.

J. Stops: Doors shall be equipped with door bumpers or door stops where specified or required to protect wall surfaces. Whenever possible, a wall-type door bumper shall be used in lieu of a floor stop. All wall bumpers shall be the concave type and of cast material with concealed screws. Floor stops shall be of cast material. All bumpers, stops and holders shall have proper type mounting and anchoring devices. Door stops and bumpers shall have US 26D or US 32D satin finish.

K. Kickplates: Where specified, doors shall be furnished with stainless steel kickplates. One kickplate shall be furnished per leaf unless otherwise specified. Kickplates shall be approximately 10-inches high and shall have a width equal to the door width less 3-inches. Finish shall be US 3D. Kickplate shall be located on the stop side of the door.

L. Pullplates: Pullplates shall be 3-1/2 x 15-inches in size with square corners and 8-inch flat bar pull. Plate material shall have a minimum thickness of 0.094-inch. Pullplate shall have the word "PULL" engraved at the top in 7/8-inch high, upper case letters. Letters shall be filled with black enamel. Plates shall include stainless steel oval head screws for installation.

M. Pushplates: Pushplates shall be 3-1/2 x 15-inches in size with square corners. Plate material shall have a minimum thickness of 0.094-inch. Pushplate shall have the word "PUSH" engraved at the top in 7/8-inch-high, upper case letters. Letters shall be filled with black enamel. Plates shall include stainless steel oval head screws for installation.

N. Lockset Function: Unless otherwise shown or specified, lockset function shall be as follows:

1. Entrance Doors: Latch bolt by both knobs; from outside by key. Outside knob locked or unlocked from inside by turn button on cylindrical locks (Fed. 161A, ANSI F81) and from door stile by pushbuttons on mortise locks (Fed. 86A, ANSI F08). Dead bolt on mortise locks from outside by key or inside by turn lever.

2. Closet, Passage, Lunchroom and Public Restroom Doors: Latch bolt by both knobs on cylindrical locks (Fed. 161N, ANSI F75) and mortise locks (Fed. 86N, ANSI F01).

O. Weatherstripping: All exterior doors shall be weatherstripped. Weatherstripping shall be in accordance with the requirements of Section 08735 of these Specifications.

P. Thresholds: Thresholds shall be furnished under Section 08735 of these Specifications.

Q. Finish: All hardware shall receive finish as specified herein or selected by the Engineer. In general and unless otherwise shown or specified, all butt hinges, locksets, panic devices and flatware shall be stainless steel with US 32D finish. Cast items, such as stops, bumpers, flush bolts, etc., shall have US 26D dull chrome finish. Those items not available in US 32D or US 26D finish shall be aluminum or anodized aluminum.

2.02 Hardware Schedule

The schedule of finish hardware to be installed on doors shall be as shown on the Drawings.

Part 3 Execution

3.01 Location

A. Before installation of any hardware, verify the positioning of each type of assembly. This will include the exact location of each element of hardware.

B. Distances from the floor to centerline of each hardware item shall be as recommended by the hardware supplier.

3.02 Installation

A. Install hardware such that it is accurately fitted, securely applied and carefully adjusted in accordance with manufacturer's instructions. Use care not to injure other work when installing.

B. When required, remove and replace doors so that door bottoms and tops may be painted.

C. Remove all visible hardware before painting is begun and replace afterwards, prior to completion of building.

D. The Contractor shall protect all hardware during construction work and replace defective units.

3.03 Cleaning

All materials shall be free from sand holes and other imperfections. Finish shall be as noted above. Protect all hardware during construction work and replace defective units. Clean and polish with clean cloth and leave in good operating condition.

END OF SECTION

Part 1 General

1.01 Scope

The work covered by this Section includes furnishing and installing thresholds and weatherstripping for all doors furnished under these Specifications as shown on the Drawings or required for a complete installation.

1.02 Coordination

The Contractor shall coordinate the work under this Section with work under the Section 08110 of these Specifications.

1.03 Submittals

A. Submit complete shop drawings and engineering data in accordance with the requirements of Section 01340 of these Specifications.

B. Submit samples (3-inch minimum length) of all resilient weatherstripping materials.

1.04 Storage and Protection

Weatherstripping and thresholds shall be stored and protected in accordance with the requirements of Section 01611 of these Specifications.

1.05 Quality Assurance

The manufacturer shall provide written certification to the Engineer that all products furnished comply with all applicable requirements of these Specifications.

Part 2 Products

2.01 Thresholds

A. Unless otherwise specified or shown, thresholds shall be of the flat saddle type with serrated surface approximately 1/2-inch in height and 4-inches in width.

B. Panic thresholds, for doors with vertical rod panic devices, shall be approximately 5/8-inch in height and 5-inches in width.

C. Thresholds for clear anodized aluminum doors or doors with stainless steel or chrome plated finished hardware shall be of extruded aluminum alloy 6063-T5 with natural mill finish.

D. Thresholds for bronze anodized aluminum doors or doors with brass or bronze finish hardware shall be of extruded architectural bronze of a type which oxidizes to a rich, dark bronze color.

E. All necessary screws and fasteners shall be furnished. Fasteners for aluminum thresholds shall be stainless steel. Fasteners for bronze thresholds shall be brass.

2.02 Weatherstripping

A. All exterior hollow metal [and flush wood] doors shall be weatherstripped as specified herein.

B. Weatherstripping at lock-side jamb, hinge-side jamb and head shall be 3/16 x 1-inch closed cell neoprene held in place on the frame by an extruded aluminum housing having a minimum thickness of 0.094-inch and a clear, anodized finish. Housing shall be furnished with a simulated bronze finish on doors with brass finish hardware. Weatherstripping shall be equal to Reese No. D578, Zero No. 139 or National Guard No. 130NS.

C. For all exterior pairs of doors without a fixed astragal, weatherstripping shall be provided to seal the gap between the doors when they are closed. The weatherstripping shall be 1/8 x 7/8-inch neoprene held in place on the door by an extruded aluminum housing, having a minimum thickness of 0.094-inch and a clear anodized finish. Housing shall be furnished with simulated bronze finish on doors with brass finish hardware. Astragal weatherstripping shall be equal to Reese No. 103 series or National Guard No. 115 series.

D. Unless otherwise shown, sill weatherstripping shall be provided by a heavy duty, automatic door bottom incorporating an extruded aluminum housing and a retracting, closed cell, neoprene plunger as the weather seal. Plunger shall close automatically with delayed action after the door closes and shall retract immediately when the door opens. Door bottom shall be adjustable and shall have full mortised construction. Door bottom shall be reversible to accommodate either right or left hinged door. Automatic door bottoms shall be equal to Reese No. 372 or National Guard No. 320N.

E. Aluminum extrusions shall be of aluminum alloy 6063-T5, anodized as specified above.

F. Closed cell neoprene shall be closed cell, neoprene, sponge rubber conforming to Military Specification R6130, Type II, Grade C.

G. All fasteners necessary for proper installation shall be provided and shall be brass or stainless steel.

Part 3 Execution

3.01 Installation

A. Surfaces to receive work in this Section shall be smooth, even, sound, thoroughly clean, dry and free of defects which would adversely affect application of this work. Surfaces which do not meet the tolerances or quality imposed within the Specifications, shall be repaired or replaced prior to initiating this work.

B. Install in strict accordance with shop drawings and the manufacturer's printed instructions.

C. Adjust automatic door bottoms for proper operation.

D. Protect all work of this Section until all related work is completed. Repair or replace damaged work at no additional cost to the Owner.

END OF SECTION

Part 1 General

1.01 Scope

The work covered by this Section consists of furnishing all labor, equipment and material required to fabricate and install all glass and glazing and related work as described herein and/or shown on the Drawings.

1.02 Submittals

A. Manufacturer's Labels: Labels showing glass manufacturer's identity, type of glass, thickness and quality, will be required on each piece of glass. Labels must remain on glass until it has been set and inspected. When glass is not cut to size by the manufacturer and is furnished unlabeled as "stock to cut", the Contractor shall submit an affidavit, or other satisfactory written evidence such as certified laboratory or mill test reports stating the quality, thickness, type and manufacturer of the glass furnished.

B. The Contractor shall submit engineering and product data on all glazing compounds and materials. If dry glazing systems are to be used and if requested by the Engineer, the Contractor shall submit samples of glazing system.

C. Prior to the installation of any glass or glazing, the Contractor shall submit a detailed schedule identifying the type and texture of all glass units added in this Contract. The schedule shall include the following product information: manufacturer, type (as described under Part 2 of this Section), thickness and size of the glass unit and color of gasket or glazing compound.

1.03 Sizes, Delivery and Storage

A. Sizes: The sizes of glass indicated on Drawings are approximate only. Determine the actual sizes required by measuring frames to receive the glass at the Project site, or from guaranteed dimensions provided by the frame supplier. No attempt shall be made to change the size of heat strengthened tempered glass after they leave the factory. All heat absorbing glass must be clean cut. Nipping to remove flares or to reduce oversized dimensions of any type of glass shall not be permitted.

B. Delivery: Deliver glass to site in suitable containers that will protect glass from the weather and from breakage.

Deliver sufficient glass to allow for normal breakage. All putty and glazing compounds shall arrive at the Project site in labeled containers which have not been opened.

C. Storage: Store glass away from construction operations in a protected place. Store glass on edge at a 5 to 7 degree angle from vertical and lean against sturdy uprights. Cushion top and bottom edges with felt and separate panels with protective paper.

1.04 Quality Assurance

The manufacturer shall provide written certification to the Engineer that all products furnished comply with all applicable requirements of these Specifications.

1.05 Warranty

Provide a warranty against defective materials and workmanship in accordance with the requirements of Section 01740 of these Specifications, with the only exception that certain products described within this Section require warranties exceeding one year.

Part 2 Products

2.01 Acceptable Manufacturers

All types of glass shall be equal to those manufactured by Pittsburg Plate Glass Company, Libby-Owens-Ford Glass Company or Mississippi Glass Company.

2.02 Clear Glass

Clear glass for windows shall be glazing quality, clear architectural float glass conforming to the requirements of Federal Specification DD-G-451d. Clear glass shall have a thickness of 1/4-inch and a daylight transmittance of not less than 88 percent. Unless noted otherwise on the Drawings, all glass shall be "clear glass" as specified below.

2.03 Tinted Glass

Tinted glass for windows shall be glazing quality, bronze or gray tinted, architectural float glass conforming to the requirements of Federal Specification DD-G-451d. Tinted glass shall have a thickness of 1/4-inch and a daylight transmittance of 41-42 percent for gray and 51-52 percent for bronze. Color of tint shall be as shown on the Drawings or selected by the Engineer.

2.04 Tempered Safety Glass

Tempered glass shall be tempered, clear float safety glass conforming to ASTM C 1048, ANSI 297.1, Consumer Products Safety Council 16 CFR 1201, and the Safety Glazing Certification Council. Tempered glass shall be made by heating and quickly cooling annealed glass so that the resulting glass has a strength 4 to 5 times that of regular annealed glass. Upon breaking, tempered glass shall fracture into many fine, pebble-like particles. Unless otherwise shown on the Drawings, tempered glass shall have a thickness of 1/4-inch.

2.05 Laminated Safety Glass

Laminated safety glass shall be clear, laminated safety glass conforming to ANSI 297.1 and Consumer Products Safety Council 16 CFR 1201. Glass shall be clear, float glass conforming to Federal Specification DD-G-451d. Laminated safety glass shall be 5/16-inch thick and shall be UL listed as a burglary-resisting glazing material.

2.06 Wire Glass

Wire glass shall be 1/4-inch thick, polished, clear glass conforming to Federal Specification DD-G-451d and ANSI 297.1. Glass shall be reinforced with diamond pattern, minimum 0.020-inch diameter, welded wire mesh. Long dimension of diamond shall be vertical. Wire glass shall be UL listed for use in fire rated and labeled doors and interior partitions. Available wire pattern styles shall be submitted to Engineer for selection. Edges of wire glass shall be sealed with sealant prior to installation.

2.08 Insulating Glass Units

Insulating glass units shall consist of two glass panels separated by a 1/2-inch air space. Glass panels shall be 1/4-inch thick, clear, tempered safety glass conforming to 2.04 of this Section. Panels shall be separated by a corrosion resistant, tubular metal spacer containing a special desiccant to provide an original air space dewpoint of -60 degrees F and to provide a moisture-free air space for the unit's warranty period. Units shall be hermetically sealed with a two-component, vulcanized structural sealant. Insulating glass units shall carry a minimum 10 year warranty against failure of the air space seal.

2.09 Glazing

A. In general, glazing practices and materials shall conform to glazing manuals published by the Flat Glass Manufacturers Association and the Sealed Insulating Glass Manufacturers Association, as appropriate, and the standards of the Architectural Aluminum Manufacturers Association.

B. Glazing Materials: Adequate provision shall be made for use of glazing compound if applicable. The glazing material shall be particularly adapted for use with the frame material and shall not require painting. Any material to which the glazing compound will not readily adhere shall be removed from the glazing surfaces by the glazing contractor. Windows may be either factory or field glazed by one of the following methods:

1. Glazing Beads: Glazing beads or retainers of any material compatible with the frame material may be used and, if required to retain the glass, shall be of sufficient strength and fixation to serve this purpose. Thickness of glazing beads is optional except as otherwise specified in a particular product specification. Rigid vinyl glazing beads, where used, shall conform to AAMA Specification PS 26-70. Neoprene glazing beads are also acceptable.

2. Channel-Type Gaskets: Gaskets shall be of material compatible with aluminum, be resistant to weathering and maintain a watertight seal between the glass and its surrounding frame. Flexible vinyl, where used, shall be equal to Commercial Standard CS 230-60. Neoprene gaskets are acceptable.

3. Glazing Compound: Glass may be back bedded and face puttied with a glazing compound meeting Federal Specification TT-G-401E. There shall be sufficient bedding compound to prevent glass-to-frame contact. Glazing clips shall be used to secure the glass in the frame before face puttying. Compound used for glazing in aluminum or stainless steel frames shall be nonhardening and noncorrosive, colored to harmonize with the frames. It shall be of type and composition that will not require any paint or other coating to protect it.

Part 3 Execution

3.01 Installation

A. All glass units shall be installed with approved glazing to match the adjacent materials and shall be cut and set accurately to assure a solid uniform tight setting to eliminate all rattling and movement of the glass. Installation shall be in conformance with the manufacturer's printed recommendations and instructions.

B. All glass shall be accurately cut to fit openings. The size of the glass unit shall be in accordance with the recommendations of the manufacturer of the window or door in which the glass is set.

C. Glass shall be set on two neoprene setting blocks placed at the exterior quarter points or between greater points and at least 6-inches from corners of the glass panel. Setting blocks shall be at least 2-inches long and 1/8-inch wider than the glass material. Neoprene material shall have 70-90 Shore Durometer hardness.

D. In dry glazing systems, soft (30-50 Shore Durometer) neoprene spacer strips shall be used at jambs and heads. Sash sills must weep to outside through three holes per sill, one at the center and one near each jamb.

E. Glazing shall not be conducted at outside air temperatures below 40 degrees F.

F. Tempered glass shall be installed with due consideration of long bow and short kink in selecting width of channel for glazing. Avoid contact between glass and window frame to prevent chipping of edges. Tempered glass panels with chipped edges shall not be used.

G. Edges of laminated glass panels shall be sealed with translucent tape or approved sealant to prevent entry of moisture and delamination. Sealant shall contain no oils, volatiles or solvents which would cause delamination. Positive drainage shall be provided so that panel edges do not stay wet.

H. Edges of wire glass panels shall be sealed to prevent rusting of wire reinforcement.

3.02 Replacements and Cleaning

A. At completion of work, all glass shall be free from cracks and other defects not allowed by the Specifications. Any defective glass that may appear before acceptance, or within the warranty period shall be removed and replaced with new glass without cost to the Owner.

B. Remove from site all boxes, crates, containers and other debris used for glazing operations.

C. Before acceptance by the Owner, the Contractor shall engage competent personnel to thoroughly clean all glass and window areas.

END OF SECTION

Part 1 General

1.01 Scope

This Section includes, but is not necessarily limited to, standards for cleaning and painting structures and equipment described in the Drawings and Specifications. Furnish all materials, equipment and labor necessary to complete the work.

1.02 Substitutions

To the maximum extent possible, all coatings shall be the products of a single manufacturer. Guidelines for determination of acceptability of product substitutions are given in Section 01630 of these Specifications. Contractors intending to furnish substitute materials or equipment are cautioned to read and strictly comply with these guidelines.

1.03 Submittals

A. All submittals shall be made in accordance with the requirements of Section 01340 of these Specifications.

B. The Contractor shall submit to the Engineer, for review, the following information concerning the materials the Contractor proposes to use in work covered by this Section:

1. A list of all components (paints or other materials) to be used in each painting system required herein.

2. A complete descriptive specification, including manufacturer's data sheet, of each component.

3. Prior to completing the purchase and delivery of the coating material selected by the Contractor, the Contractor shall obtain a letter from the material supplier stating that the selected material is suitable and compatible for application and use as directed under these Specifications, and that if properly applied will provide metal protection and a pleasing appearance for five years or longer.

4. A color chart for each product to be applied.

1.04 Project Meeting

Prior to ordering any of the materials covered under this Section, the Contractor, Engineer, painting subcontractor and paint manufacturer’s representative shall attend a progress meeting in accordance with the requirements of Section 01200 of these Specifications, and review the work to be performed under this Section.

1.05 Painting Requirements

A. Finish paint all exposed surfaces except prefinished items, anodized or lacquered aluminum, stainless steel and copper surfaces. Exposures and surfaces are defined in 3.07 of this Section. Items to be left unfinished or to receive other types of finishes, such as tile, are specifically shown on the Drawings or specified.

1. Unpainted Products: Full field cleaning and priming will be performed in accordance with specification requirements for unpainted products. Maintain adequate equipment on the site to assure proper cleaning.

2. Shop Primed Products

   a. Manufactured products may be shop cleaned and primed. Shop cleaning must equal or exceed cleaning specified in the Painting Schedule. Clean as specified and reprime all abrasions, weld splatter, excessive weathering and other defects in the shop prime coating.

   b. Manufacturers furnishing shop primed products shall certify that cleaning was performed in accordance with specification requirements and that the specified primer was used.

   c. Fully field clean and prime any shop primed products which the Engineer determines that were not cleaned in accordance with the Specifications prior to priming, that the wrong primer was applied, that the primer was applied improperly, or has excessively weathered, or that the product is otherwise unacceptable.

3. Finish Painted Products: Certain products such as electrical control panels and similar items may, with the approval of the Engineer, be furnished finish painted. Properly protect these products throughout the Project to maintain a bright and new appearance. If the finish surfaces are defaced, weathered or not of the selected color, repaint as necessary.

4. Existing Surfaces

   a. Properly protect existing finish painted items and surfaces from damage throughout the Project.

   b. Repair any damage to existing coatings repaired in accordance with the requirements of this Section, at no expense to the Owner.

5. Hardware: Remove all electrical plates, surface hardware, fittings and fastenings prior to painting operations. These items are to be carefully stored, cleaned and replaced upon completion of work in each area. Do not use solvent to clean hardware that may remove permanent lacquer finish.

1.06 Quality Assurance

A. 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. The following information shall be included on the label of all containers of materials supplied under this item:

1. Manufacturer's name.

2. Type of paint or other generic identification.

3. Manufacturer's stock number.

4. Color (if any).

5. Instructions for mixing, thinning, or reducing (as applicable).

6. Manufacturer's application recommendations.

7. Safety and storage information.

C. All coating material used on this Project shall be purchased specifically for this Project and furnished in new, unopened containers.

D. The Contractor shall 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.

1.07 Manufacturer’s Representative During Painting Operations

An authorized representative of each coating manufacturer shall be present at the start-up and weekly during painting operations. Such representatives shall instruct and observe the Contractor’s workers on the manufacturer’s application recommendations.

1.08 Testing Equipment

A. The Contractor shall furnish and make available to the Engineer the following items of testing equipment for use in determining if the requirements of this 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. "Surface Profile Comparator" as published by SSPC (with magnifier and three discs).

4. "Visual Standard for Abrasive Blast Cleaned Steel", as published by SSPC (SSPC-VIS 1-89).

5. "Visual Standard for Power- and Hand-Tool Cleaned Steel", as published by SSPC (SSPC-VIS 3).

6. Holiday (pin hole) detector (low voltage).

7. Sling-psychrometer or other on-site device used to calculate relative humidity and ambient air temperature.

8. Magnetic dry film gauge, meeting the requirements of SSPC-PA2, Type I or Type II, including calibration.

9. “Guide and Reference Photographs for Steel Surfaces Prepared by Waterjetting” as published by SSPC (SSPC-VIS 4).

1.09 Product Handling

A. Delivery

1. Deliver materials in original, sealed containers of the manufacturer with labels legible and intact.

2. Each container shall be clearly marked or labeled to show paint identification, date of manufacture, batch number, analysis or contents, and special instructions. At all times a copy of every component’s MSDS shall be available.

B. Storage

1. Store only acceptable Project materials on the Project site.

2. Store material in a suitable location and in such a manner as to comply with all safety requirements including any applicable federal, state and local rules and requirements. Storage shall also be in accordance with the instructions of the paint manufacturer and the requirements of the insurance underwriters.

3. Restrict storage area to paint materials and related equipment.

4. Place any material, which may constitute a fire hazard, in closed metal containers and remove daily from the Project site.

C. Material Safety Data Sheets: A copy of every component's MSDS shall be available at all times on the Project site.

1.10 Material Schedules

Material Schedules at the end of this Section list prime coats, intermediate coats, finish coats and cover coats that comprise a complete and compatible system of surface protection for the particular substrate. Maintain the unity of these systems, making sure all coats applied to any surface are from the same system and same manufacturer. Verify with the manufacturer the compatibility of the materials used.

Part 2 Products

2.01 Abrasive Material

A. The abrasive used in the abrasive cleaning shall be a material acceptable to the regulatory agencies of the State of Georgia for use in the described work. The material shall be of a shape and size to produce a uniform surface of acceptable profile to properly bond the prime coat.

B. The abrasive may be a combination of materials, including additives such as dust inhibitors and Blastox®.

C. If Blastox® is used, it shall be blended with the blasting abrasive by a blending facility authorized by the TDJ Group, Inc.

2.02 Coating Materials

A. Acceptable Manufacturers: The only acceptable manufacturers and products shall be those listed in the Material Schedules at the end of this Section.

B. All applicable data currently published by the paint manufacturer relating to surface preparation, coverages, film thickness, application technique, drying and overcoating times is included by reference as a part of this Section. It is the responsibility of the Contractor to obtain and fully understand the appropriate data sheets for the coatings specified.

C. Products

1. Paints shall be factory mixed and delivered to the site in unbroken original packages bearing the manufacturer's name and brand designation and shall be applied in strict accordance with the manufacturer's printed specifications. Two-component coatings shall be mixed in accordance with manufacturer's instructions. All two-component coatings, once mixed, shall be applied within the pot-life recommended by the manufacturer.

2. Unless otherwise specified, paints shall be of the best grade. All thinners, driers, varnish, etc., shall be of the best grade and shall be furnished by the coating manufacturer for use with the specified paints.

D. Colors: The Owner will select the colors to be used on the various portions of the work. Provide color cards for the coatings proposed. Where more than one coat of paint is required, job tint off-shade the paint for each undercoat to show complete coverage.

2.03 Mixing and Tinting

A. When possible, all paints and other materials shall be mixed and tinted by the paint manufacturer prior to delivery to the job site.

B. When job site mixing and/or tinting is required, the manufacturer's recommendations shall be strictly adhered to. The Contractor shall be solely responsible for the proper conduct of all on-site mixing and/or tinting.

2.04 Pipe and Equipment Identification

Different colors will be used on pumps, motors, valves, piping systems and other surfaces as shown in Table 1.

2.05 OSHA Safety Color Usage Guide

A. OSHA Safety colors, in accordance with ANSI Z3.1, shall be used for marking physical hazards and safety equipment and locations. The following OSHA Safety Color Usage Guide will be used in determining the coating color and type of marking required.

Safety Red	Safety Orange	Safety Yellow	Safety Green
		Physical Hazard CAUTION (Generally used with Black in checks or stripes)	Safety Equipment and Locations
Fire protection equipment	Exposed box housings	Unguarded edges of platforms	First aid kits and stretchers
Fire boxes	Exposed edges of pulleys, gears, etc.	Elevator door edges	First aid signs, dispensaries and drinking water stations
Extinguishers	Exposed box housings	Bollards	
Exit signs	Safety starting buttons	Pulley Blocks	
Sprinkler piping		Material handling equipment	

Safety Red	Safety Orange	Safety Yellow	Safety Green
Portable containers of flammable liquids			
Emergency stop bars			

2.06 Pre-Blast Lead Treatment Coating

The pre-blast lead treatment coating shall be Enviro-Prep System product number 33010, as manufactured by Hoffer's, Inc. Coatings Division (800.596.6282), or Pre Tox 2000 as manufactured by NexTec, Inc. (800.338-8296).

Part 3 Execution

3.01 General

A. Protect other surfaces from paint and damage. Furnish sufficient shields and protective equipment to prevent spray or droppings from fouling surfaces not being painted. Repair damage as a result of inadequate or unsuitable protection.

B. The Contractor's on-site representative shall keep a record of work performed each day under this Section and shall submit it to the Engineer weekly. The forms for this record will be furnished by the Engineer.

C. No coat of paint shall be applied until the surface has been inspected and accepted by the Engineer. The Contractor shall give at least 24 hours notice to the Engineer when cleaning is to be performed to prevent inspection delays. The Contractor shall provide the necessary access for inspection by the Engineer.

D. Shop applied prime coatings which are damaged during transportation, construction or installation shall be thoroughly cleaned and touched-up in the field as directed by the Engineer. The Contractor shall use repair procedures which insure the complete protection of all adjacent primer. The specified repair method and equipment may include wire brushing, hand or power tool cleaning, or dry air blast cleaning. In order to prevent injury to surrounding painted areas, blast cleaning may require use of lower air pressure, small nozzle and abrasive particle sizes, short blast nozzle, distance from surface, shielding and masking. If damage is too extensive or uneconomical to touch-up, then the item shall be re-cleaned and coated or painted as directed by the Engineer.

3.02 Environmental Conditions

A. Environmental conditions which affect coating application include, but are not necessarily limited to, ambient air temperature, surface temperature, humidity, dew point and environmental cleanliness. Comply with the manufacturer's recommendations regarding environmental conditions under which coatings may be applied.

B. Surface preparation and cleaning of the exterior surfaces must be performed during periods of still air or only a slight breeze so that fallout of the dust produced does not drift onto adjacent property. The Owner reserves the right to temporarily stop the Contractor from exterior blasting (or painting) when by observation it is apparent that the wind direction or velocity prevents compliance with this requirement. Any clean-up of fall-out on adjacent property shall be the responsibility of the Contractor.

C. All blast residue from the tank shall be properly disposed of off-site by the Contractor.

D. No paint shall be applied upon damp or frosty surfaces, or in wet or foggy weather. No paint shall be applied in temperatures below 40 degrees F, when freezing (32 degrees F) is predicted within 24 hours of application, or under temperature or humidity conditions not recommended by the manufacturer. However, in no case shall coatings be applied when the surface temperature is within 5 degrees F of dew point, and in no cases shall coating be applied over a damp surface.

3.03 Safety

A. General

1. The Contractor is responsible for the safety of all workers and subcontractors and suppliers performing work on this Project.

2. The Contractor shall protect the Owner, their agents, and the General Public from harm attributable to the Contractor's performance, or non-performance, of the work on this Project. The protection shall include, but not be limited to, providing the necessary safety equipment and instructions for its use by the Owner, and their agents.

3. The Contractor shall protect the existing structures and environment from damage attributable to the Contractor's performance, or non-performance, of the work on this Project.

4. The Contractor shall comply with the applicable standards of 29 CFR Part 1910 and 29 CFR Part 1926.

5. The listing of the following potential hazards shall in no way relieve the Contractor's responsibility for safety on this Project.

B. The interior of tanks may be considered a confined space hazard. The Contractor shall confirm to the Owner, in writing, prior to the start of the Project that the Contractor has training programs, trained personnel, and is otherwise in compliance with CFR 1910.146.

3.04 Surface Preparation

A. General: All surfaces shall be thoroughly clean, dry, and free from oil, grease or dust. All concrete shall have cured a minimum of 21 days before painting. All fabricated metal products shall have all weld flux and weld spatter removed and sharp peaks in

welds ground smooth. The Engineer will inspect the surface preparation prior to the application of coatings. If the preparation is found to be satisfactory, a written order will be given to proceed with coatings.

B. Ferrous Metals: Standards for the surface preparation of ferrous metals required in the Material Schedules are the standards of the SSPC – The Society for Protective Coatings (SSPC, SP-1 through SP-10). Inspection of these surfaces will be evaluated by field comparison with visual comparator panels. These panels shall be securely wrapped in clear plastic and sealed to protect them from deterioration and marring.

C. Concrete Surfaces: For all concrete surfaces, the following surface preparation shall be employed:

1. CC-1 - Wash: Wash and scrub all surfaces with a solution of 1-1/2 ounces of soap chips and 1-1/2 ounces of trisodium phosphate in each gallon of water used. Flush away all soap and dirt with clean water. After this washing the surface will be re-checked and any rough areas not suitable for painting shall be sandblasted smooth.

2. CC-2 - Acid Etch: Surface preparation for painting shall not commence until 7 days after the concrete has been pronounced cured. Wash and scrub all surfaces with a solution of 1-1/2 ounces of soap chips and 1-1/2 ounces of trisodium phosphate in each gallon of water used. Flush away all soap and dirt with clean water and then etch the surface with a 15 percent or stronger solution of muriatic acid until an openfaced granular texture, similar to fine sandpaper, is obtained. Any areas that remain smooth are to be re-etched until the desired texture is achieved. Flush and scrub away with clear water all acid and loosened particles.

3. CC-3 - Blast Cleaning: Remove all form oil and dirt by washing the surface with a solution of 1-1/2 ounces of soap chips and 1-1/2 ounces of trisodium phosphate in each gallon of water used. Blast clean all laitance and other foreign material from the surface of the concrete until an openfaced granular texture similar to fine sandpaper is achieved. These results should be accomplished with blast cleaning similar to "brush blasting" steel surfaces.

4. Prior to the surface preparation noted in paragraphs 1, 2, and 3 above, all concrete surfaces to be painted shall have a rubbed stone finish in accordance with Section 03300, Article 3.15, paragraph A. 1. of these Specifications.

D. Wood Surfaces: All wood surfaces shall be clean, dry and adequately protected from dampness. Sandpaper to a smooth, even surface, then dust off. After priming coat has dried, apply shellac to all knots, pitch and resinous sapwood. Putty all nail holes, cracks, open joints and other defects; color putty to match finish paint or stain.

3.05 Application

A. Surface Preparation: After specified surface preparation, all surfaces shall be brushed free of dust or foreign matter. Surfaces shall be completely dry before any paint is applied. All voids, open or hollow places in masonry shall be repaired with an epoxy patching compound.

B. Application: Paint shall be evenly spread in the proper thickness, so that there shall be no drops, runs or saggings of the coating. Where runs and drops do occur, they shall be removed and the surface re-coated to the satisfaction of the Engineer. Sufficient time, as directed by the manufacturer, shall be allowed for the paint to dry before the application of succeeding coats.

C. Protection of Work Area: Use drop cloths or other suitable means to protect other surfaces of the structure or equipment in place. Upon completion of the work, remove all paint spots from surfaces as directed by the Engineer.

D. Inspection: The Engineer will inspect each coat prior to the application of subsequent coats. If the work is found to be satisfactory, a written order will be given to proceed.

E. Defective Work: Remove and replace, at the direction of the Engineer, any painting work found to be defective or applied under adverse conditions.

3.06 Painting Schedule

A. General: The Painting Schedule summarizes the painting systems to be applied to the various surfaces. Items which appear in the Painting Schedule are defined in following paragraphs.

B. Exposure terms refer to the environmental conditions to which different surfaces may be exposed. A surface may exist in more than one exposure, e.g. an exterior wall can be categorized not only as "above grade", but also as "below grade", where the exposure is delimited by the grade line.

1. Interior: All surfaces within the confines of a building or other enclosure not constantly exposed to weather, including concealed surfaces subject to trapped moisture, heat or other deteriorating conditions and all surfaces exposed to view.

2. Exterior

a. Above Grade: All surfaces above finished grade and exposed to weather.

b. Below Grade: All surfaces below the finished grade line. Building surfaces with this exposure shall only be painted when they are structurally common with an interior surface, e.g. exterior walls of a dry pit, not the exterior wall of a below grade tank.

C. Surfaces

1. Floors: Interior surfaces subject to foot or roller traffic.

2. Building Surfaces: All structural and architectural surfaces except floors. Building surfaces include, but are not limited to, doors and frames, windows and frames, floor doors and walls.

3. Piping: All plumbing and process piping and accessories including valves, fittings, pipe supports, electrical conduit and similar related items.

4. Equipment: All mechanical, electrical, and architectural equipment, items, and accessories installed in the work and not defined above. Equipment includes, but is not limited to: pumps, motors, cabinets, ducts, tanks and process equipment.

3.07 Material Schedules

Material Schedules list pretreatment coats, wash coats, seal coats, prime coats, intermediate coats, finish coats and cover coats that comprise a complete and compatible system of surface protection for the particular substrate. Maintain the unity of these systems, making sure all coats applied to any surface are from the same system and same manufacturer. Verify with the manufacturer the compatibility of the materials used.

3.08 Maintenance Materials

Furnish the Owner at least one gallon of each type and color of paint used for finish coats and one gallon of each type of thinner required. Containers shall be tightly sealed and clearly labeled.

3.09 Coating Repair

Where coatings have been damaged, the surfaces shall be cleaned and repainted. Surface preparation shall conform to SSPC-SP 11, and feathered into undamaged areas. Painting shall be performed as specified for the damaged surface.

Painting Schedule

Exposures	Surfaces	System Schedules				
		Concrete & Concrete Block Substrate	Non-Ferrous Metals Substrate	Ferrous Metals Substrate	Wood Substrate	Drywall Substrate
Interior	Floors	-	-	-	-	-
	Building Surfaces**	134	-	[144] [147]	221	160
	Equipment*	-	157	[144] [147]	-	-
	Piping*	-	157	[144] [147]	-	-
Exterior Above Grade	Building Surfaces**	234	257	247	221	-
	Equipment*	-	257	247	-	-
	Piping*	-	257	247	-	-
Exterior Below Grade	Piping*	-	257	247	-	-
Submerged Water	Piping*	-		344W	-	-
	Equipment*	-		344W	-	-
Submerged Wastewater	Piping*			544		
	Equipment*			544		

* See coating, lining, and/or painting paragraphs in individual piping or equipment Specification Sections.

** See finish schedule for where each type shall be used.

Schedule Numbering Guide

First Number - Exposure		Second Number - Substrate		Third Number - Coating Type		Final Letter	
1	Interior and Weather Protected	1	Non-Ferrous Metals	1	Alkyd	S	Sewage
2	Exterior Weather Exposure	2	Wood	2	Asphaltic	W	Potable Water
3	Submerged in Potable Water but Protected from Sunlight	3	Concrete, Concrete Block, Masonry	4	Epoxy	F	Floors
4	Submerged in Potable Water and Exposed to Sunlight	4	Ferrous Metals	5	Vinyl	C	Severe Chemical Exposure
5	Submerged in Wastewater	5	Galvanized Ferrous Metals	6	Coal Tar		
		6	Drywall	7	Polyurethane		
		7	PVC Pipe	8	Acrylic		
				9	Zinc		
				0	Latex		

Material Schedules

System: 134
Type: Epoxy
Use: Interior Concrete and Masonry

Surface Preparation: CC-1

NTS: This is rarely used for concrete. Other options include:
(1) do nothing
(2) rubbed stone finish (see Section 03300) or
(3) Brushed finish (Thorocoat) (see Section 03300)

Coat	Minimum Dry Film Thickness (Mils)	Carboline	Tnemec	Induron	Ameron	Sherwin Williams
1st		Sanitile 600/600 TG	Epoxy-Masonry Filler 54-660	Polyfill Block Filler	Amerlock 400 BF	Kem Cati-Coat HS Epoxy Filler
2nd	4.0	Sanitile 655	Series 66 Hi-Build Epoxoline	Armorguard Epoxy	Amerlock Series	Macropoxy 646 FC Epoxy
3rd	4.0	Sanitile 655	Series 66 Hi-Build Epoxoline	Armourguard Epoxy	Amerlock Series	Macropoxy 646 FC Epoxy
System	8.0					

System: 144
Type: Epoxy
Use: Interior Ferrous Metal

Surface Preparation: SP-10

Coat	Minimum Dry Film Thickness (Mils)	Carboline	Tnemec	Induron	Ameron	Sherwin Williams
1st	3.0 – 5.0	Carboguard 893 SG	Series 66-1211 Epoxoline Primer	Armorguard P-14 Primer	Amerlock Series	Macropoxy 646 FC Epoxy
2nd	4.0 – 6.0	Carboguard 890	Series N69-Color Hi-Build Epoxoline II	Armorguard Epoxy	Amerlock Series	Macropoxy 646 FC Epoxy
3rd	4.0 – 6.0	Carboguard 890	Series N69-Color Hi-Build Epoxoline II	Armorguard Epoxy	- - -	Macropoxy 646 FC Epoxy
System	12.0					

System: 147
Type: Polyurethane
Use: Interior Ferrous Metal

Surface Preparation: SP-10

Coat	Minimum Dry Film Thickness (Mils)	Carboline	Tnemec	Induron	Ameron	Sherwin Williams
1st	3.0	Carboguard 893 SG	Series 66-1211 Epoxoline Primer	Armorguard P-14 Primer	Amerlock Series	Macropoxy 646 FC Epoxy
2nd	4.0 – 6.0	Carboguard 893 SG	Series 66-Color Hi-Build Epoxoline	Armorguard Epoxy	Amercoat 450 Series	Macropoxy 646 FC Epoxy
3rd	2.0 - 4.0	Carbothane 134 HG	Series 1074-Color Endura-Shield	Indurethane 5500 Enamel	- - -	Sherthane 2K Urethane
System	10.0					

System: 157
Type: Polyurethane
Use: Galvanized Metals

Surface Preparation: SP-1 With Manufacturer's Recommended Pre-Treatment

NTS: Paint galvanized metal only when absolutely necessary.

Coat	Minimum Dry Film Thickness (Mils)	Carboline	Tnemec	Induron	Ameron	Sherwin Williams
1st	5.0	Carboguard 893 SG	Series 66 Hi-Build Epoxoline	Pretreat using Vinyl Wash Primer Armorguard Epoxy	Pretreat using Galvapret 5 Amercoat 370 or 385	Macropoxy 646 FC Epoxy
2nd	2.0	Carbothane 134 HG	Series 1074 Endura-Shield IV	Indurethane 5500 Enamel	Amercoat 450 Series	Sherthane 2K Urethane
System	7.0					

System: 221
Type: Alkyd
Use: Exterior Wood

Surface Preparation: As Specified For Wood

Coat	Minimum Dry Film Thickness (Mils)	Carboline	Tnemec	Induron	Ameron	Sherwin Williams
1st	2.0	Sanitile 120	Series 36-603 Undercoater	AC301	Amercoat 5105	A-100 Alkyd Primer
2nd	1.5 – 2.0	Carbocoat 139	Series 23-Color Enduratone	Amorlux 2500 Enamel	Amercoat 5450	Industrial Enamel B-54
3rd	1.5 – 2.0	Carbocoat 139	Series 23-Color Enduratone	Armorlux 2500 Enamel	Amercoat 5450	Industrial Enamel B-54
System	5.0					

System: 234
Type: Epoxy
Use: Exterior Concrete and Masonry

Surface Preparation: CC-3
Note: Concrete shall be at least 28 days old before any of these coatings are applied.

NTS: This is rarely used for concrete. Other options include:
(1) do nothing
(2) rubbed stone finish (see Section 03300) or
(3) Brushed finish (Thorocoat) (see Section 03300)

Coat	Minimum Dry Film Thickness (Mils)	Carboline	Tnemec	Induron	Ameron	Sherwin Williams
1st	8.0 – 10.0	Sanitile 600/600 TG	Series 156 Enviro-Crete	AC-403	Amerlock 400BF	Loxon Primer
2nd	5.0 – 7.0	Carboguard 890	Series 156 Enviro-Crete	AC-403	Amerlock 2	Loxon Masonry Coating
3rd	As Needed	-			- - -	Loxon Masonry Coating
System	13.0					

NTS: Consult with Carboline Technical Service regarding the suitability of the Carboline vinyl ester product for the intended chemical exposure, immersion service, temperature, and recommended product thickness.

System: 245
Type: Vinyl Ester
Use: Ferrous Metal
Surface Preparation: SP-5

Coat	Minimum Dry Film Thickness (Mils)	Tnemec	Sauereisen	Carboline	Ameron	Sherwin Williams
1st	12.0 – 18.0	Series 120-5002 Vinester Beige Primer	Fibercrete	Plasite 4007 Off-White		Magnalux 304 FF Flake Filled Vinyl Ester
2nd	12.0 – 18.0	Series 120-5001 Vinester Gray Finish	Fibercrete	Plasite 4007 Gray		Magnalux 304 FF Flake Filled Vinyl Ester
System	24.0					

System: 247
Type: Polyurethane
Use: Exterior Ferrous Metal
Surface Preparation: SP-10

Coat	Minimum Dry Film Thickness (Mils)	Carboline	Tnemec	Induron	Ameron	Sherwin Williams
1st	3.0	Carboguard 893 SG	Series 66-1211 Epoxoline	Armorguard P-14 Primer	Amercoat 370 or 385	Macropoxy 646 FC Epoxy
2nd	4.0 - 6.0	Carboguard 893 SG	Series 66-Color Epoxoline	Armorguard Epoxy	Amercoat 370 or 385	Macropoxy 646 FC Epoxy
3rd	2.0 - 3.0	Carbothane 134 HG	Series 1074 Endura-Shield IV	Indurethane 5500 Enamel	Amercoat 450 Series	Sherthane 2K Urethane
System	11.0					

System: 257
Type: Polyurethane
Use: Exterior Non-Ferrous Metals
Surface Preparation: SP-1

Coat	Minimum Dry Film Thickness (Mils)	Carboline	Tnemec	Induron	Ameron	Sherwin Williams
1st	4.0 - 6.0	Carboguard 893 SG	Series 66-Color Hi-Build Epoxoline	Amorguard Epoxy	Amercoat 370 or 385	Macropoxy 646 FC Epoxy
2nd	2.0 - 3.0	Carbothane 134 HG	Series 1074-Color Endura-Shield IV	Indurethane 5500 Enamel	Amercoat 450 Series	Sherthane 2K Urethane
System	8.0					

System: 542
Type: Asphaltic
Use: Below Grade Piping
Surface Preparation: SP-2 or SP-3

Coat	Minimum Dry Film Thickness (Mils)	Carboline	Tnemec	Induron	Ameron	Sherwin Williams
1st	8.0 – 12.0	Bitumastic 300 M	46-465 H.B. Tnemecol	Ruff Stuff 2100	78HB	Targuard
2nd	As Needed					
System	10.0					

Pipe Identification and Color Coding

	Paint Colors		
Pipe System	Pipe	Letters and Arrows	Stencil Text
Air (Compressed)	Light Green	Black	Air
Drains (Plant)	Black w/White Bands	White	Drain
Potable Water	Light Blue	White	Potable Water (Cold) (Hot)
Raw Sewage (Wastewater)	Dark Grey	Orange	Sewage
Sump Drains (Plant)	Light Grey w/Orange Bands	Orange	Sump
Utility Water	Dark Green w/Yellow Bands	Yellow	Utility Water (Non-Potable)

Color Coding General Notes

1. All banding to be 2-inches wide and four feet on center.

2. Sample, drain, vent, metering, blowoff, decant, and hot lines shall be painted the same color combination as the piping system from which the line originates unless specified otherwise above. The additional pertinent text shall be applied to the pipe.

3. Insulated pipe, jacketed with canvas, shall be painted with the color combination specified above.

4. Insulated pipe, jacketed with aluminum and/or stainless steel shall have the jacket unpainted. When valves and fittings for such lines are not insulated, the valves and fittings shall be color coded.

5. Building service lines such as plumbing lines, HVAC lines, and electrical conduit, shall not be color coded but shall be painted the same color as the background construction.

6. All lettering shall be done in capital letters of approved size and type.

7. Legend symbols shall be applied on piping on every run and spaced not greater than 8 feet apart.

8. Text shall be applied on piping in the middle of pipe runs for runs under 50 feet or in one room, whichever is the least distance. On runs greater than 50 feet, text shall be applied at third points in the run and no more than 35 feet apart.

9. Pumps, chemical tanks and other items of equipment to be painted shall be painted a color corresponding to their service, in accordance with the above schedule.

END OF SECTION

Part 1 General

1.01 Scope

The work covered by this Section includes furnishing and installing portable fire extinguishers, including brackets, as specified herein and/or shown on the Drawings. General locations and quantities of portable fire extinguishers are shown in Table 1 of this Section.

1.02 References

A. Standard Building Code

B. Standard Fire Prevention Code

C. National Fire Protection Association (NFPA) Standards

1. 10 Portable Fire Extinguishers (1994)

2. 101 Life Safety Code (1994)

1.03 Submittals

A. Complete shop drawings and engineering data shall be submitted to the Engineer in accordance with the requirements of Section 01340 of these Specifications.

B. Submit complete operation and maintenance data on the fire extinguishers in accordance with the requirements of Section 01730 of these Specifications.

1.04 Storage and Protection

Fire extinguishers shall be stored and protected in accordance with the requirements of Section 01640 of these Specifications.

Part 2 Products

2.01 General

A. Portable fire extinguishers shall be furnished by a reputable, experienced manufacturer of fire protection equipment and shall conform to the applicable requirements of USCG, UL, DOT and OSHA. All fire extinguishers shall be UL listed and FM approved.

B. All portable extinguishers shall be suitable for operation over a temperature range of -40 to +120 degrees F in an indoor or outdoor environment.

C. Portable fire extinguishers shall be furnished in the sizes and types shown on the Drawings. Unless otherwise shown or specified, the following ratings and capacities shall apply:

1. Type 1 - Tri-class dry chemical fire extinguishers located in light and ordinary hazard areas shall be rated minimum 3-A; 40-B:C and shall be charged with six pounds of ammonium phosphate.

2. Type 2 - Carbon dioxide fire extinguishers shall be rated 10-B:C and shall be charged with fifteen pounds of carbon dioxide.

D. Portable fire extinguishers shall be the products of Amerex, Ansul, Figgie, Flag, Potter-Roemer or Walter Kidde.

2.02 Tri-Class Dry Chemical Fire Extinguishers

Tri-class dry chemical fire extinguishers shall have a drawn aluminum or steel cylinder, squeeze handle with locking pin, nozzle assembly with pressure gauge and heavy-duty corrosion-resistant wall bracket suitable for use in a vibrating environment.

2.03 Carbon Dioxide Fire Extinguishers

Carbon dioxide fire extinguishers shall have a cold drawn, AISI 4130 steel cylinder conforming to DOT 3AA, squeeze handle with locking pin, chrome-plated brass nozzle assembly, one-piece, moulded discharge horn and heavy-duty, (minimum 16 gauge red polyester coated steel) corrosion-resistant wall bracket suitable for use in a vibrating environment.

2.04 Fire Extinguisher Cabinets

A. Where cabinets occur in fire-rated walls, cabinets shall be UL rated and bear the UL label compatible with wall rating, insuring that integrity of walls is not breached.

B. Cabinets shall be recessed with vertical “FE” letter and dark bronze anodized finish, Model 1027 F10 for Type 1 Extinguishers and Model 3027 F10 for Type 2 Extinguishers, as Manufactured by J.L. Industries, Inc., or equivalent as manufactured by Larsen's Manufacturing.

2.05 Identifying Signs

A permanent laminated plastic identifying sign approximately 10-inches wide x 14-inches high and with a minimum thickness of 1/8-inch shall be provided for each fire extinguisher not located in a fire extinguisher cabinet. The sign shall have a white background and contrasting red characters and markings, and shall be installed with mechanical fasteners or pressure sensitive tape and adhesive on finished gypboard walls. Identifying signs shall be located at each extinguisher and as shown on the Drawings.

Part 3 Execution

3.01 Installation

A. Portable fire extinguishers shall be installed in accordance with NFPA No. 10, Portable Fire Extinguishers. Fire extinguishers shall be installed in clearly visible, readily accessible locations, as shown on the Drawings or directed by the authority having jurisdiction. Travel distances to fire extinguishers inside buildings shall not exceed 50 feet for Class B:C rated units and 75 feet for Class A rated units.

B. Unless otherwise shown or specified, fire extinguishers shall be wall mounted on suitable brackets or hangers with the top of the unit approximately five feet above the floor or working surface. Fire extinguishers mounted on unfinished masonry, tile, or concrete surfaces shall be secured to a dressed and finished wooden board, approximately 12-inches wide by 24-inches high with a nominal thickness of 1-inch. The board shall be securely anchored to the wall and shall be painted OSHA fire protection red. Pressurized water fire extinguishers shall be installed indoors in flush mounted, metal wall cabinets with hinged doors having glass windows and latching handles. See architectural drawings for locations of other extinguisher cabinets.

C. All portable fire extinguishers shall be fully charged at the time of Final Acceptance.

D. Carbon dioxide fire extinguishers shall not be installed in pump station drywells or other similar enclosed areas with limited ventilation or any area classified as a confined space by OSHA. Halon extinguishers shall not be acceptable substitutes for carbon dioxide extinguishers.

E. Identifying signs shall be installed directly over the fire extinguisher with the bottom of the sign approximately six feet above the floor or working surface.

3.02 Surface Preparation and Shop Painting

Fire extinguishers and accessories shall be cleaned, shop primed and shop painted with a red polyester finish in accordance with the requirements of Section 09900 of these Specifications.

END OF SECTION

Part 1 General

1.01 Scope

A. The water pressure booster system shall be a factory-assembled system including VFDs and pump control panel. Items will be supplied to the pump manufacturer for factory system testing prior to shipment to the site. The pump manufacturer shall include all internal wiring, pumps, motors, piping, valves, structural steel base with pipe supports, vibration isolation, internal conduit, wiring, mounting hardware, VFDs, control panel and all the necessary and required accessories and appurtenances for a complete and operable system.

1.02 Operating Requirements

The water pressure booster system shall deliver the flow rates at the conditions specified in Articles 2.02 and 2.11 of this Section. These requirements are based on two pumps operating in a parallel configuration with a third pump in a standby operational mode.

1.03 Submittals

A. Supplier shall submit shop drawings and engineering data in accordance with Section 01340 of these Specifications.

B. Supplier shall submit operation and maintenance manuals in accordance with Section 01730 of these Specifications.

C. Supplier shall submit the results of the complete functional test performed at the factory prior to the system being shipped to the site.

D. Submit a certified letter stating that both the system and the pumps have been satisfactorily tested as specified herein and are in compliance with the design and specification requirements.

1.04 Storage and Protection

Supplier's equipment shall be stored and protected in accordance with these Specifications.

1.05 Quality Assurance

A. The Supplier shall provide written certification to the Engineer that all equipment furnished complies with all applicable requirements of these Specifications.

B. The Supplier shall provide unit responsibility for all items specified in this Section. Unit responsibility shall require that all items be products of, or warranted by, the Supplier. The Supplier shall be responsible for all coordination between components and provide all submittals, installation and start-up assistance, and certification on the equipment as a unit.

1.06 Warranty

The complete pumping system shall be warranted in writing by the supplier as specified in Section 01740 of these Specifications.

Part 2 Products

2.01 Acceptable Suppliers

The water pressure booster system shall be assembled by SyncroFlo Inc., Flo-Pak or USEMCO.

2.02 Booster Pumps (Pump No. P-M-1, P-M-2, P-M-3, P-P-1, P-P-2, and P-P-3)

A. Pumps shall be horizontal, single-stage, double-suction, split case centrifugal pumps (manufactured by Peerless, Flowserve or Patterson). Each pump shall have a nameplate with capacity, head, impeller diameter, speed, model number, and serial number. The pump and motor shall be equipped for vibration isolation. The suction and discharge nozzles shall be located in the lower half of the casing. Each pump/motor assembly shall be mounted to a fabricated steel base built specifically for the pump and connected motor so as to facilitate proper mounting. Each pump/motor mounting attachment point shall be complete with means for vibration isolation.

B. Mansell Road and Providence Road Pump Stations shall satisfy the conditions specified below. The pump system shall induce sufficient head, over the specified flow range, to produce the specified system discharge pressure, losses through water pressure booster system, including all piping, fittings, and valves furnished with the system shall be taken into account by the supplier.

C. Pumps shall be capable of operating under the following conditions while satisfying the conditions of Section 2.11.

Mansell Road Pump Station	Design
Packaged Pump System design, gpm @ feet of total head	3,750 gpm @ 38 feet**
Minimum Pump Efficiency, %	85% *
Pump Speed, RPM	1200
Motor Horsepower	60 hp

Providence Road Pump Station	Design
Packaged Pump System design, gpm @ feet of total head	2,000 gpm @ 58 feet **
Minimum Pump Efficiency, %	85% *
Speed, RPM	1200
Motor Horsepower	50 hp

*Design point shall be no less than 70% of best efficiency point (BEP) and no greater than 125% of BEP.

**** Does not include losses through water pressure booster system, which must be taken into account by the manufacturer.

D. Casing: The casing shall be a horizontally split design, constructed of close-grained cast iron. The bearing bracket shall be integrally cast with the lower half casing. The upper casing shall be fitted with lifting lugs or eyebolts. Necessary vents, drain plugs, suction and discharge connections shall be provided. The lower casing shall have flanged suction and discharge with tapped connections for drains and gauges. Flanges shall conform to ANSI/ASME B16.1, Class 125. Provide renewable wearing rings designed to provide a smooth flow of water into the impeller eye. Provide casing rings with set screws as a positive means to prevent rotation. Upper and lower casing halves shall be bolted and dowelled together. Removal of the upper casing half shall permit inspection, maintenance and removal of the entire rotating element without disturbing suction and discharge piping or motor alignment. The upper casing shall contain connections for water seal piping and priming and vent connections.

E. Impeller: Provide a double suction type impeller. Dynamically balance the impeller and shaft. Mount the impeller on the shaft with a single key that extends beyond the impeller hub to lock the impeller and shaft sleeves. Liquid hone and vibratory finish the impeller. Fit the impeller with removable wear rings held in place with set screws.

F. Shaft: Heat treat the shaft and accurately machine and grind over the entire length. Protect the shaft from wear and erosion in the pump and stuffing box by removable shaft sleeves. Key the shaft sleeves to the shaft with the same key extended from the impeller and secure with separate bronze shaft nuts. Provide sleeves with O-ring seals.

G. Shaft Seal: The pump manufacturer shall provide the pump with a mechanical seal meeting the following requirements:

1. All of the seal components shall be split in half including the elastomers, gland, rotary and stationary seal faces and rotary holder. The non-shaft elastomers must incorporate a ball and socket to provide easier handling during installation. No glue is permitted to be applied to the elastomers. The seal shall be able to be installed outside of the stuffing box without any equipment disassembly required.

2. The seal shall be of rotating, hydraulically balanced, O-ring design in order to provide maximum interchangeability in pump and mixer applications without equipment modification. The design shall seal positive pressure and vacuum without special configuration.

3. The stationary seal face shall be mechanically loaded with multiple springs to ensure no leakage when the pump is shut off. The springs shall be isolated from the pumped product in order to eliminate potential corrosion or clogging problems.

4. The seal shall be capable of being installed without sleeve or shaft replacement. Two flush ports with standard NPT tapped connections shall be provided in the gland.

5. The rotary holder shall have a drive pin to ensure positive drive of rotating parts.

6. The seal shall be capable of sealing 400 psig pressure and (25 inches Hg) at 3,600 rpm.

7. The gland and rotary holder shall be 316 stainless steel. The springs shall be Elgiloy to prevent chloride stress corrosion. The rotary seal face shall be pure unfilled P8412 carbon. The stationary seal face shall be 99.5% Alumina Ceramic or solid Silicon Carbide. Elastomers shall be Viton, Ethylene Propylene or Aflas.

8. The seal shall be Chesterton 442-6 split mechanical seal.

H. Bearings: Provide grease lubricated bearings. The outboard bearing shall be of the angular-contact type, and the inboard bearing shall be a single row, radial type ball bearing. Thrust bearings shall be removable and replaceable without removing the upper casing half. Size the bearings in accordance with AFBMA standards for a B-10 life of 100,000 hours. Provide removable bearing housings that are bolted and dowelled to bearing brackets that are integrally cast with the pump's lower casing half.

I. Flexible Coupling: Directly connect the pump to its driver by means of a Sier-Bath Style "C", all metal, flexible type coupling. Provide coupling guards per OSHA standards.

J. Pump Base: The baseplate shall be one piece, fabricated steel with a continuous drip ring to college leakage. The pump base shall be equipped with vibration isolation.

K. Motors

1. Motors shall be in accordance with Section 16150 of these Specifications.

2.03 Butterfly Valves

A. Furnish as specified in Section 15100 of these Specifications.

2.04 Check Valves

Pump check valves shall be provided on the discharge of each pump. Pump station bypass shall be through a check valve located between the suction header and the discharge header. Bypass check valve shall be of the same size as the headers. The bypass check valve shall have isolation butterfly valves on either side to allow removal with the station in service. Check valves shall be of the silent type. Check valves shall begin to close as forward velocity diminishes and shall be fully closed at zero velocity preventing flow reversal. Valve bodies shall be cast from grade 35 cast-iron or better and shall be free from blow holes, sand holes, and other impurities. The valve design shall incorporate a center guided, spring loaded poppet, guided at opposite ends and having a short linear stroke that generated a flow area equal to the pipe diameter. Internals shall be machined bronze disc, seat, and stem guide. Disc shall incorporate a Buna-N insert to provide resilient sealing. Dual disc style or swing check valves shall not be accepted. Valves shall be sized to permit full pump capacity to discharge through them without exceeding a pressure drop of 2.5 psi. Check valves shall be flanged model 1800R rated at 250 psi working pressure as manufactured by Val-Matic, APCO, or GA Industries.

2.05 Pressure Relief Valve

A. Pressure relief valve shall be single-seated, diaphragm operated, globe and pilot-controlled. It shall be hydraulically operated. Valve spring shall be of stainless steel. Seat ring shall be of stainless steel and readily replaceable with no special tools.

B. Diaphragm assembly shall be fully guided, top and bottom. Diaphragm shall be of nylon reinforced Buna-N synthetic rubber and shall be fully supported by the valve casting in both the full-open and full-closed positions to eliminate strain on the diaphragm. All necessary repairs shall be possible without removing valve from the line. Packing glands are not permitted. Disc shall be synthetic rubber (Buna-N) and have a rectangular cross section. Valve disc and seat shall have an anti-cavitation design of intermeshing orifices to prevent cavitation from discharge pressure to atmosphere.

C. The main valve shall be equipped with the following accessories to ensure proper operation.

1. All control valve pilots shall have stainless steel seats, Buna-N sealing surface and a Buna-N diaphragm. Pilot valve bodies shall be from bronze.

2. Pilot control shall be sensitive to discharge pressure. Pilot shall be reverse-acting, spring-loaded diaphragm type that operates by hydraulic. This pilot shall function to monitor downstream pressure, opening on a adjustable set point pressure.

3. Isolation cocks shall be provided on control tubing at the valve inlet, outlet, and bonnet ports on valves 4-inches and larger. These valves shall be situated such that the control valve may be manually closed and the valve trim isolated and serviced.

4. Strainers shall be provided to remove any solids that may be of sufficient size to damage or plug the pilots and other control components. The inner mesh shall be MONEL and shall be designed to support the outer screen. The outer screen shall be of 0.008-inch MONEL wire, having a 40 x 40 mesh.

D. An isolation butterfly valve shall be provided at the inlet of the pressure relief valve, conforming to the requirements of the pump suction/discharge isolation valve specification.

E. Valve shall be Model 50-01 as manufactured by Cla-Val Company or Model 108-2 as manufactured by OCV.

2.06 Automatic Air Valve

A. Valve shall be automatic air valve designed to allow escape of air, and close water-tight when liquid enters the valve. A valve shall be located on the discharge and suction header. The valve body shall be cast iron, sized to function for the conditions and designed to facilitate disassembly for cleaning and maintenance. The float shall be stainless steel; the valve seat and all working parts shall be of corrosion-resistant materials. Valve shall be equipped with the necessary attachments, including isolation valves.

B. Air valve shall be manufactured by APCO Valve Corporation, Val-Matic, or G.A. Industries.

2.07 Piping

A. Steel Pipe and Fittings

1. All pipe and fittings shall be welded steel pipe designed to meet the system service requirements. System manufacturer is responsible for providing pipe supports for pump station piping and valves.

2. Pipe shall be furnished in accordance with AWWA C200 Standard Section 2.1, manufactured to meet the requirements of ASTM A 139, Grade A, B, C or D, or ASTM A 53, Grade A or B, Type E or S, or may be fabricated to meet the requirements of AWWA Standard C200 Section 3.1 through Section 3.6 of steel sheet conforming to ASTM A 570, Grade 30, 33, 36, 40 or 45, or of steel plate conforming to ASTM A 283, Grade C or D, or ASTM A 36 or ASTM A 572, Grade 42. Pipe shall be a minimum Schedule 40 up to and including 10-inches in diameter. Piping larger than 10-inches in diameter shall have a thickness of 0.375-inch.

3. Fittings shall be fabricated in accordance with AWWA C200, Section 4 from pipe conforming to the above standards.

4. Piping of 6-inches diameter and larger shall be bevel cut only by Oxyfuel or Plasma-arc cutting techniques to assure and facilitate proper weld lay down and penetration.

5. The interior and exterior of the steel pump and transmission piping shall have applied to it a fusion bonded epoxy coating that conforms to AWWA C-213-91 for Steel Water Pipeline. The powder coating product shall be National Sanitation Foundation (NSF) Standard 61 certified material. The final product shall be capable of meeting Salt Spray Resistance of ASTM B 117 (1,000 hour) with no blistering, undercutting or rust bleed; Humidity Resistance of ASTM D 2247 (1,000 hour) with no blistering, undercutting or rust bleed; and Impact Resistance of ASTM G14-72 (160 inch-pounds). The fusion bonded epoxy coating shall provide a total dry mil thickness of 12.0 to 14.0 mils.

6. Joints: Flanges shall be in accordance with AWWA C207, Class E.

7. Acceptance will be on the basis of the Engineer's inspection and the manufacturer's written certification that all steel pipe and specials were manufactured in accordance with AWWA C200.

B. Control Piping

1. Control piping shall be hard drawn copper tubing or stainless steel pipe. All purge, blowdown and drain piping shall be neatly and securely attached to the pump system.

2. Copper Piping: Copper piping shall meet the requirements of ASTM B 88, Type K. Fittings shall be sweat type wrought copper, ANSI B 16.22. Where required, sweat to screw adapters shall be cast bronze ANSI B 16.18, wrought solder joint ANSI B 16.22. Unions shall be cast bronze or bronze with solder connections. Joints shall be made with 95/5 solder for Type K pipe.

3. Stainless Steel: All stainless steel pipe shall conform to ASTM A 269, Grade Type 316 and shall be Schedule 40, unless otherwise specified or shown on the Drawings. Fittings for stainless steel pipe shall be stainless steel threaded type.

C. Miscellaneous Piping Appurtenances

1. Pipe Supports

a. Pipe supports shall be fully welded at both end points, the pipe and the system base, and where required to support removable components, the pipe support at that point shall employ a boltable yoke onto a flange with the yoke taking three bolts. The yoke shall be welded to the top of tubular member forming the pipe support.

b. Pipe supports shall be provided so that none of the weight of discharge piping is transferred to the pump discharge flange.

2. Pipe Connections: All plumbed devices within the system where removal may be required, meters, control valves, pumps and like equipment, shall have their removal from the piping facilitated by sufficient quantity of correctly placed adapters and/or couplings.

2.08 Variable Speed Drives

Variable frequency drive (VFD) for each booster pump station will be provided by the pump system manufacture. Drives shall be in accordance with Section 16489 of these Specifications. Drives will be mounted remotely from pumps in an air conditioned room with in the pump station building.

2.09 Loop Descriptions

The control loop functionality is described in Section 17050 of these Specifications.

2.10 Controls

A. General: The pump control panel shall be furnished under the responsibility of the Water Pressure Booster System manufacturer.

B. The control panel shall be manufactured by the Division 17 control system manufacturer as described in Section 17100 to perform the functionality described in Section 17050.

C. The control panel shall be tested by the Water Pressure Booster System manufacturer with the pumps as a system prior to being shipped to the jobsite. The Owner and the Engineer shall be notified in writing at least 3 weeks in advanced of the proposed testing date(s) so that the testing may be witnessed.

D. The control panel shall be mounted remotely from the pumps in an air conditioned room within the pump station.

E. Pressure Transmitters: Provide two smart pressure transmitters for sensing system suction and discharge pressure. Each pressure transmitter shall provide a 4-20 mADC analog output (2-wire) to the control panel. The pressure transmitters shall be provided with an integral digital indicator. All wetted parts shall be 316 stainless steel. Pressure transmitters shall have an accuracy of +/- 0.15 percent and shall be manufactured by Rosemount or Endress-Hauser.

F. Provide and electromagnetic flowmeter to measure station flow. Magnetic flow meter shall be manufactured by Krohne, Rosemount, or Endress-Hauser.

G. Pressure Gauges: Provide two pressure gauges for direct readout of suction pressure and discharge pressure. Pressure gauges shall have 316 stainless steel Bourdon tube and socket, 316 stainless steel movement, phenolic case with 4.5-inch dial having white face with black lettering, acrylic lens, blowout protection, glycerin filled, 0.5-inch MNPT connection on the bottom of the gauge. The discharge and suction gauge shall be 0-160 psi. Pressure gauges shall be manufactured by Ashcroft or U.S. Gauge.

2.11 Painting

A. The entire booster system, including the skid but not including the control panel, shall be cleaned (SSPC SP-6) and painted with a coating system equal to the following with a total dry film thickness of not less than 6.0 mils:

1. 1st Coat: Tnemec Series 66-1211 Epoxoline Primer, 2.0 - 3.0 Mils DFT

2. 2nd Coat: Tnemec Series 66 Hi-Build Epoxoline, 2.5 - 5.0 Mils DFT

3. 3rd Coat: Tnemec Series 70 Endura Shield, 1.5 - 2.0 Mils DFT

B. The underside of the skid shall be coated with an epoxy based, coal tar lining or a mastic material, not less than 10.0 mils thick.

C. Provide one quart of finish paint for job-site touch-up use.

2.12 Factory Testing

A. The water pressure booster system shall have a complete factory electric operating, sequence and capacity performance test for compliance with specified requirements. Additionally, there shall be a hydrostatic test of all piping to 1-1/2 times the operating pressure, prior to shipment.

B. Furnish certified factory performance test data for the capacity performance test including capacity, head, horsepower and efficiency at flow rates from 0 to 100 percent of design flow for the water pressure booster system at both minimum and maximum suction side pressures specified for each individual pump and combination of the two pumps operating together.

C. The factory operating and performance test may be witnessed by the Engineer and Owner. The Supplier shall notify the Engineer in writing at least three weeks prior to the factory performance test. The Owner's travel costs will be paid by the Owner.

D. Before the water pressure booster system is shipped from the factory, the Supplier shall transmit three copies of a certified letter stating that both the system and the pumps have been satisfactorily tested as specified herein and are in compliance with the design and specification requirements. The certified factory test data and performance test curves for the system shall accompany the certified letter. This data shall be provided to the engineer in a submittal format prior to the pump skid being delivered to the site. The pump system shall not be delivered to the site until a written approval is received from the engineer.

E. The control panel shall be tested with the complete system.

F. After factory testing is complete, the Suppliers shall have a complete system for delivery to the job site. The Supplier is responsible for delivering a complete system to the job site.

2.13 System Operating Requirements

A. Mansell Road Pump Station

1. System shall be based on a minimum suction pressure of 85 psi and a maximum suction pressure of 97 psi. The system shall operate at a minimum discharge pressure of 101 psi and a maximum discharge pressure of 113 psi for all pumps. For pump testing purposes, pressure and flow specified shall be measured at the end of the discharge and suction headers respectively. The booster pump station shall supply 7,500 gpm with two pumps operating in parallel configuration.

2. All control logic shall reside in the control panel furnished with the pump station. Pump control logic shall be provided by a PLC residing in the control panel.

B. Providence Road Pump Station

1. System shall be based on a minimum suction pressure of 104 psi and a maximum suction pressure of 117 psi. The system shall operate at a minimum discharge pressure of 129 psi and a maximum discharge pressure of 142 psi for all pumps. For pump testing purposes, pressure and flow specified shall be measured at the end of the discharge and suction headers respectively. The booster pump station shall supply 4,000 gpm with two pumps operating in parallel configuration.

2. All control logic shall reside in the control panel furnished with the pump station. Pump control logic shall be provided by a PLC residing in the control panel.

2.14 Complete System

The system shall be skid-mounted and ready for operation with only main piping, telemetry connections, mounting of the control panel, main power connections and any other necessary equipment that is required to make the system operational.

2.15 Pump Station Skid

A. The pump station structural base shall be a fabricated base and floor system of plate steel and structural steel members complete with a non-slip surface in walkway areas.

B. The substructure shall be designed and fabricated to support the equipment live and dead loads plus the burden imposed by loading, transporting and unloading of this equipment. All plate and shapes used in the substructure shall meet or exceed the material requirements of ASTM A 36.

C. The pump system structural steel base shall be anchored to the concrete floor slab according the pump manufactures recommendations. After the steel base is anchored the base shall be filled with concrete. The concrete shall be sloped to not allow water to pool on the pump skid. The top of the structural steal base shall be protected from concrete and cleaned after the concrete is placed.

2.16 Spare Parts

A. Provide two split mechanical seals for each of the two systems.

B. The seals shall be factory wrapped and protected and placed in an environmentally protected package for long term storage.

Part 3 Execution

3.01 Inspection and Testing

Following installation, the supplier will demonstrate to the Engineer's satisfaction, the ability of the pump station to operate continuously over the conditions specified in this Section and Section 17050 of these Specifications. The manufacturer shall make, at the manufacturer's own expense, all necessary changes, modifications, and/or adjustments required to assure satisfactory operation as specified herein.

3.02 Supplier Service

A. Furnish the services of a factory representative for one, eight hour day per pump station during the installation phase of the equipment. The factory representative shall have full knowledge and experience in the installation of the type of equipment being installed.

B. Furnish the services of a factory representative who has complete knowledge of proper operation, start-up procedures, and maintenance requirements, for one, eight hour day per pump station to inspect the final installation, supervise a functional test of the equipment, and provide training to the Owner's staff.

C. Supplier service shall be provided in accordance with Section 01655 of these Specifications.

3.03 Contractor Services

The Contractor shall provide the Supplier access to the system at all times the Supplier desires access. The Contractor shall cooperate with the Supplier in the start-up and testing of the system, and shall provide personnel to operate valves and other appurtenances which it has installed to assist in the start-up and testing.

END OF SECTION

Part 1 General

1.01 Scope

A. The work covered by this Section includes furnishing all materials, labor and equipment required to furnish and install all hoist equipment and accessories as specified herein and/or shown on the Drawings.

B. Each hoist shall consist of, but not be limited to, hoist, trolley and monorail.

1.02 Design Data

A. Booster Pump Station: Manual Hoist with Push Type Trolley

1. Capacity: 2 Tons.

2. Lift: 10‘.

3. Type: Army Type Hoist with Push Type Trolley.

1.03 Submittals

A. Shop drawings shall be submitted in accordance with the requirements of Section 01340 of these Specifications.

B. Operation and maintenance manuals shall be submitted in accordance with the requirements of Section 01730 of these Specifications.

Part 2 Products

2.01 Acceptable Manufacturers

Hoist equipment shall be equal to that as manufactured by Acco-Wright Hoist and Crane Division, York, PA or Lift-Tech International, Inc.

2.02 Army Type Hoists

A. The frame shall be case structural aluminum alloy 6061 T6 or better, machined to rigidly hold hoist gear train in perfect alignment.

B. The gear case cover shall be structural aluminum alloy machined to form a rugged impact resistant sealed gear case.

C. Gear train shall be a simple reduction of heat traced steel gears arranged so that the load is carried by gear teeth on each side of the load gear. The pinion shafts shall be of steel, heat treated for maximum durability and wear resistance and ground for concentricity and fit. All gearings shall be supported between anti-friction bearings with no overhung gears. All connections between gears and shaft shall be by means of splines cut from solid bar stock.

D. Load pocket wheels shall be 4-pocket, heat traced, steel castings. Idler wheels in multiple reeved models shall also be 4-pocket, heat treated, steel castings.

E. The load brake shall be of the ratchet and pawl actuated, self-adjusting type to securely hold the load at any level and provide smooth precise control in lowering. The brake flange shall be steel, fully machined and heat treated with ACME L.C. ground thread. Ratchet wheel shall be steel, heat treated and finish ground and shall operate on an anti- friction bearing for smooth lowering. The brake hub shall be corrosion resistant, bronze alloy and hard chrome plated for long wear.

F. All operating parts of the trolley hoists shall be enclosed to protect them. Gears shall be enclosed in a tightly sealed housing and with pressure type lubricant.

G. Load chain and hoist chain shall be cadmium plated steel alloy, coil type hoisting chain.

H. A chain bucket shall be provided to automatically collect the chain as the hook rises.

Part 3 Execution

3.01 Installation

The Contractor shall install, inspect and test hoisting equipment shown on the Drawings and as called for in Section 01640 of these Specifications.

END OF SECTION

Part 1 General

1.01 Scope

A. The work described in this Section and/or indicated on the Drawings shall include, except where otherwise noted, the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition all mechanical systems. All mechanical work shall be accomplished by workers skilled in the various trades involved.

B. Prior to the ordering or purchase of any equipment or materials or the layout or installation of any work, visit and examine the site and shall examine and understand the work shown on the Drawings and described in these Specifications. If any work involves existing equipment, ductwork, piping, buildings, etc., first verify model numbers, electrical characteristics, sizes, dimensions, etc. to be compatible with the work shown on the Drawings.

C. Throughout the course of the Project, schedule and coordinate work with the Owner and other trades to optimize space utilization and avoid conflict or interference with the work of other trades, structural elements, doors, windows, lights, conduit and other equipment or systems.

D. Unless otherwise shown on the Electrical Drawings, the mechanical work shall include:

1. The furnishing and installation of all motors in accordance with Division 16, motor starters, relays and other controls and control wiring necessary for the proper operation of all mechanical equipment. Power wiring to mechanical equipment and a 120 volt source for control power shall be provided as a part of the electrical work.

2. All controls and control wiring shall be provided under this Division and installed according to Division 16 of these Specifications. Where control power is not available in the vicinity of mechanical equipment, a transformer shall be furnished and installed to convert power voltage to control voltage. The transformer may be an integral part of the starter.

3. Magnetic starters or combination starters as shown on the Drawings or specified herein, complete with running indication lights in an approved enclosure, shall be furnished and installed for mechanical equipment automatically started and stopped, or otherwise controlled by thermostats, timers, or other devices. Starters for all manually controlled equipment shall include running indication lights in an approved enclosure. Switches for starters shall be as shown on the Drawings or specified herein. All starters shall comply with the requirements of Section 16050.

E. All electrical items provided under Division 15 of these Specifications shall be provided in accordance with applicable sections of Division 16. Enclosures shall be the same NEMA type as specified in Section 16050 or on the Electrical Drawings.

F. Produce complete finished operating systems and provide all incidental items required as part of the work, regardless of whether such item is particularly specified or indicated.

1.02 Qualifications

All materials shall be furnished by manufacturers fully experienced, reputable and qualified in the manufacture of the particular material to be furnished. All material shall be designed, constructed and installed in accordance with standard practices and methods and shall comply with these Specifications as applicable.

1.03 Submittals

A. Submittals for all mechanical work shall conform to the requirements of Section 01340 of these Specifications.

B. Drawings and Specifications

1. The Drawings are diagrammatic and, unless specifically dimensioned, are intended to show only the general arrangement of equipment and accessories, and the general routing of piping, ductwork, etc. The Drawings do not specifically show every fitting, offset, contour, etc. required to accomplish the intended work or to avoid every interference that may be encountered. Arrange all work to fit within the allowed space without modifying any building structure or property, and make readily accessible all equipment and accessories requiring servicing or maintenance.

2. Should any changes be deemed necessary in items shown on the Drawings, shop drawings, descriptions and the reason for the proposed changes shall be submitted to the Engineer for approval.

3. Exceptions and inconsistencies in Drawings and Specifications shall be brought to the Engineer's attention before Bids are submitted.

4. Titles of Sections and Articles in these Specifications are introduced merely for convenience and are not to be construed as complete segregation of tabulation of the various units of material and/or work.

C. Operating and Maintenance Instructions: Complete, neatly framed instructions for the care and operation of all equipment shall be provided and installed where directed. Instruct the Owner's personnel during the adjustment and testing period in the presence of both the Owner's representative and the Engineer, demonstrate the complete operation of each and every piece of apparatus. In the case of heating and air conditioning equipment, both the heating and cooling functions shall be fully

demonstrated at such times as are required. Instructional periods shall be for such lengths of time as may be necessary to thoroughly familiarize operating personnel with the proper care, operation and maintenance of the equipment.

D. Permits and Inspections

1. Obtain and pay for, as part of the mechanical work, all permits, fees, licenses, taxes, assessments, etc. necessary for performing the work outlined in the Contract Documents.

2. All applicable certificates of inspection shall be delivered to the Owner at the completion of the work.

1.04 Transportation and Delivery

A. As part of the mechanical work, provide and pay for all transportation, delivery and storage required for all equipment and materials.

B. The mechanical contractor shall closely coordinate the ordering and delivery of all mechanical equipment with other trades to assure that equipment will be delivered in time to be installed in the building without requiring special or temporary access or building modifications. Certain equipment may have to be installed prior to the erection of the building walls or roofs.

1.05 Storage and Protection

A. Upon receipt of all equipment and materials, they shall be properly stored to protect them from vandalism, theft, the elements and other harm or damage. Any equipment or materials received in a damaged condition, or damaged after receipt, shall not be installed. Only new undamaged equipment in first-class operating condition shall be installed.

B. Provide protection covers, skids, plugs or caps to protect equipment and materials stored or otherwise exposed during construction.

1.06 Quality Assurance

A. The manufacturer shall provide written certification to the Engineer that all equipment furnished complies with all applicable requirements of these Specifications.

B. Codes and Standards

1. All mechanical work shall be performed in accordance with all applicable codes, ordinances, rules and regulations of local, state, federal or other authorities having jurisdiction. As a minimum, this shall include:

a. 2000 Standard Building Code

b. 2000 Standard Mechanical Code

c. 2000 Standard Energy Conservation Code

d. 2000 Standard Plumbing Code

e. 2000 Standard Fuel Gas Code

f. 2000 Standard Fire Code

g. National Fire Protection Association Codes

h. Unless otherwise specified on the Drawings, the latest edition of all codes, including state and local amendments or ordinances, shall be followed. Where code or other requirements exceed the provisions shown on the Contract Documents, notify the Engineer. Where provisions of the Contract Documents exceed code or other requirements, the Work shall be performed in accordance with the Contract Documents.

2. All equipment, products and materials used in mechanical work shall be Underwriter's Laboratories listed or labeled as applicable.

3. Schedule all required tests and inspections with a minimum of 72 hours prior notice to the Owner and the Engineer.

C. Allowable Tolerances: Equipment shall be readily adaptable for installation and operation in the structures shown on the Drawings. No responsibility for alteration of a planned structure to accommodate other types of equipment will be assumed by the Owner. Equipment which requires alteration of the structures will be considered only if the Contractor assumes all responsibility for making and coordinating all necessary alterations. All such alterations shall be made at the Contractor's expense.

Part 2 Products

2.01 Materials and Construction

A. General

1. All equipment, materials, accessories, etc. used as part of the mechanical work shall be new, of the best grade and quality and of current production, unless specified otherwise. Equipment not specified in the Contract Documents shall be suitable for the intended use and shall be subject to approval by the Engineer.

2. All equipment, products and materials used in mechanical work shall be Underwriter's Laboratories listed or labeled as applicable.

3. All equipment, products and materials shall be free of defects and shall be constructed to operate in a safe manner without excessive noise, vibration, leakage or wear.

4. Electric motors shall be standard efficiency, drip-proof type unless otherwise specified.

B. Piping: See appropriate sections of Division 15 for Specifications on various piping systems. See Part 3 of this Section for general stipulations on installation of piping systems.

C. Valves: See appropriate sections of Division 15 for Specifications and Part 3 of this Section for general stipulations on valve installation.

D. Unions: Provide and install unions between each item of equipment and the valve controlling and/or the various piping connections to it.

1. Steel Pipe: Unions 2-1/2-inches and smaller shall have ground joints. Unions 3-inches and larger shall have flanged unions.

2. Copper Pipe: Unions 2-1/2-inches and smaller shall have brass ground joints, copper to copper. Unions 3-inches and larger shall have brass flanged unions, with brass bolts.

3. PVC Pipe: Unions 2-inches and smaller shall have threaded Buna O-rings. Unions 2-1/2-inches and larger shall be flanged.

E. Strainers

1. Strainers in water lines shall have cast iron bodies, with standard pattern, stainless steel or monel baskets with standard perforations and shall be equal to Hellan Fluid Strainer, Type D, unless otherwise specified in other sections of Division 15.

2. All strainers shall be of the same size as the piping in which they are installed. Provide dielectric union, if necessary, to isolate strainer from pipe material.

F. Equipment Bases: Each piece of equipment which is motor driven shall be furnished with an approved base, which shall be in addition to the foundation. Each base shall be furnished integral with the equipment or apparatus, or shall be furnished as a separate item, designed to accommodate the equipment or apparatus. Submit shop drawings for all foundations and supports for review.

G. Dielectric Isolation

1. Wherever copper, brass or bronze piping systems are connected to steel or iron piping systems, this connection shall be made with dielectric isolators. The dielectric isolators shall be so designed that non-ferrous piping materials shall be isolated by the use of Teflon or nylon isolating materials made up in the form of screwed type unions or insulating gaskets and bolt sleeves and washers for standard flanged connection. All dielectric isolators shall be selected for the pressure of the system involved.

2. Dielectric isolators shall be Watts, Epco, Crane or Maloney.

Part 3 Execution

3.01 Installation

A. General

1. All equipment, materials, accessories, etc. used as part of the mechanical work shall be installed according to the manufacturer's recommendations and in accordance with the best practice and standards for the work.

2. All work shall be performed by competent personnel satisfactory to the Owner and Engineer. All work requiring particular skill shall be performed by persons that have had special training and past experience in that line of work.

B. Equipment Support

1. Major equipment supports (concrete foundations, framed structural openings, etc.) shall be furnished and installed under other Divisions of the Contract Documents as shown on the Drawings. The mechanical work shall include the furnishing and installation of all miscellaneous equipment supports, housekeeping pads, structural members, rods, clamps and hangers required to provide adequate support of all mechanical equipment.

2. Unless otherwise shown on the Drawings, all mechanical equipment, piping and accessories shall be installed level, square and plumb.

3. All equipment, piping, etc. supported by structural joists shall be supported by the top chord only of such joists. Hangers shall not be attached to the bottom chord of any joists.

C. Pipe and Ductwork Penetrations

1. Sleeves shall be installed in all masonry or concrete walls, floors, roofs, etc. for pipe and ductwork penetrations. Sleeves for pipe shall be standard weight steel pipe. Sleeves for ductwork shall be 20 gauge galvanized steel. Sleeves shall be sized to provide a minimum of 1/4-inch clearance between the sleeve and pipe or duct. For insulated pipes or ducts, the clearance shall be between the sleeve and the insulation. Each penetration shall be firestopped or otherwise protected by listed materials with a minimum fire rating equivalent to the rating of the structural element where it occurs.

2. As far as possible, all pipe and ductwork penetrations shall be provided for at the time of masonry or concrete construction. Where drilling is required, only core drills shall be used. Star drills shall not be used.

3. All pipes penetrating walls or floors of any construction shall be installed with escutcheon plates on both sides of the penetration securely fastened to the wall

or floor. In exposed areas, escutcheon plates shall be chrome-plated. All escutcheons plates shall be sized to completely conceal the penetration. Ductwork penetrating walls or floors of any material shall be installed with closure plates on both sides of the penetration. Penetrations through exterior walls shall be sealed weathertight.

4. All penetrations through fire rated structures shall be firestopped with materials listed for such use and shall equal or exceed the rating of the structure being penetrated.

D. Flashing

1. All piping and ductwork penetrating roofs shall be flashed in an approved manner, shall be watertight and shall conform to the requirements detailed in other sections of these Specifications.

2. Flashing for piping shall be sheet lead of not less than six pounds per square foot, shall have a base not less than two square feet, and shall extend up over and into the open end of the pipe. All flashing shall be properly caulked and sealed.

E. Welding

1. All welded pipe joints shall be made by the fusion welding process, employing a metallic arc or gas welding process.

2. All welding operations shall conform to the latest recommendations of the American Welding Society or to the applicable provisions of the ASME Code for Pressure Piping. Pay for all electrical energy and/or gas used in welding.

F. Equipment Connections

1. Extend waste and water to the various items of equipment as indicated or required, terminating the lines where and as directed. Make all final plumbing connections. Provide shut-off valves and unions at each water connection to each item of equipment requiring same.

2. During the roughing-in phase of the work, extend service lines to the various items of equipment, terminating them at the proper points for connection to those items of equipment as indicated on the detailed drawings of the equipment and/or as directed. During the time the equipment is being installed or after it is in place, make all final connections thereto.

G. Cutting and Patching: Where cutting or patching becomes necessary to permit the installation of any work or should it become necessary to repair any defects that may appear in patching, the Contractor shall make the necessary repair at no cost to the Owner.

H. Large Apparatus and Equipment: All large apparatus and equipment which is specified or shown to be furnished or installed under this Contract, and which may be too large to be moved into its final position through the normal building openings planned, shall be placed in its approximate final position before any obstructing structure is installed. All apparatus shall be cribbed up from the floor and cared for as specified under "Storage and Protection" or as directed by the Engineer.

I. Cross Connection and Interconnections

1. No plumbing fixture, device or piping shall be installed which will provide a cross connection or interconnection between a distributing supply for drinking or domestic purposes and a polluted supply, such as drainage system or a soil or waste pipe which will permit or make possible the backflow of sewage, polluted water or waste into the water supply system.

2. Verify location of all existing utilities and make all connections to existing facilities as required.

J. Thermal Expansion of Piping

1. Furnish and install all devices required to permit the expansion and contraction of all work subject to expansion and contraction of the water supply and circulating systems. In these systems employ expansion joints and guides where required or directed by the Engineer. Swing joints, turns, expansion loops or long offsets shall be provided wherever shown on the Drawings or wherever necessary to allow for the expansion of piping within the building. Broken pipes or fittings broken due to rigid connections must be removed and replaced at no cost to the Owner.

2. Anchor all lines having expansion joints so that expansion and contraction effect is equally distributed. Verify exact locations of anchors and guides with the Engineer prior to making installation. The lines having expansion joints shall be accurately guided on both sides of each joint. These guides shall consist of saddles and "U" clamps where not otherwise indicated and shall be properly arranged and supported. Submit complete details for approval.

3. In installing expansion members, exercise care to preserve proper pitch on lines. Furnish and install all special fittings, connectors, etc., as required.

3.02 Surface Preparation, Shop, and Field Painting

A. Unless otherwise specified herein or shown on the Drawings, general painting of mechanical equipment shall be in accordance with Section 09900 of these Specifications.

B. Touch-up painting of mechanical equipment shall be part of the mechanical work. All equipment and materials that are painted or coated by the manufacturer shall be touched-up prior to completion to conceal any and all scratches or other finish

irregularities and to maintain the integrity of the paint or coating. All painting and coating shall match the original and shall conform to the requirements detailed in other sections of these Specifications.

3.03 Inspection and Testing

A. Testing of Pipelines: Refer to Section 02666 of these Specifications for general requirements.

B. The mechanical work shall include all materials and labor required to properly test and balance all mechanical systems as required by codes and as described herein.

C. Concealed, underground and insulated piping shall be tested in place before concealing, burying or covering. Tests shall be conducted in the presence of the Engineer or designated representative. Equipment, materials and instruments required for tests shall be furnished without incurring additions to the Contract. The Contractor shall schedule all required tests and inspections with a minimum of 72 hours prior notice to the Owner and the Engineer.

D. Unless otherwise specified herein, all mechanical piping shall be tested as required by Code to 1-1/2 times the rated system pressure or 150 psig, whichever is greater. Care shall be taken to isolate all equipment not suitable for this test pressure by installing pipe caps or blank flanges at the equipment connections. All valves and fittings shall be tested under pressure.

E. Unless more stringent requirements are specified herein, the following procedures shall be used for pressure testing building mechanical piping gravity-drained piping systems. Soil, waste and vent piping shall be tested with water before installing fixtures. Water test shall be applied to the system either in its entirety or in sections. If the test is applied to the entire system, all openings in the piping shall be closed except to highest opening, and the system shall be filled with water to the point of overflow. If the system is tested in sections, each opening except the highest opening of the section under test shall be plugged and each section shall be filled with water and tested with at least a 10-foot head of water. Each joint or pipe in the building except the uppermost 10 feet of the system shall be submitted to a test with at least a 10 foot head of water. The water shall be kept in the system, or in the portion under test, for at least one hour before the inspection starts; no drop in the water level will be acceptable.

F. The services of an independent testing and balancing agency shall be used to balance the air and water distribution systems.

3.04 Cleaning

A. At all times, the premises shall be kept reasonably clean and free of undue amounts of waste, trash and debris by periodic cleaning and removal. After completion, all foreign material, trash and other debris shall be removed from the site.

B. After all equipment has been installed, but prior to testing and balancing, all equipment, piping, ductwork, etc. shall be thoroughly cleaned both inside and out.

C. All air moving equipment operated during construction shall have filters in place and changed regularly so as to be clean.

D. After testing and balancing and just prior to Owner review and acceptance, all systems shall be finally cleaned and shall be left ready for use. Air filters shall be new and piping strainers shall be clean.

END OF SECTION

Part 1 General

1.01 Scope

A. Provide all labor, materials, equipment and incidentals necessary to construct all ductile iron pipe and appurtenances located inside and under buildings and structures, and test as shown on the Drawings and as specified herein.

B. Ductile iron pipe and appurtenances covered under this Section shall include all interior pipe and accessories to the outside face of structures and buildings, except where there is no joint at the outside face. Where there is no joint at the exterior face, this Section shall include all ductile iron pipe and accessories within two feet of the exterior face of the structure or building.

C. This Section includes piping and fittings in utility vaults and manholes.

1.02 Submittals

A. Complete shop drawings and product data on all piping and fittings shall be submitted to the Engineer in accordance with the requirements of Section 01340 of these Specifications.

B. Shop drawings shall indicate piping layout in plan and/or elevations and shall include a complete schedule of all pipe, fittings, specials, hangers and supports. Special castings shall be detailed showing all pertinent dimensions. Special coatings shall be clearly identified.

C. The Contractor shall furnish the Resident Project Representative with lists 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.

D. The Contractor shall submit written evidence to the Engineer that the products furnished under this Section will conform 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 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.

Part 2 Products

2.01 Ductile Iron Pipe (DIP)

A. Ductile iron pipe shall be utilized for all piping except where shown otherwise on the Drawings.

B. Ductile iron pipe shall be manufactured in accordance with AWWA C151. All pipe, except specials, shall be furnished in nominal lengths of 18 to 20 feet. Sizes will be as shown on the Drawings. All pipe shall have a minimum pressure rating as indicated in the following table, and corresponding minimum wall thickness, unless otherwise specified or shown on the Drawings:

Pipe Sizes (inches)	Pressure Class (psi)
4 - 12	350
14 - 18	350
20	300
24	250
30 - 54	200

C. Flanged pipe minimum wall thickness shall be equal to Special Thickness Class 53. Flanges shall be furnished by the pipe manufacturer.

2.02 Fittings and Accessories

A. Fittings shall be ductile iron and shall conform to or AWWA C153/ANSIA21.53 with a minimum rated working pressure of 250 psi.

B. Flanged elbow fittings shall be ANSI pattern using short radius elbows except where noted differently on the Drawings. Special fittings, ductile iron wall pipes and sleeves shall conform to the dimensions and details as shown on the Drawings.

C. All grooved-end fittings shall conform to the laying length requirements of AWWA C110/ANSI A21.10, end preparation requirements of AWWA C606, and wall thickness requirements of AWWA C110/ANSI A21.10.

D. Welded-on Outlets: Welded-on outlets shall be ductile iron body type and shall be faced and tapped for AWWA C110/ANSI A21.10 flange or mechanical joint connection. All welding, fabrication and outlet hole drilling shall be performed by the manufacturer. Outlets shall be free of burrs. Sizes shall be as indicated on the Drawings. The outlets shall be welded on minimum Special Thickness Class 51 ductile iron pipe greater than 12-inches and Special Thickness Class 52 for smaller pipe.

E. Thrust Collars: Thrust collars shall be welded-on ductile iron body type capable of withstanding a thrust due to 250 psi internal pressure on a dead end from either direction on that pipe size. The welded-on collars shall be continuously welded to the pipe by the pipe manufacturer.

F. Solid sleeves shall permit the connection of plain end ductile iron pipe. Solid sleeves shall meet the requirements of ANSI/AWWA C110 for long pattern and have a

minimum pressure rating of 250 psi. Solid sleeves shall have mechanical or restrained joints as specified in this Section and as shown on the Drawings. Solid sleeves shall be used only in locations shown on the Drawings [or at the direction of the Engineer].

G. Tapping Saddles: Tapping saddles shall be ductile iron body type with O-ring gasket and alloy steel straps. Connection shall be flanged or mechanical joint as detailed on the Drawings. Tapping saddles shall be equal to ACIPCO A-10920 (mechanical joint) and ACIPCO A-30920 (flange joint).

H. Flange Adapter: The flange adapter shall permit the connection of unthreaded, ungrooved, open-ended ductile iron pipe to ANSI/ASME B16.1, Class 125 flanges. The flange adapter shall meet the test requirements of ANSI/ASME B16.1 for Class 125 flanges. The adapter shall be a ductile iron casting incorporating gripping wedges and gasket. The gasket shall provide a compression seal between the adapter, the pipe and the adjacent flange. Flange adapters are to be used only in locations specifically shown on the Drawings and shall be installed in accordance with the manufacturer's recommendations. The flange adapter shall be EBAA Iron Megaflange-Flange Adapter Series 2100.

I. Service Clamps: Service clamps shall be ductile iron, double strap clamps equal to Mueller.

2.03 Joints

A. General

1. Unless shown or specified otherwise, joints for buried service shall be push-on or restrained joint type for pipe and standard mechanical, push-on or restrained joints for fittings. Joints for exposed service shall be flanged for pipe and fittings, unless shown otherwise.

2. Provide the necessary bolts for connections. All bolts and nuts shall be threaded in accordance with ANSI B1.1, Coarse Thread Series, Class 2A external and 2B internal fit. All bolts and nuts shall be made in the U.S.A.

3. In all cases, gaskets shall be made of material that will not be damaged by the fluid being transported nor by the environment in which the pipe is installed.

B. Push-On and Mechanical Joints

1. Joints shall conform to AWWA C111/ANSI A21.11.

2. Bolts and nuts shall be Tee Head bolts and nuts of high strength low-alloy steel in accordance with ASTM A 242 to the dimension shown in AWWA C111/ANSI A21.11.

3. Gaskets shall be in accordance with AWWA C111/ANSI A21.11 and shall be constructed of plain rubber unless otherwise shown on the Drawings.

4. Mechanical joint glands shall be ductile iron.

C. Flanged Joints

1. Flanged joints shall conform to AWWA C115/ANSI A21.15. Flanges shall be ductile iron and shall be furnished by the pipe manufacturer.

2. Flanged joints shall be bolted with through stud or tap bolts of required size as directed. Bolt length and diameter shall conform to ANSI/AWWA C115 for Class 125 flanges shown in ANSI/ASME B16.1.

   a. Bolts for exposed service shall be zinc plated, cold pressed, steel machine bolts conforming to ASTM A 307, Grade B. Nuts for exposed service shall be zinc plated, heavy hex conforming to ASTM A 563. Zinc plating shall conform to ASTM B 633, Type II.

3. Gaskets shall be made of 1/8-inch thick, Neoprene. Gaskets may be ring type or full face type.

4. For 16-inch and larger flanged joints use gaskets equal to American “Toruseal” or US Pipe “Flange Tyte”.

5. Flanged ductile iron pipe shall have flanges cast solidly or threaded to the pipe barrel. 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 threaded type flanges shall be assembled, faced, and drilled at the point of manufacture, unless otherwise approved by the Engineer.

6. Flange filler shall conform to AWWA C110/ANSI A21.10. Joint bolt length shall be increased by the thickness of the flange filler.

7. Where tap or stud bolts are required, flanges shall be drilled and tapped accordingly.

D. Restrained Joints

1. Restrained joints: Restrained joints shall be manufactured restrained joint or restraining gasket joint as specified below.

   a. Manufactured restrained joints shall be American, FLEX-RING or LOK-RING, U.S. Pipe TR FLEX or HP LOK, or Clow SUPER-LOCK.

   b. Restraining gasket joints shall be assembled with American Fast-Grip gaskets or US Pipe FIELD LOK gasket.

c. Retainer glands on a mechanical joint may be used as a restrained joint only where retainer glands are specifically shown on the Drawings or where specifically specified.

d. Where retainer glands are allowed, in lieu of retainer glands specified elsewhere, the joint may be assembled with US Pipe MJ FIELD LOK gasket.

e. No field welding for manufactured restrained joint pipe assembly will be permitted. Where field cutting of restrained joint pipe is required, the joint may be assembled with American Field Flex-Rings or US Pipe TR FLEX GRIPPER Rings.

2.04 Wall Sleeves and Wall Pipes

A. Where piping passes through concrete structures, furnish and install wall sleeves unless wall pipes or other provisions are specifically shown on the Drawings.

B. Wall Sleeves

1. For pipe sizes smaller than 3-inches, wall sleeves shall be steel oversize sleeves furnished with a full circle, integral or continuously welded waterstop collar. The sleeve seal shall be the mechanically expanded, synthetic rubber type. Provide all associated bolts, seals and seal fittings, pressure clamps or plates necessary to achieve a watertight installation. Sleeves shall extend the full thickness of the concrete. Sleeves and seal shall be Link Seal.

2. For larger pipe sizes, wall sleeves shall be statically cast ductile iron mechanical joint wall sleeves. Unless specified or shown otherwise for a specific situation, wall sleeves shall be mechanical joint bell-plain end type with waterstop/thrust collar. The collar shall be capable of withstanding a thrust force caused by a 250 psi dead end load from either direction on that size pipe. Sleeves shall be constructed with studs and mechanical joint retainer gland on the air side of the concrete structure. Provide retainer gland where shown on the Drawings. Where the concrete structure is exposed to dirt on one side and is wet on the other side, construct with studs and glands on the dirt side.

C. Wall Pipes

1. Wall pipes shall be either statically cast ductile iron with integral waterstop/thrust collar or centrifugally cast ductile iron with a continuously welded waterstop/thrust collar. The welded-on collar shall be attached to the pipe by the manufacturer. The collar shall be capable of withstanding a thrust force caused by a 250 psi dead end load from either direction on that size pipe. Wall pipes shall be furnished uncoated on the outside and cement lined on the inside. Unless specified or shown otherwise, wall pipes shall be flange end type.

2. Wall pipes shall be lined in one manufacturer's facility and delivered to the job site ready for use.

2.05 Coatings

The exterior of pipe and fittings for buried service shall be factory coated with an asphaltic coating conforming to AWWA C151/ANSI 21.51 for ductile iron pipe, AWWA C115/ANSI 21.15 for flanged pipe and AWWA C110/ANSI 21.10 for fittings. Pipe and fittings which shall be exposed or submerged shall be factory coated with a general purpose rust inhibitive primer compatible with the type of paint which will be field applied in accordance with the requirements of Section 09900 of these Specifications.

2.06 Linings

A. Pipe and fittings shall be cement lined in accordance with AWWA C104/ ANSI A21.4, standard thickness, unless specified otherwise.

2.07 Retainer Glands

Retainer glands for ductile iron pipe shall be Megalug Series 1100, as manufactured by EBAA Iron, Uni-Flange Series 1400, as manufactured by Ford Meter Box Company, or Star Pipe Products Star-Grip Series 3000.

2.08 Pipe Supports

Pipe supported from underneath and not subject to expansion shall have cast-in-place concrete supports as shown on the Drawings or adjustable pipe saddle supports on properly sized pipe stanchions and ample, properly grouted floor flanges. Saddle supports shall be equal to Grinnell, Figure 264.

Part 3 Execution

3.01 Cutting

A. When new or existing pipe is required to be cut, the pipe shall be cut in such a manner as to leave a smooth end normal to the axis of the pipe.

B. All cutting of ductile iron pipe shall be performed with a cutting saw. All burrs shall be removed from the inside and outside edges of all cut pipe. All damaged linings and coatings shall be repaired.

C. Lining Repair: Repair epoxy linings and recoat spigot ends of cut pipe with Protecto 101 or Madewell 1104 coal tar epoxy in accordance with the manufacturer's recommendations and as specified below:

1. Remove all burrs and areas of loose lining materials by sanding or scraping to bare metal.

2. Remove oil and lubricants used during field cutting.

3. Lining shall be stripped back a minimum of 1-inch from the spigot end into well adhered lined areas.

4. Roughen 1 to 2-inches of good lining with a rough grade (40 grit) emery paper, rasp or small chisel, to allow an overlap between new and existing lining.

5. Apply lining repair material in the number of coats required to match the thickness requirements as specified in Part 2 of this Section and in accordance with the manufacturer's recommendations.

3.02 Joint Assembly

A. General: Ductile iron pipe shall be assembled in accordance with ANSI/AWWA C600.

B. Push-On Joints: The inside of the bell and the outside of the pipe from the plain end to the guide stripe shall 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. The plain end shall be centered in the bell and the spigot pushed home.

C. Mechanical Joints

1. 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.

2. Joint bolts shall be tightened by the use of wrenches and to a tension recommended by the pipe manufacturer. When tightening bolts, the gland shall be brought up toward the pipe bell. 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.

3. After installation, bolts and nuts in buried piping shall be given two heavy coats of a bituminous paint. Bolts and nuts for exposed or submerged service shall be coated in accordance with the requirements of Section 09900 of these Specifications.

D. 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 torque 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 for exposed or submerged service shall be coated in accordance with the requirements of Section 09900 of these Specifications.

4. Flanged filler shall be used only where shown on the Drawings or approved by the Engineer to make up minor differences in pipe length, less than 3-inches. Joint bolts shall be increased in length by the thickness of the flange filler.

3.03 Drilling and Tapping

A. Wherever required ductile iron pipe and fittings shall be drilled and tapped to receive 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. Unless shown otherwise, small diameter pipes, less than 2-inches, shall be connected to ductile iron pipe using one of the following methods:

1. Direct tap.

2. Direct tap with service clamp.

3. Direct tap boss.

4. Tapped plug or flange on tapping saddle.

C. In no case shall the effective number of threads be less than 4.

3.04 Constructing Beneath and Beyond Structures

A. Construct beyond buildings and structures in accordance with Section 02610 of these Specifications.

B. All ductile iron pipe installed under buildings or basins shall be encased and backfilled in accordance with Section 02200 of these Specifications.

C. All ductile iron pipes entering buildings or basins shall be adequately supported between the structure and undisturbed earth to prevent damage resulting from settlement of backfill around the structure.

3.05 Constructing Within Structures

A. Proper and suitable tools and appliances for safe and convenient handling and laying of pipe and fittings shall be used. 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. All pipe and fittings shall be carefully examined by the Contractor for defects just before installing and no pipe or fitting shall be installed if it is defective. If any defective pipe or fitting is discovered after having been installed, it shall be removed and replaced in a satisfactory manner with a sound pipe or fitting by the Contractor at Contractor's own expense.

C. All pipes and fittings shall be thoroughly cleaned before they are installed and shall be kept clean until they are used in the completed work. Open ends of pipe shall be kept plugged with a bulkhead during construction.

D. All elbows, tees, brackets, crosses, and reducers in pressure piping systems shall be adequately restrained against thrust.

E. Wall pipe and wall sleeves shall be accurately located and securely fastened in place before concrete is poured. All wall pipe and sleeves shall have wall collars properly located to be in the center of the wall where the respective pipes are to be installed. Pipe passing through the sleeve shall extend no more than three feet beyond the structure without a piping joint.

F. Wall pipe and wall sleeves shall be constructed when the wall or slab is constructed. Blocking out or breaking of the wall for later installation shall not be permitted.

G. 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.

H. Exposed ductile iron piping shall be supported as shown on the Drawings and specified in Section 15094 of these Specifications.

3.06 Field Painting

Field painting of exposed and submerged pipe shall be in accordance with the requirements of Section 09900 of these Specifications.

3.07 Inspection and Testing

All testing shall be in accordance with the requirements of Section 02666 of these Specifications.

3.08 Insulation and Heat Tracing

Provide insulation and heat tracing in accordance with Section 15250 of these Specifications.

3.09 Disinfection

Following installation and testing, potable water lines shall be disinfected in accordance with the requirements of Section 02675 of these Specifications.

END OF SECTION

Part 1 General

1.01 Scope

A. Furnish all labor, materials, equipment and incidentals required to complete and make ready for operation all valves and appurtenances as shown on the Drawings and as specified herein.

B. The equipment shall include, but is not limited to, the following:

1. Butterfly Valves
2. Gate Valves
3. Check Valves
4. Flap Valves
5. Tapping Sleeves and Valves
6. Valve Boxes
7. Stem Guides

1.02 Submittals

A. Submit to the Engineer within 30 days after execution of the Contract a list of materials to be furnished, the names of the suppliers and the date of delivery of materials to the site.

B. Complete shop drawings of all valves and appurtenances shall be submitted to the Engineer for approval in accordance with Section 01340 of these Specifications. Clearly indicate make, model, location, type, size and pressure rating.

1.03 Storage and Protection

Valves and all associated accessories shall be stored and protected in accordance with the requirements of Section 01640 of these Specifications.

1.04 Quality Assurance

The manufacturer shall provide written certification to the Engineer that all equipment furnished complies with all applicable requirements of these Specifications.

Part 2 Products

2.01 Acceptable Manufacturers

A. Provide valves of same manufacturer throughout where possible.

B. Provide valves with manufacturer's name and pressure rating clearly marked on the outside of the valve body.

C. Acceptable manufacturers are as follows:

1. Butterfly valves shall be manufactured by Mueller, Pratt, Val-Matic, or DeZurik.

2. Gate valves shall be manufactured by American Flow Control or Mueller.

3. Check valves shall be manufactured by G-A Industries, APCO Valve Corporation or CCNE.

4. Tapping sleeves shall be Mueller H-610.

5. Tapping valves shall be Mueller H-667.

6. Valve boxes shall be Clow F-2450.

2.02 Materials and Construction

A. Valve Connections

1. Provide valves suitable to connect to adjoining piping as specified for pipe joints. Use pipe size valves.

2. Thread pipe sizes 2-inches and smaller.

3. Flange pipe sizes 2-1/2-inches and larger.

4. Solder or screw to solder adapters for copper tubing.

B. Butterfly Valves (BV)

1. Butterfly valves shall be resilient seated, short body design, and shall be designed, manufactured, and tested in accordance with all requirements of AWWA C504, and as modified below. Valves shall be designed for a rated working pressure of 250 psi. Class B, AWWA C504 Section 5.2 testing requirements are modified as follows:

a. the leakage test shall be performed at a pressure of 250 psi;

b. the hydrostatic test shall be performed at a pressure of 500 psi; and

c. proof of design tests shall be performed and certification of such proof of design test shall be provided to the Engineer.

2. Valve bodies shall be ductile iron conforming to ASTM A 536, Grade 65-45-12 or ASTM A 126, Grade B cast iron. Shafts and shaft hardware shall be ASTM A 564, Type 630 stainless steel, machined and polished. Valve discs shall be ductile iron, ASTM A 536, Grade 65-45-12. The resilient valve seat shall be located either on the valve disc or in the valve body and shall be fully field adjustable and field replaceable.

3. Valves shall be installed with the valve shafts horizontal. Valves and actuators shall have seals on all shafts and gaskets on valve actuator covers to prevent the entry of water. Actuator mounting brackets shall be totally enclosed and shall have gasket seals.

4. Operators: Valves for buried service shall have a nut type operator and shall be equipped with a valve box and stem extension, as required.

5. Valve ends shall be mechanical joint type, except where flanged or restrained joint ends are shown. Flange joints shall meet the requirements of ANSI B16.1, or Class 250, but drilled and faced to Class 125 dimensions.

C. Motorized Actuators for Butterfly Valves

1. Actuator shall be an electric motor driven gear reducer with integral controls for motorized and manual operation or rising and non-rising stem valves. The actuator shall be provided and sized by the valve manufacturer to meet the maximum torque requirements of the valve. The actuating unit shall be mounted on and assembled to the valve. The actuator shall provide quarter-turn operation for butterfly valves.

2. Each motor shall be high torque, totally enclosed in a NEMA rated housing. The motor starting torque shall be equal to 2-1/2 times the running torque. The motor shall have AIEE standard Class F insulation. The grease tight operation shall be assured by the use of dual motor shaft seals.

3. The gearing shall be combined helical/spur and worm gear type, accurately machined. Helical gears shall be alloy steel, hardened and ground. Gearing shall be grease lubricated, with high speed parts on anti-friction bearings. An inspection plate on the housing shall be provided to allow inspection of the handwheel declutching mechanism, the motor gears, and for relubrication.

4. Each unit shall include a handwheel for manual operation of the valve drive sleeve through direct gearing. The handwheel shall not rotate during electrical operation. The motor shall not rotate during hand operation. In no case will the handwheel ever be connected with the motor. When the unit is being operated manually, it shall be automatically returned to the electric operation when the handwheel is released.

5. The transfer from electric to manual operation shall be accomplished by a declutching lever arm which will disengage the motor mechanically but not electrically. The unit shall be capable of being clutched or declutched when operated electrically with no damage to the clutch or gear mechanism.

6. The actuator shall operate the valve from full open to full closed in 60 seconds.

7. The controls shall provide a reversing actuator, mechanical and electrical interlock, and thermal overload relays. The contactor shall break all lines to the motor.

8. Position limit switches shall be provided for both open and close positions of travel and shall be connected directly to the valve through continuous gearing, and follow its position at all times. Mechanisms employing intermittent tooth gearing and rotary drive switches are not acceptable.

9. A double acting, adjustable torque limit switch shall be provided, capable of deleting excessive torque caused during seating, unseating, or obstructions. Torque control accuracy shall be within ± five percent.

10. The controls shall provide for local and remote operation. The controls shall include a transmitter for remote indication of valve position.

11. The actuator and controls shall be rated for weatherproof.

12. Actuators for modulating service shall contain all the design and control features as required for the open/close actuators. In addition, they shall contain the following controls:

    a. Actuators shall respond to a 4-20 mA input signal.

    b. Actuators shall be capable of a maximum pulse rate of 100 starts per hour with an accuracy of ± two percent.

    c. Actuators shall have a system adjustment span of zero - deadband.

    d. Actuators shall have a plug in circuit card and capabilities of either "lock in last position" or "fail to close position".

    e. Actuators shall be capable of transmitting a 4-20 mA signal for remote indication of valve position. This signal shall be generated by a resistance to current (R/I) converter.

    f. All controls and terminal blocks shall be contained in the same compartment which is integral to the actuator.

13. Motorized actuators shall be Limitorque L120 Series (multi-turn), Limitorque LY Series (1/4 turn), EIM M/MG Series, EIM 2000 Series (multi-turn), or EIM Q or R Series (1/4 turn).

D. Gate Valves (GV)

1. Gate valves 3-inches in diameter and larger shall be double-disc type conforming to the requirements of AWWA C500.

2. Unless shown otherwise, valves with diameters 14-inches and less shall be designed for vertical installation. Geared operators, where required, are shown on the Drawings.

3. Valves with diameter 16-inches and greater shall be designed for horizontal installation with tracks and rollers, bypass valves, and bevel gear type operator.

4. Valve ends shall be mechanical joint type except where flanged ends are shown.

5. Valves shall open per Owner's standard and shall have O-ring type stem seals.

6. Buried valves shall be equipped with valve boxes. Provide extension stems where required.

7. Manually operated valves, including geared valves, shall be non-rising stem type. All valves six feet or more above the floor shall have chain type operator.

E. Check Valves (CV)

1. Check valves shall be hinged disc type with cast iron body and bronze or bronze-fitted disc. Valves shall be designed for the operating head indicated and shall not slam shut on pump shutdown. Valves shall be equipped with a 1/2-inch stop cock at the high point of the valve for bleeding air from the line.

2. Valves shall be outside weight and lever cushioned type. The cushion chamber shall be attached to the side of the valve body externally and constructed with a piston operating in a chamber that will effectively prevent hammering action at the pump discharge heads specified. The cushioning shall be by air, and the cushion chamber shall be so arranged that the closing speed will be adjustable to meet the service requirements.

3. Valve ends shall be flanged, meeting the requirements of ANSI B16.1, Class 125.

4. Check valves shall be manufactured by APCO, CCNE or GA Industries.

F. Flap Valves

1. Provide resilient seat flap valves as shown on the Drawings. Valve body and flap shall be cast iron in accordance with ASTM A 126, Class B. The flange shall be drilled for mounting to ASME/ANSI B16.1, Class 125 flange.

2. Resilient seat shall be wide seating Buna-N or neoprene, bonded in a groove machined into the valve body.

3. Hinge links shall be high tensile bronze conforming to ASTM B 584, Class A-865 or 304 stainless steel. Each hinge arm shall have two pivot points. A lubrication fitting shall be provided for each pivot.

4. Valves shall be manufactured by Rodney Hunt, Waterman or Hydro Gate.

G. Tapping Sleeves and Valves

1. Tapping Sleeves: Provide caulked type sleeves, suitable for use on both ductile iron and steel pipe, in the sizes shown on the Drawings.

2. Tapping Valves: Provide valves of the mechanical joint type with "O" ring seals, in the sizes shown on the Drawings.

H. Valve Boxes (VB): Valve boxes shall be adjustable cast iron.

I. Stem Guides (SG): Fully adjustable stem guides with bronze bushings shall be installed as shown on the Drawings and wherever necessary to prevent unsupported stem lengths of 10 feet or more.

Part 3 Execution

3.01 Installation

A. All valves and appurtenances shall be installed in the locations shown on the Drawings, true to alignment and properly supported. Any damage to the above items shall be repaired to the satisfaction of the Engineer before they are installed.

B. Install all floor boxes, brackets, extension rods, guides, the various types of operators and appurtenances as shown on the Drawings that are in masonry floors or walls, and install concrete inserts for hangers and supports as soon as forms are erected and before concrete is poured. Before setting these items, the Contractor shall check all plans and figures which have a direct bearing on their location and he shall be responsible for the proper location of these valves and appurtenances during the construction of the structure.

C. Pipe for use with flexible couplings shall have plain ends as specified in the respective pipe sections.

D. Buried flanged or mechanical joints shall be made with cadmium plated bolts. All exposed bolts shall be made with cadmium plated bolts. All exposed bolts and nuts shall be heavily coated with two coats of bituminous paint.

E. Prior to assembly of split couplings, the grooves as well as other parts shall be thoroughly cleaned. The ends of the pipes and outside of the gaskets shall be moderately coated with petroleum jelly, cup grease, soft soap or graphite paste, and the gasket shall be slipped over one pipe end. After the other pipe has been brought to the correct position, the gasket shall be centered properly over the pipe ends with

the lips against the pipes. The housing sections shall then be placed. After the bolts have been inserted, the nuts shall be tightened until the housing sections are firmly in contact without excessive bolt tension.

F. Prior to the installation of sleeve type couplings, the pipe ends shall be cleaned thoroughly for a distance of 8-inches. Soapy water may be used as a gasket lubricant. A follower and gasket, in that order, shall be slipped over each pipe to a distance of about 6-inches from the end, and the middle ring shall be placed on the already laid pipe end until it is properly centered over the joint. The other pipe end shall be inserted into the middle ring and brought to proper position in relation to the pipe already laid. The gaskets and followers shall then be pressed evenly and firmly into the middle ring flares. After the bolts have been inserted and all nuts have been made-up fingertight, diametrically opposite nuts shall be progressively and uniformly tightened all around the joint, preferably by use of a torque wrench of the appropriate size and torque for the bolts.

3.02 Surface Preparation and Shop Painting

Ferrous surfaces of valves and appurtenances shall receive a coating of rust-inhibitive primer compatible with the finish paint specified in Section 09900 of these Specifications.

3.03 Field Painting

All metal valves and appurtenances specified herein and exposed to view shall be painted as part of the work in Section 09900 of these Specifications.

3.04 Inspection and Testing

Following installation, operating tests will be performed to demonstrate to the Engineer that all equipment and accessories will function in a satisfactory manner. The Contractor shall make, at Contractor's own expense, all necessary changes, modifications and/or adjustments required to ensure satisfactory operation.

3.05 Cleaning

Prior to acceptance of the work of this Section, thoroughly clean all installed materials, equipment and related areas in accordance with Section 01710 of these Specifications.

END OF SECTION

Part 1 General

1.01 Scope

A. Work specified in this Section is subject to the provisions of Section 15050.

B. Furnish and install markers, tags and nameplates for heating, ventilating, air conditioning, plumbing and fire protection equipment, piping, controls, and valves to fully identify these items in reference to a master list.

C. Furnish a complete list of all equipment, piping, controls and valves with coordinated designations and locations for each device.

1.02 References

American National Standards Institute (ANSI) Standards: A13.1 Scheme for the Identification of Piping Systems

1.03 Submittals

A. Submit product data in accordance with Sections 01340 and 15050 of these Specifications.

B. Submit catalog cuts, product samples, installation instructions and any other information required to determine compliance with the Contract Documents.

C. Submit complete list of equipment, piping, controls and valves with identification codes and locations. Coordinate this list with the equipment identifications utilized in other sections of the Specifications and by the various trades involved in the work.

1.04 Quality Assurance

A. All materials of a similar type shall be the product of a single manufacturer.

B. Identification materials shall be manufactured by a company regularly producing this type of product. Materials used shall be specifically manufactured for identification purposes.

1.05 Sequencing and Scheduling

A. Coordinate installation of identification devices with the installation of the mechanical equipment.

B. Installation of identification devices may be done at the equipment manufacturer's factory.

C. Install identification devices prior to final testing and balancing of the mechanical systems.

Part 2 Products

2.01 Acceptable Manufacturers

Mechanical identification items shall be manufactured by W.H. Brady Company, Seton Name Plate Corporation, or Champion America, Inc.

2.02 Pipe Markers

A. Markers and direction-of-flow arrows for piping which will be accessible for maintenance shall be of semi-rigid plastic.

B. Letter sizing shall be manufacturer's standard, graduated in accordance to the pipe size.

C. Marker background color and letter color shall be coded to identify pipe contents in accordance with ANSI A13.1.

D. Provide pipe markers with acrylic facing for stainless steel piping subject to halogen corrosion.

2.03 Valve Markers

A. Provide 1-1/2-inch diameter polished brass markers, not less than 19 gauge thickness.

B. Letters shall be 1/4-inch high. Numbers shall be 1/2-inch high. Both letters and numbers shall be stamped and black-filled.

C. Valve marker fasteners shall be either meter seals, four-ply 18 gauge smooth copper wire, brass "S" hooks, or brass jack chain.

D. Markers shall bear indications corresponding to the notations on the framed wiring diagrams, control diagrams and operating instructions.

2.04 Equipment Nameplates

A. Provide 2-1/2 x 3/4-inch aluminum nameplates with black enamel background and either etched or engraved lettering.

B. Provide corrosion-resistant fasteners.

C. Nameplates shall bear indications corresponding to the notations on the framed wiring diagrams, control diagrams and operating instructions.

2.05 Control Nameplates

A. Provide laminated white plastic nameplates with black lettering.

B. Each switch position shall be clearly indicated.

C. Word nameplates to identify the respective product and function.

D. Provide corrosion-resistant fasteners.

Part 3 Execution

3.01 Pipe Markers

A. Install adjacent to each valve and fitting, except on plumbing fixtures and equipment at each branch and riser take-off.

B. Install at each pipe passage through wall, floor and ceiling construction.

C. Install at each pipe passage to underground.

D. Install on 25 foot centers on horizontal pipe runs.

3.02 Valve Markers

Fasten to valve body in a manner which will facilitate being easily read.

3.03 Equipment Nameplates

Mount securely to the appropriate piece of equipment.

3.04 Control Nameplates

Mount securely to the appropriate control device such that switch position and control function are easily read.

3.05 Valve List Frame

Secure on mechanical room wall; mount one valve list in frame.

END OF SECTION

Part 1 General

1.01 Scope

A. All work specified in this Section is subject to the provisions of Section 15050.

B. Design, furnish and install mechanical vibration control and isolation devices of the type specified or as required for proper operation of the mechanical equipment specified in other sections of the Contract Documents.

1.02 Coordination

A. The isolation devices and channel frames shall be products of a single vibration isolation manufacturer. Submittal data shall include size, type, load and deflection of each isolator selected. Submittal data shall also include clearly outlined procedures for setting and adjusting all isolation devices. The isolation manufacturer's representative shall maintain an adequate stock of springs and isolators of the type used so that any changes required during construction and checking can be accomplished promptly.

B. Coordinate the vibration isolation supports with the manufacturers of the equipment to be isolated. Prior to submitting detailed shop drawings to the Engineer for review, the equipment manufacturer shall approve the shop drawings in writing.

C. Special care should be taken when selecting vibration isolators and housekeeping pad thickness to insure sufficient height to the drain pan outlet to allow installation of the water seal and sufficient slope to the floor.

Part 2 Products

2.01 Acceptable Manufacturers

Vibration isolators shall be manufactured by Mason Industries, Amber/Booth, or Vibration Mountings, Inc. provided the equipment meets or exceeds the requirements of the Contract Documents.

2.02 Description

A. All vibration isolators shall be furnished with zinc electo-plated hardware to prevent corrosion and bolt freeze-up and to maintain attractive appearance. To prevent corrosion, steel of cast iron housing shall be treated by phosphating and painting while aluminum housing shall be etched in ChromiCoat solution and painted.

B. Hanger type vibration isolators shall contain a steel spring and 0.3-inch deflection neoprene element in series. The neoprene element shall be molded with a rod isolation bushing that passes through the hanger box.

C. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 15 degree arc before contacting the hole and short circuiting the spring. Springs shall have minimum additional travel to solid height equal to 50 percent of the rated deflection.

D. Provide steel spring isolation at air handling units. Isolators shall be sized for deflection of 1-inch.

E. Provide spring isolated mounting rails for cooling towers. The rail shall be specifically designed for use with the cooling tower provided and shall extend completely underneath the tower.

F. Provide a resilient cross ribbed neoprene isolation pad under packaged water chillers.

Part 3 Execution

3.01 Installation

A. Vibration isolators shall be installed in complete conformance with the manufacturer's recommendations and the Contract Documents. After installation, the isolation manufacturer's representative shall check the various isolators and certify that they have been installed in accordance with his recommendations. Three copies of the certifying letter shall be submitted to the Engineer.

B. Vibration isolators shall be the product of one manufacturer.

C. Vibration isolators for piping risers shall be installed at riser clamps.

END OF SECTION

Part 1 General

1.01 Scope

A. Work specified in this Section is subject to the provisions of Section 15050.

B. Furnish and install thermal insulation for equipment, ductwork, piping and tanks as indicated below.

C. Furnish and install acoustical duct liner board to the extent indicated in the Contract Documents.

1.02 References

A. The latest edition of the testing standards indicated below shall be used as test procedures to verify compliance of submitted products with performance standards specified herein. Manufacturers of submitted products shall certify that materials furnished are tested in accordance with these standards.

1. American Society for Testing and Materials (ASTM) Standards

   ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials

2. National Fire Protection Association (NFPA) Standards

   NFPA 255 Method of Test of Surface Burning Characteristics of Building Materials

3. Underwriters Laboratories, (UL) Standards

   UL 723 Test for Surface Burning Characteristics of Building Materials

1.03 Quality Assurance

A. Insulation products shall have a Flame Spread Rating not exceeding 25 and Smoke Developed Rating not exceeding 50.

B. Insulation or duct liner shall not emit volatile organic compounds or other noxious substances through “off gassing” or promote the growth of fungi or bacteria.

C. Installation shall be performed by workers skilled in the fitting and installation of insulation products.

1.04 Submittals

A. Submit product data in accordance with the provisions of Sections 01340 and 15050.

B. Submit catalog cuts, performance data, sealing tape, mastic and all other information required to demonstrate compliance with the Contract Documents.

C. Submit manufacturer's installation instructions.

Part 2 Products

2.01 Acceptable Manufacturers

Insulation products shall be manufactured by CertainTeed, Knauf, Johns-Manville, Owens-Corning, IMCOA, Pittsburgh-Corning and Armstrong.

2.02 Equipment Insulation

A. Equipment insulation shall be glass fiber board with factory applied foil-skrim-kraft vapor barrier. Thermal conductivity shall not exceed 0.23 BTU·in/hr/Ft^2/°F at 75 degrees F.

B. Equipment carrying conditioned air located in control room shall be provided with 1-inch thick insulation of the type indicated below unless insulation has been factory-furnished by equipment manufacturer.

2.03 Ductwork Insulation

A. Board type insulation material shall be fiberglass, minimum density 3 lbs/cu. ft., and thermal conductivity of 0.23 BTU·in/hr/Ft^2/°F at 75 degrees F mean temperature. Facing shall be factory applied 0.02 perm (maximum) vapor barrier, consisting of glass fiber scrim reinforced laminated facing of aluminum foil and Kraft paper. Board type insulation applications include, but are not limited to – exposed rectangular ductwork.

B. Blanket type insulation material shall be fiberglass, minimum density 1lb/cu. ft., and maximum thermal conductivity of 0.27 BTU·in/hr/Ft^2/°F at 75 degrees F mean temperature. Facing shall be factory applied 0.02 perm (maximum) vapor barrier, consisting of glass fiber scrim reinforced laminated facing of aluminum foil and Kraft paper. Blanket type insulation applications include, but are limited to – exposed round ductwork; concealed round and rectangular ductwork.

C. Ductwork carrying conditioned supply air located in control room shall be insulated with 1-inch thick insulation.

2.04 Pipe Insulation

A. Materials (Indoor Piping for Temperatures 150° F and Less)

1. Piping insulation shall be flexible elastomeric closed-cell type, slipped on the pipe prior to connection whenever possible. Where the slip-on technique is not possible, the insulation shall be pre-slit and snapped over the pipe with pre-

applied adhesive. Butt joints shall be sealed with insulation manufacturer's adhesive or heat fuse method. Where required, the insulation shall be covered with insulation manufacturer's finish. Sealer shall be latex caulk. Thermal conductivity shall not exceed 0.27 BTU·in/hr/Ft^2/°F at 75 degrees F mean temperature.

2. Fittings shall be insulated using fabricated fitting covers of flexible elastomeric closed-cell type insulation in accordance with the manufacturer's instructions. Join slit seams and mitered joints with insulation manufacturer's adhesive or heat fuse method.

Part 3 Execution

3.01 Installation

A. Insulation shall be installed in accordance with the manufacturer's recommendations.

B. Insulation butt joints shall be sealed with tape a minimum of 2-inches wide matching the character of the insulation vapor barrier.

C. Insulation bonding must be by glue, self-adhesive lap or tape. Staples are not permitted. Mechanical fasteners shall only be located on the underside of ductwork three feet or greater in width. Seal all vapor barrier punctures.

D. Surface to be insulated and insulation shall be clean and dry during installation.

E. Insulation shall be continuous through wall or floor penetrations.

3.02 Pipe Insulation

A. Pipe hangers shall be outside of the pipe insulation.

B. Install pipe insulation on exterior pipe below grade to a depth at least six inches below the frost line or 30 inches below grade, whichever is greater.

C. Seal edges of pipe insulation with approved mastic to create a water and vapor proof seal.

D. Insulate all of the services listed below. Where domestic service is called out, it is defined as piping concealed above ceilings and within walls or exposed in return air plenums and mechanical rooms.

1. Domestic potable water piping.

2. Domestic non-potable water piping.

3. ACU condensate piping.

E. Insulate all piping, valves and fittings that are heat traced in addition to those services specified herein.

F. Paint or identify insulation on services in accordance with Sections 09900 and 15190.

END OF SECTION

Part 1 General

1.01 Scope

A. Work specified in this Section is subject to the provisions of Section 15050.

B. Furnish, install and test the sanitary sewer system as indicated on the Contract Documents. Do not scale Drawings.

1.02 References

A. This specification references the latest edition of the publications listed below. Work shall be performed and materials shall be furnished in accordance with these publications as referenced herein:

1. 2006 International Plumbing Code

2. American National Standards Institute (ANSI)

B16.1	Cast Iron Pipe Flanges and Flanged Fittings Class 25,125, 250 and 800
B16.12	Cast Iron Threaded Drainage Fittings
B16.23	Cast Copper Alloy Solder Joint Drainage Fittings-DWV

3. American Society for Testing and Materials (ASTM)

A 48	Gray Iron Castings
A 74	Cast Iron Soil Pipe and Fittings
A 395	Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
A 888	Hubless Cast Iron Soil Pipe and Fittings
B 306	Copper Drainage Tube-DWV
C 564	Rubber Gaskets for Cast Iron Soil Pipe and Fittings
D 2146	Polypropylene Molding and Extrusion Materials
D 2665 or F 441	Chlorinated Polyvinyl Chloride (CPVC) Plastic Pipe, Schedules 40 and 80
D 2665 or F 439	Fittings: Solvent Weld Socket Type, Same Schedule as Piping

F 493 Solvent Cement

4. American Water Works Association (AWWA)

C110 Gray-Iron and Ductile-Iron Fittings, 3-inches through 48-inches, for Water and other Liquids

C112 2-inch and 2-1/2-inch Cast Iron Pipe, Centrifugally Cast, for Water or other Liquids

C302 Reinforced-Concrete Water Pipe - Noncylinder Type, Not Prestressed

5. Cast Iron Soil Pipe Institute (CISPI)

301 Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

6. Federal Specifications (FS)

WW-P-421D Pipe, Cast Gray and Ductile Iron, Pressure (For Water and Other Liquids)

WW-P-541E Plumbing Fixtures (General Specification)

7. National Bureau of Standards (NBS)

Handbook H28

8. Underwriters Laboratories, Inc. (UL) Standards

UL 58 Steel Underground Tanks for Flammable and Combustible Liquids

UL 971 Listed Non-Metal Pipe

UL 1316 Glass Fiber-Reinforced Plastic Underground Storage Tanks for Petroleum Products

1.03 Submittals

A. Submit product data in accordance with Sections 01340 and 15050.

B. Submit product data on all products proposed for installation under this Section, including but not limited to the following:

1. Pipe and fittings.

2. Drains.

3. Cleanouts.

C. Submit installation and maintenance instructions and spare parts lists.

1.04 Quality Assurance

A. Work shall be performed by workers skilled in the installation of sanitary drainage systems.

B. Installation and testing shall be supervised by a licensed master plumber licensed in the State of Georgia who shall be responsible for the installation of the entire system in accordance with the 2006 International Plumbing Code.

C. Installation tools and equipment shall not damage products.

1.05 Jobsite Conditions

Coordinate installation with other building systems in a manner which will preclude interferences.

Part 2 Products

2.01 Polyvinyl Chloride (PVC) DWV PIPE

A. PVC Pipe and Fittings, 2 to 8-inch diameter, concealed or buried:

1. Pipe in accordance with ASTM D 2665.

2. Fittings: Solvent weld socket type, DWV pattern, same schedule as piping, in accordance with ASTM F 1866.

3. Solvent Cement: ASTM D 2564.

2.02 Drains

A. Floor Drain (FD-1)

1. Coated cast iron with double drainage flange, weepholes, bottom outlet, square top, square medium-duty loose-set grate and secondary strainer.

2. Floor drain shall be Josam Series 35460, Smith, Wade, or Zurn.

2.03 Cleanouts

A. Cleanout bodies shall be cast iron conforming to ASTM A 74.

B. Floor Cleanouts (FCO): Adjustable, with bronze tapped plug, scoriated nickel-bronze cover and, if for membraned floors, a clamping device.

C. Cleanout plugs shall not be larger than 4-inches. Cleanouts for cast iron soil pipe shall consists of a longsweep 1/4 bend or one or two 1/8 bends extended to the place indicated; other cleanouts shall be T-pattern, 90-degree branch drainage fittings having screw plugs.

D. Cleanouts shall be manufactured by Josam, Smith, Wade, Zurn, or Ancon.

2.04 Piping Specialties

A. Gaskets for Flanged Joints: Full-face, either neoprene, asbestos, or rubber; rubber gaskets: AWWA C302.

B. Vent Caps for Service Weight Soil Pipe: ASTM A 74.

C. Gaskets, Glands and Bolts for Mechanical Joint Pipe and Fittings: AWWA C110, AWWA C112 and FS WW-P-421C.

D. Unions for Ferrous Pipe 3-Inches in Diameter and Smaller: 150 pound steam-working-pressure zinc-coated malleable iron ground-joint type.

E. Couplings for Joining Hubless Cast Iron Pipe and Fittings: Cast iron housing conforming to ASTM A 48, Class 30A, have bitumastic coating, neoprene gasket conforming to ASTM C 564 and 18-8 stainless steel bolts and nuts.

F. Solder for Solder-Jointed Tubing: 95 percent tin and five percent antimony; flux shall be non-corrosive.

G. Joint in Sanitary Lines Immediately Inside Exterior Wall and Joint Between Pipe of Dissimilar Metal: Dielectric insulating joint, union or coupling.

H. Threaded joints shall have ANSI taper pipe threads conforming to NBS Handbook H.

I. Joint Compound: Either graphite, inert filer and oil or polytetra-fluoroethylene tape.

J. Joints in cast iron soil pipe and fittings having a double seal, compression-type molded neoprene gasket shall have a modified hub to provide a positive seal.

2.05 Flashing

Either soft-temper or cold-rolled copper weighting not less than 16 ounces per square foot or sheet lead weighting not less than four pounds per square foot.

2.06 Escutcheon

Polished chromium-plated pressed steel, split-hinged, locking type held in place by either an internal tension spring or a set-screw and encompass sleeve or opening.

Part 3 Execution

3.01 Installation

A. Horizontal soil and waste pipe grades shall not be less than 1/4-inch per foot for 2-1/2-inch size and smaller, and not be less than 1/8-inch per foot for 3-inch size and larger.

B. Changes of soil, waste, and drain pipe sizes shall be made with reducing fittings. Changes in direction shall be with either 45 degree wyes; long or short-sweep 1/4, 1/6, 1/8, or 1/16 bends; or elbows.

C. Install trap at each fixture and piece of equipment connecting to the sanitary sewer system. Place trap as near fixture and equipment as possible; do not double-trap fixture.

D. Slip joints will be permitted only in trap seals or on inlet side of traps. Union connections shall be made with either tucker or hub drainage fittings.

E. Install and connect products in accordance with product manufacturer's printed installation instructions. Apply joint compound to threaded joints and tighten joints to a degree which will prevent leaks.

F. Interior of pipe, pipe fittings, drains and cleanouts shall be clean before being installed and foreign substances on interior surfaces shall have been removed.

G. Cut ends of copper tube square and remove burrs. Clean outside of tube, where tube engages fittings and inside of fitting contacting tube, with an abrasive material before soldering. Tube and fittings shall not be annealed when making connections. Core solder will not be permitted. Apply heat uniformly around tube and fitting joints in copper tube 2-1/2-inches and larger; use multiflame torch.

H. Join sections of hubless pipe with cast iron assemblies. Tighten threaded assemblies to 60 inch-pounds torque on each joint with a torque wrench specifically designed for the purpose. Retorque each screw not less than 24 hours after initial tightening.

I. Surfaces and structures to, and on, which sewer products will be affixed, placed and erected shall be capable of supporting those products.

J. Set pipe and fittings to line and grade before making-up joints

K. Angular deflection of joints shall not exceed the recommendations of the pipe and fitting manufacturer. Should alignment require deflections to exceed those

recommended, achieve indicated deflection with either special bends or short lengths of pipe.

L. Products to be buried shall rest on excavation bottom; recess lower quadrant of pipe and fittings, and ends thereof; into excavation bottom. Bells shall face upstream. Space between inside of bells and outside of spigots shall be even all around. Ring joints shall be made-up only after retaining groove has been cleaned and only after ring and groove have been lubricated.

M. Excavations shall be free from water and extraneous material immediately before sewer products to be buried are placed therein. Bottoms of trenches shall have been shaped to support bottom quadrant of pipe and fittings and ends thereof. Should rock and material unsuitable to support product exist at design elevation, excavate 8-inches below design elevation and backfill additionally excavated space with sand.

N. Secure products not to be buried to hangers, supports and anchors. Tighten bolts and nuts of flanged joints to a degree which will prevent leaks.

O. Seal open ends of products at end of work period and in a manner which will prevent water and foreign material from entering; remove seals when work resumes.

P. Install escutcheons where exposed piping, bare or insulated, passes through floors, walls and ceilings. Fasten escutcheons to pipe or pipe covering.

Q. Pipe sleeves for pipes passing under footings or through foundation walls shall be Schedule 40 ductile iron pipe extending one foot beyond either face of the footing or wall.

R. Solvent-Welded PVC Joints: All solvent-welded PVC joints shall be installed in accordance with ASTM 2855.

3.02 Floor Drain Installation

A. Coordinate floor drain locations and installation elevations with the Structural and Architectural Drawings.

B. Install floor drains at the local low point in the floor slab.

C. Install floor drains with membrane clamping rings if the floor slab contains a membrane.

D. Protect the floor drain during the floor slab pour to prevent extraneous material from entering the drain or waste piping. Cover during the remainder of the construction to prevent blockage with construction debris.

3.03 Inspection and Testing

A. Test installed sanitary drainage and building sewer systems with water and air in accordance with International Plumbing Code.

B. If system exhibits leaks, repair leaks and retest system until system exhibits no leaks.

C. Test piping that will be buried and concealed prior to concealment.

3.04 Cleaning

A. Remove foreign material from product surfaces, but do not remove manufacturers' labels until Project has been accepted by the Owner, then remove labels.

B. Repair pipe coating that may have been damaged during pipe installation.

END OF SECTION

Part 1 General

1.01 Scope

A. Work specified in this Section is subject to the provisions of Section 15050.

B. Furnish, install and test plumbing fixtures as indicated in the Contract Documents.

1.02 References

A. This Specification references the latest edition of the publications listed below. Work shall be performed and materials shall be furnished in accordance with these publications as referenced herein:

1. 2006 International Plumbing Code

1.03 Submittals

A. Submit product data in accordance with the applicable requirements of Sections 01340 and 15050.

B. Submittal data shall include catalog cuts for fixtures and all accessories. Product data shall completely describe all features and materials of construction.

C. Submit service and maintenance manuals and spare parts lists for all fixtures.

1.04 Quality Assurance

A. Inspect surfaces and structures to, and on, which plumbing fixtures will be affixed, placed, and installed before starting the work of this Section; surfaces shall be capable of supporting fixtures.

B. Surfaces which will be concealed by plumbing fixtures shall have been finished before fixtures are installed.

C. Inspect fixtures before installing.

Part 2 Products

2.01 Hose Bibbs/Wall Hydrants

A. Hose Bibbs (HB-1)

1. Provide brass hose bibbs with removable wheel handle, 3/4-inch inlet and 3/4-inch male hose thread outlet with vacuum breaker.

2. Provide with polished chrome finish.

3. Inlet connection shall be copper tubing solder-type.

4. Hose bibbs shall be Woodford 24P, or equal by Nibco or Chicago.

B. Non-Freeze Wall Hydrant (NFWH-1)

1. Provide 1-inch size non-freeze wall hydrant, cast bronze construction, with integral vacuum breaker-backflow preventer and 1-inch hose thread outlet.

2. Wall hydrant shall be Josam 71050, or equal by Jonespec, or J. R. Smith.

Part 3 Execution

3.01 Installation

A. Install plumbing fixtures in accordance with the manufacturer's installation instructions.

B. Caulk and seal around installed fixtures for a neat, finished appearance; coordinate with architectural finishes and cabinetry related to the plumbing fixtures.

C. Install fixtures in accordance with all requirements of the 2006 International Plumbing Code.

3.02 Demonstration

A. Test plumbing fixtures for proper operation and adjustments of valves, levels, etc.

B. Inspect plumbing connections to fixtures for leaks or damage. Repair as required.

END OF SECTION

Part 1 General

1.01 Scope

A. Work specified in this Section is subject to the provisions of Section 15050.

B. Furnish and install natural gas distribution piping, pressure regulating valves, shutoff valves, safety devices and other items required for a complete system.

1.02 References

A. This specification references the latest edition of the publications listed below. Work shall be performed and materials shall be furnished in accordance with these publications as referenced herein:

1. 2006 International Building Code

2. 2006 International Gas Code

3. National Fire Protection Association (NFPA) Standards

   NFPA 54 National Fuel Gas Code

   NFPA 70 National Electrical Code

4. American Society for Testing and Materials (ASTM) Standards

   ASTM A 53 Pipe, Steel, Black and Hot-dipped, Zinc-coated, Welded and Seamless

   ASTM A 106 Seamless Carbon Steel Pipe for High Temperature Service

   ASTM B 88 Specification for Seamless Copper Water Tube

   ASTM B 197 Cupola Malleable Iron

   ASTM B 280 Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service

   ASTM D 2513 Specification for Thermoplastic Gas Pressure Piping Systems

   ASTM D 2517 Specification for Reinforced Epoxy Resin Gas Pressure Pipe and Fittings

5. American National Standards Institute (ANSI)

Z21.15	Manually Operated Gas Valves
Z21.18	Gas Appliance Regulators
Z21.21	Automatic Valves for Gas Appliances

1.03 Submittals

A. Manufacturers' data, shop drawings and catalog cuts shall be submitted for all components and materials in accordance with Sections 01340 and 15050.

B. The Contractor shall obtain approval and permits from the authority having jurisdiction for the proposed installation prior to submitting to the Engineer.

1.04 Quality Assurance

A. Manufacturers of equipment shall be firms capable of showing at least five years of experience in the design and manufacture of natural gas equipment.

B. Installation of natural gas system components shall be performed by skilled workers experienced in the installation of gas systems employed by and under direct supervision of a licensed contractor.

1.05 Coordination

A. Installation scheduling of natural gas system components shall be coordinated with the building construction schedule to cause no delays in the execution of other portions of the construction contract.

B. Coordinate natural gas service requirements with the local gas company for proper meter selection and installation.

Part 2 Products

2.01 Pipe and Fittings

A. Pipe shall be Schedule 40 black steel, ASTM A 53 or A 106.

B. Outdoor aboveground piping shall be primed and painted with products suitable for the installation environment. Coordinate finish color selection with the Engineer.

C. Pipe Fittings

1. Malleable Iron, ASTM A 197, screwed end, 150 psig rated.

2. Steel butt-weld or socket-weld pipe fittings, Schedule 40.

D. Copper tubing of standard Type K or L conforming to ASTM B 88 or ASTM B 280 may be used only upon approval of the Engineer.

E. Outside underground pipe only may be polyethylene gas piping, Type PE3408 in accordance with ASTM D 2513 if operating pressure is less than 15 psig. Reinforced epoxy resin pipe and fittings conforming to ASTM D 2517 may be used only upon approval of the Engineer.

2.02 Valves and Accessories

A. Valves and accessories shall be AGA certified and stamped certifying compliance with ANSI Z21.15, ANSI Z21.18 or ANSI Z21.21 as applicable.

B. Shutoff valves 2-inches and smaller shall be cast iron body gas cock, threaded ends; Crane No. 1228, Nibco or Stockham.

C. Shutoff valves greater than 2-inches shall be cast iron body gas cock, threaded ends; Crane No. 324, Nibco or Stockham.

Part 3 Execution

3.01 Pipes and Fittings

A. Install piping in accordance with NFPA 54 and the Standard Gas Code. Piping shall also be supported in accordance with Section 15094 where requirements exceed the 2006 International Gas Code.

B. Test all piping in accordance with NFPA and the Standard Gas Code.

C. Plastic piping shall be buried underground entirely and shall not be used within or under any building or slab.

D. Gas piping shall be electrically continuous and bonded to a grounded electrode but shall not itself be used as a grounding electrode.

E. Underground gas piping shall also be installed in accordance with Section 02610.

3.02 Demonstration

A. The Contractor shall instruct Owner's personnel in proper operation and maintenance of gas system components after final system testing is completed.

B. Provide written confirmation to the Owner that the gas system has been tested, inspected by the authority having jurisdiction, and is in satisfactory working order.

END OF SECTION

Part 1 General

1.01 Scope

A. All work specified in this Section shall comply with the provisions of Section 15050.

B. Furnish and install all refrigerant piping, fittings, valves and accessories for heating, ventilating and air conditioning systems.

1.02 Submittals

A. Submit product data for refrigerant piping components in accordance with the provisions of Sections 01340 and 15050.

B. Submit piping layout drawings in sufficient detail to show all fittings, hanger and support locations and accessories.

C. Submit written approval from the HVAC equipment manufacturer certifying that line sizes, line lengths and piping accessories are acceptable and shall cause no equipment performance problems.

1.03 Quality Assurance

A. Pre-manufactured refrigerant piping assemblies shall be fabricated by companies with at least five years experience in manufacturing refrigerant piping assemblies.

B. Installation of refrigerant piping shall be performed by skilled pipefitters with experience in refrigerant piping installation.

1.04 Delivery, Storage and Handling

A. Store piping in a clean, dry location and not subject to damage.

B. Store piping with evacuation charge intact and ends capped.

C. Handle piping carefully to prevent kinked bends or flattened areas. Pipe with this damage shall not be installed on the Project.

Part 2 Products

2.01 Pipe and Pipe Fittings

A. Refrigerant Piping

1. Piping: Copper tubing, ASTM B 88, Type L, Hard Drawn, Soldered. Copper tubing for refrigeration service shall be ACR type shipped evacuated and with ends capped to prevent contamination.

2. Fittings: Wrought copper, ANSI/ASME B16.26, soldered.

B. Condensate Drains

1. Piping: PVC pipe, ASTM D 1785 Schedule 40, solvent welded.

2. Fittings: PVC socket type, ASTM D 2466, solvent welded.

2.02 Pipe Specialties

A. Pipe Sleeves: Pipe sleeves shall be provided where pipes pass through any concrete or masonry walls or partitions, through any concrete floors or roofs, and through any fire rated enclosure. Annular spaces between wall (or insulation) and sleeve shall be packed with UL labeled fire proofing material sufficient to maintain or exceed the fire rating of the structure as manufactured by Dow or 3M. Provide escutcheons on both sides of sleeve to contain packing.

B. Flexible Pipe Connections: Flexible connection for chiller refrigerant relief piping shall be flexible metal hose constructed of 320 stainless steel wire braid. Hose shall be designed for working pressure or not less than 125 psig and temperatures up to 250 degrees F and shall be 12-inches long with screwed end connections for chiller refrigerant relief piping.

C. Unions: Unions shall be the same material and working pressure as the fittings specified for the piping system. Unions on piping 2-1/2-inches in size and larger shall have a bolted flanged joint.

D. Dielectric Adaptors: Connection between copper and ferrous piping shall be made with an insulating type dielectric adapter.

Part 3 Execution

3.01 Installation

A. Workmanship: Pipe shall be cut accurately to measurements established at the job site and worked into place without springing or forcing. Pipes shall be installed to permit free expansion and contraction without damage to joints, hangers or the building.

B. Changes in direction shall be made with fittings, except where branches are two or more sizes less than the size of the main, the branch may be made using forged steel branch connections such as weldolets, threadolets, latrolets, sweepolets and elbolets by Bonney Forge, Capital Manufacturing, or WFI, Inc.

C. Pitch/Grade: All piping shall be installed with sufficient pitch to ensure drainage and venting.

D. Solder Joint Connections: Copper tubing shall be cut square; ends shall be reamed and all filings removed from interior of pipe. Joints shall be soldered with solder applied through the feed holes and drawn through the full fitting length. Excess solder shall be wiped from joint before solder hardens. Solder shall be a 95/5 tin antimony solder with a petroleum base flux. Soldering to be in accordance with ANSI/AWS A5.8.

E. Threaded Connections: Screw-thread joints shall be made with cut tapered threads. Joints shall be made tight with Teflon tape unless otherwise specified. Not more than two threads shall show after the joint is made tight. Pipes shall have burrs removed by reaming cut end.

F. Welded Connections

1. Mitering or notching pipe to form elbows and tees will not be permitted. Field and shop bevels shall be in accordance with the recognized standards and shall be done by mechanical means or flame cutting. Where beveling is done by flame cutting, surfaces shall be cleaned of slag, scale and oxidation prior to welding. Before welding, the component parts to be welded shall be aligned so no strain is placed on the weld when finally positioned. Height shall be aligned so that not part of the pipe wall if offset by more than 20 percent of the wall thickness. Flanges and branches shall be set true. This alignment shall be preserved during the welding operations. Connections larger than 6-inches shall be made with backing rings at welds.

2. Where temperature of the component parts being welded reaches 32 degrees F or lower, the material shall be heated to approximately 100 degrees F for a distance of three feet on each side of the weld before welding, and the weld shall be finished before the material cools to 32 degrees F.

3. Defective welds shall be removed and replaced at no additional cost to the Owner. Repairing of defective welds by adding new material over the defects or by peening will not be permitted.

4. Electrodes shall be stored in a dry, heated area and shall be kept free of moisture or dampness during fabrication operations. Electrodes that have lost part of their flux shall be discarded.

5. Welding to be in accordance with ANSI/AWS D1.1.

G. Refrigerant lines to packaged HVAC equipment shall be sized by the equipment manufacturer prior to submittal. Written acceptance by the equipment manufacturer of the refrigerant line sizing shall be submitted.

H. Dielectric Isolation

1. Wherever copper, brass or bronze piping systems are connected to steel or iron piping systems, this connection shall be made with dielectric isolators. The

dielectric isolators shall be so designed that non-ferrous piping materials shall be isolated by the use of Teflon or nylon isolating materials made up in the form of screwed type unions or insulating gaskets and bolt sleeves and washers for standard flanged connection. All dielectric isolators shall be selected for the pressure of the system involved.

2. Dielectric isolators shall be Watts, Epco, Crane or Maloney.

I. Insulation shall be applied to refrigerant piping after piping tests are completed and accepted. Suction piping shall be insulated. Liquid piping shall be insulated if clamped with suction piping and the two lines shall be insulated as a unit. Hot gas piping shall not be insulated except where it passes through a finished space, supply or return air plenum or duct, or presents a personnel hazard through regular contact. Insulation shall be as described in Section 15250.

3.02 Flushing and Cleaning

A. Refrigerant Piping: Flush all solid particles from the piping with compressed nitrogen or freon if the piping has not been evacuated. Purge piping with nitrogen or other gas acceptable by the pipe manufacturer to remove all moisture and contaminants.

B. The systems shall not be used, except for chemical cleaning, until the Engineer has been assured that cleaning has been accomplished.

3.03 Field Quality Control

A. All tests shall be made before piping is painted, covered, concealed or backfilled.

B. The testing requirements for the respective systems shall include all those of the applicable governing codes, such as state, local and insurance, and those specified herein. All code-required inspection certificates shall be furnished by the Contractor to the Engineer.

C. The Contractor shall provide all pumps, gauges, valves and other equipment and material necessary to properly conduct the tests. Before testing, remove or otherwise protect from damage, control devices, air vents, fixtures, meters and other equipment that is not designed to withstand test pressures.

D. Systems receiving pneumatic test shall be filled with nitrogen gas and charged to test pressure. Hold test pressure for one hour minimum. Exterior surface of pipe shall show no cracks or leaks and shall be completely drop dry.

E. Pneumatic Pressure Test Criteria

1. Refrigerant Suction Piping: 200 percent of unit operating pressure.

2. Refrigerant Liquid Piping: 200 percent of unit operating pressure.

3. Refrigerant Gas Piping: 200 percent of unit operating pressure.

F. If inspection or test shows defects, such defective work or material shall be replaced. All repairs to piping systems shall be made with new material. No caulking on screwed joints, cracks or holes will be acceptable. Failed welds must be cut out and replaced. Where it becomes necessary to replace pieces of pipe, such replacements shall be in the same length as the defective piece. Tests shall be repeated after all defects have been made good.

END OF SECTION

Part 1 General

1.01 Scope

A. All work specified in this Section shall comply with the provisions of Section 15050.

B. Furnish all appropriate labor, tools, materials and equipment necessary to supply, receive, store and install split system air conditioning units.

1.02 References

1. 2006 International Mechanical Code

2. Underwriter's Laboratory (UL) Standards

3. American National Standards Institute (ANSI) Standards

   ANSI/ASHRAE 15 Safety Code for Mechanical Refrigeration

4. National Fire Protection Association (NFPA) Standards

   NFPA 70 National Electrical Code

   NFPA 90A Installation of Air conditioning and Ventilating Systems

5. Air Moving and control Association (AMCA)

   AMCA 210 Laboratory Methods for Testing Fans for Rating

   AMCA 301 Method of Publishing Sound Ratings for Air Moving Devices

1.03 Submittals

A. Submit shop drawings in accordance with the requirements of Section 15050 and Division 1.

B. Shop drawings shall include, but not necessarily limited to, the following:

1. Identification by equipment number.

2. Performance Data: Including evaporator and condenser air quantity, unit KW input, evaporator fan brake HP, fan rpm, air velocity and pressure loss across evaporator coil.

3. Equipment operation weight.

4. Catalog data marked to indicate specified components used.

5. Unit specifications and drawings describing construction methods, including materials, metal gauges and component spacing and thickness.

6. Fan characteristic curve for each fan selection.

7. Operating sound level data of fan.

8. Arrangement of unit.

9. Complete dimensional data of each representative unit.

10. Arrangement, location and size of drains and electrical connections.

11. Complete cooling performance for each unit.

12. Mounting details.

1.04 Warranty

Split system air conditioning units shall include a one year warranty on all parts and labor and a five year warranty on all compressors.

Part 2 Products

2.01 Acceptable Manufacturers

Acceptable manufacturers for split system air conditioning units are: Trane, York, and Carrier.

2.02 General

Split system air conditioning units shall comply with the requirements listed in this Section and capacities, performance, and arrangements as indicated on the Drawings. Units shall be completely factory assembled, piped, internally wired and run-tested to check cooling and heating operation, fan rotation, and control sequences.

2.03 Indoor Fan-Coil Unit

A. General: Indoor fan-coil unit shall include an insulated casing, centrifugal fan, motor, starter, control transformer, DX cooling coil, electric heater, insulated drain pan, throw-away filters and all accessories required for proper, safe, and reliable operation.

B. Unit Casing

1. The casing shall be of unitary, insulated construction erected on a structural steel base frame with heavy gauge galvanized steel panels, ribbed, flanged and reinforced for structural strength and rigidity. The panels shall be removable

providing access to all internal parts and shall be secured by corrosion resistant screws or bolts. Panel shall have a neoprene gasket around entire periphery.

2. Frame shall be free standing such that panels are not an integral part of the unit frame or support. Coil shall be removable through access panels without dismantling unit.

3. The unit shall be furnished with an insulated drain pan under the complete fan and coil section. The drain pan shall have a threaded condensate drain connection.

4. The entire fan and coil section shall be insulated with a minimum of 1-inch thick, 3 lbs/cu.ft. density fiberglass insulation. Unit may have instead of fiberglass blanket, 1-inch (minimum) of foamed-in-place under pressure polyurethane foam. Insulation shall be fireproof, vermin proof, and odorless.

5. All surfaces, inside and out, shall be chemically cleaned, phosphatized, zinc-coated steel, thoroughly rinsed, hot air blast dried, and coated with baked enamel paint. Finish shall be factory applied.

6. The unit shall be provided with extended collar to facilitate duct connection.

C. Indoor Fan

1. Fans shall be tested and rated in accordance with AMCA 210. Fans shall be direct or belt drive type. Motors shall be rated for continuous duty with a 1.15 service factor. Motor shall have internal overload protection and be resiliently mounted.

2. Fan wheels shall be heavy-duty, centrifugal, forward curved, double-width, double-inlet (DWDI) type mounted on a polished steel shaft coated with a rust inhibitor. Bearings shall be designed for a minimum L-10 life of 120,000 hours.

D. Filters: Filter section frames shall hold filters in place and effect a seal between sections to prevent bypass of air around filters. Filters shall be 2” thick, disposable, 30 percent efficient per ASHRAE Standard 52. A spare set of filters for each unit shall be delivered to the Owner after startup.

E. DX Cooling Coil: Coil shall be fabricated of seamless copper tubing with continuous configurated aluminum plate fins. Fins collars shall be drawn and belled, and then securely bonded to the tubes by means of mechanical expansion of the tube. Fin spacing shall be not less than eight fins per inch nor more than twelve fins per inch. The coil shall be factory pressure and leak tested at 375 psig.

F. Electric Heater: Electric heater shall be factory installed in the air handling unit. Heater shall be provided with thermal overload relay and control transformer. Heating elements shall be constructed of heavy-duty nickel chromium elements. Heater shall be UL approved.

2.04 Outdoor Unit (Condensing Unit)

A. General

1. Outdoor units shall include hermetic/semi-hermetic compressors, fans, motors, drives, outdoor coil and all accessories required for proper, safe and reliable operation.

2. Outdoor unit shall be pad mounted as indicated on the Drawings.

B. Unit Casing: The casing shall be of galvanized steel and of unitary construction erected on a structural steel base frame. Access panels shall be provided for easy access to all internal parts.

C. Compressors: Compressor shall be mounted on vibration isolators. Vibration eliminators shall be used in the compressor suction and discharge lines. Compressor shall be furnished with crankcase heater and a discharge line muffler. Refrigerant circuit shall be provided with a suction line accumulator, an ASME liquid line receiver, filter/dryer and refrigerant check valve.

D. Outdoor Coils

1. Outdoor coils shall be fabricated of seamless copper tubing. Coils shall have continuous configurated aluminum plate fins. Fin collars shall be drawn and belled, then securely bonded to the tubes by means of mechanical expansion of the tube. Fin spacing shall be not less than eight fins per inch nor more than 12 fins per inch.

2. Coils shall be factory pressure and leak tested to 400 psig. Coils shall be vacuum dehydrated at 175 degrees F and shipped with a dry holding charge.

3. Provide PVC coated metal grilles for coil protection.

E. Outdoor Fans: Outdoor fans shall be propeller type with aluminum blades, with all exposed fan and shaft surfaces suitably weatherproofed. Fan motors shall be designed for outdoor application with built-in thermal overload protection. All fan electrical wiring shall be factory installed in accordance with NEMA Standards. Fans shall be statically and dynamically balanced, provide draw-thru vertical air discharge.

2.05 Unit Controls

A. Unit shall be furnished with main power disconnect, fuses, starters, relays, and magnetic contactors for compressors and fan motors. A factory-mounted, 24 volt control power transformer shall be furnished. Internal control and power wiring shall be numbered and harnessed and shall be connected to numbered terminal strips.

B. Outdoor unit operating and safety controls shall include high pressure cutout, low pressure cutout, crankcase heaters, freezestat, compressor overload protection and compressor motor winding thermostat for each compressor. Provide low ambient controls for winter startup and operation up to 0 deg F.

C. Control circuit shall incorporate a non-recycling relay, which shall lock out the compressor to prevent short cycling.

D. Provide compressor time delay circuit (five minute minimum) and electric defrost cycle with field selectable interval timer. Unit shall be capable of simultaneous heating duty and defrost cycle operation when using electric heaters.

E. Provide NEMA 3R disconnects for outside units and NEMA 1 (or as scheduled or shown on the Drawings) disconnects for inside units meeting the requirements of Division 16.

Part 3 Execution

3.01 Installation

A. Install and adjust each unit in accordance with the Drawings and the manufacturer's recommendations. The Contractor is responsible for charging the unit, installation of refrigerant piping between indoor and outdoor units and installation of a mixing box and economizer cycle controls.

B. Demonstrate operation of unit complete with all control functions and safety devices. Provide written certification to the Engineer to insure that such demonstration has been successfully completed.

C. Anchor condensing units to service pads with full-size bolts and minimum 4-inches embedment.

D. Route fan coil unit condensate piping to drain in accordance with applicable codes.

E. Install new air filters prior to final acceptance and occupancy by the Owner. Do not operate the units at any time without proper air filters in place.

F. Verify proper operation of the air conditioning system complete with all operating and safety controls.

END OF SECTION

Part 1 General

1.01 Scope

A. All work specified in this Section is subject to the provisions of Section 15050.

B. Furnish and install electric heaters of the type and capacity scheduled in the Contract Documents.

1.02 References

A. The latest edition of the publications listed below is included as part of these Contract Documents.

1. 2006 International Mechanical Code

2. National Fire Protection Association (NFPA)

   NFPA 70 National Electrical Code (NEC)

   NFPA 90A Installation of Air Conditioning and Ventilating Systems

3. Underwriters Laboratories (UL) - UL listed products

1.03 Submittals

A. Submit product data in accordance with the provisions of Sections 01340 and 15050.

B. Submit product data on all products proposed for installation under this Section, including but not limited to the following:

1. Unit heaters.

2. Unit heaters, corrosion resistant.

C. Submittal data shall include catalog cuts and other information required to evaluate conformance with these Specification requirements. Data submitted shall include at least the following:

1. Materials of construction.

2. Heating capacity.

3. Electrical requirements.

4. Accessory items.

5. Installation and maintenance instructions.

6. Disconnects.

1.04 Coordination

Electric heaters of a specific manufacturer have been used as the basis of design. Any modifications to controls, electrical connections, structural supports, etc., that result from the use of equipment by any other manufacturer shall be coordinated with all other trades; this coordination shall occur before delivery of the equipment from the manufacturer. Any modifications shall be performed without incurring additions to the Contract.

Part 2 Products

2.01 Unit Heaters

A. Unit heaters shall have steel housing, adjustable horizontal louvers, propeller-type fan resilient-mounted, motor with built-in automatic reset thermal overload protection, 3-pole heavy duty contactor, thermostat and 24 volt control power transformer. Heater shall be UL listed.

B. Heating elements shall be steel and monel spiral finned, with fins copper brazed to sheath.

C. Each unit heater shall be provided with an integral or wall mounted thermostat as indicated on the equipment schedules set at 70 degrees F (adjustable 40 - 100 degrees F). Thermostats shall be as specified in Section 15950.

D. Acceptable Manufacturers: Chromalox LUH Series, Q-Mark MUH Series or Markel.

2.02 Unit Heaters, Corrosion Resistant

A. Heavy stainless steel sheet metal housing and fan with stainless steel hardware, adjustable discharge louvers and rear wire protective grille. Heater shall be UL listed.

B. 304 stainless steel fin tube heating elements with terminals protected by NEMA 4X enclosure.

C. Epoxy painted, totally enclosed, permanently lubricated ball bearing fan motor.

D. NEMA 4X rated electrical enclosure.

E. Each unit heater shall be provided with an integral or NEMA 4X room thermostat as indicated in the equipment schedules set at 70 degrees F (adjustable from 40 - 100 degrees F).

F. Moisture and corrosion resistant automatic reset thermal cutout and 3-pole heavy duty contactor.

G. Mounting brackets, epoxy painted.

H. Acceptable Manufacturers: Chromalox HDH Series, Q-Mark JUW Series or Indecco Triad Series.

Part 3 Execution

3.01 Installation

A. Electric heaters shall be installed in complete conformance with the manufacturer's recommendations and the Contract Documents.

B. Coordinate electrical construction with heater installation.

C. Mount wall mounting brackets rigidly to building structure with amply sized anchor bolts or machine bolts.

D. Touch up any epoxy painted surfaces damaged during installation with paint materials recommended by the heater manufacturer.

3.02 Demonstration

A. Test operating controls for proper heater operation to maintain temperature setpoint conditions.

B. Verify proper operation of all safety controls.

C. Adjust discharge louvers for even air distribution in the heated space.

END OF SECTION

Part 1 General

1.01 Scope

A. Work specified in this Section is subject to the provisions of Section 15050.

B. Furnish and install unitary fans of the size, type, capacity and characteristics described within the Contract Documents.

1.02 References

A. This Specification references the latest edition of the publications listed below. Work shall be performed and materials shall be furnished in accordance with these publications as referenced herein.

1. 2006 International Mechanical Code

2. Underwriter's Laboratories (UL) Standards

   UL 705 Power Ventilators

3. National Fire Protection Association (NFPA) Standards

   NFPA 70 National Electrical Code

   NFPA 90A Installation of Air Conditioning and Ventilating Systems

4. Air Movement and Control Association (AMCA) Standards

   AMCA 99 Standards Handbook

   AMCA 210 Laboratory Methods of Testing Fans for Rating Purposes

   AMCA 300 Test Code for Sound Rating Air Moving Devices

5. American Society for Testing and Materials (ASTM) Standards

   D 4167 Standard Specification for Fiber-Reinforced Plastic Fans and Blowers

1.03 Submittals

A. Submit product data in accordance with the provisions of Sections 01340 and 15050.

B. Submit product data on all products proposed for installation under this Section, including but not limited to the following:

1. Wall-mounted propeller fans

C. Submittal data shall include catalog cuts, performance curves and other information required to evaluate conformance with these Specification requirements. Data submitted shall include at least the following:

1. Materials of construction.

2. Fan performance data and AMCA certification.

3. Fan motor, horsepower, starters, electrical data and/or disconnects where specified or shown.

4. Fan accessories.

5. Installation and maintenance instructions.

6. Spare parts lists.

7. Disconnect switches where specified herein.

D. Motors shall meet the requirements of Division 16.

1.04 Quality Assurance

A. Provide factory built and tested fan equipment. Test fans in accordance with AMCA 210 and 300. Fans shall bear the AMCA Certified Performance Seal for both air and sound performance.

B. Provide factory balanced fan wheel and shaft assemblies. Provide statically and dynamically balanced fan assemblies. Imbalance shall not exceed limitations of the fan bearings for maximum rated design life.

C. Belt drives shall be designed for not less than 150 percent of the connected driving capacity. Motor sheave shall be adjustable to provide not less than 20 percent speed variation. Sheaves shall be selected to drive the fan at a speed to produce the scheduled capacity when set in the approximate midpoint of the sheave adjustment. Motors with V-belt drives shall be provided with adjustable bases.

D. Units shall be rigidly constructed of materials suitable for the intended service and shall be installed with accessories listed on the Contract Documents.

E. Fans shall bear the Underwriter's Laboratories label.

Part 2 Products

2.02 Wall-Mounted Propeller Fans

A. Provide belt driven sidewall propeller fans complete with fan blade, one piece steel fan panel with spun venturi and driver support frame, motor and drive, bearings, gravity shutter, outlet screens, motor side guards and mounting collars.

B. The propeller fan blade shall have six die formed gusseted blades welded to a spherically formed hub. Provide keyway slots and set screws to secure fan wheel to the shaft.

C. The steel fan panel shall be of one piece construction with spun venturi, formed flanges and welded corners. The fan panel shall have a drive support frame providing a rigid platform for the motor and shaft. Provide a thermally fused powdered epoxy coating 4-5 mils thick.

D. Fan shaft shall be ground and polished steel with slotted keyways.

E. Bearings shall be the ball bearing pillow block type. Bearing shall be rated for an average life of 100,000 hours.

F. Provide matching factory fabricated motor side guards, outlet screens and mounting collars.

G. Shutters for supply fans shall be motorized heavy-duty, weatherproof type constructed of 16 gauge galvanized steel. Shutters shall come complete with a properly sized control transformer. Shutters for exhaust fans shall be gravity type. Color charts shall be submitted with shutter shop drawings. All material edges and surfaces shall be thoroughly cleaned and deoxidized prior to application of an inhibitive primer.

H. Acceptable Manufacturers: Loren Cook X Stream Series, Acme or Greenheck.

Part 3 Execution

3.01 Installation

A. All units shall be installed in accordance with manufacturer's recommendations and as shown on the Drawings. Provide adequate supports from wall or structure to prevent sagging, vibration and damage.

B. Units shall be interlocked and controlled as shown on the Drawings and as described in Section 15950 of these Specifications.

3.02 Demonstration

A. Verify proper rotation of fan wheel.

B. Verify proper operation of backdraft damper, and motorized shutter.

C. Adjust fan speed by adjusting or replacing sheaves to obtain proper air flow.

END OF SECTION

Part 1 General

1.01 Scope

A. Work specified in this Section is subject to provisions of Section 15050.

B. Provide materials, labor, accessories, and duct supports necessary to completely fabricate and install ductwork shown on the Contract Documents.

1.02 References

A. The latest edition of the publications listed below is included as part of these Contract Documents:

1. 2006 International Mechanical Code

2. Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) Standards

   a. HVAC Duct Construction Standards

   b. HVAC Systems Duct Design

   c. Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems

   d. Rectangular Industrial Duct Construction Standards

   e. Round Industrial Duct Construction Standards

3. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Standards

   a. Fundamentals

   b. Equipment

   c. HVAC Systems and Applications

   d. Refrigeration

4. National Fire Protection Association (NFPA) Standards

   NFPA 90A Installation of Air Conditioning and Ventilating Systems

   NFPA 90B Warm Air Heating and Air Conditioning Systems

5. Underwriter's Laboratories (UL) Standards

   UL 181 Factory Made Air Ducts and Connectors

6. Air Diffusion Council (ADC) Standards

   ADC FD-72 R1 Flexible Air Duct Test Code

7. American Society for Testing and Materials (ASTM) Standards

   ASTM A 90 Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles

   ASTM A 525 General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process

   ASTM A 527 Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock Forming Quality

1.03 Submittals

A. Submit product data in accordance with the provisions of Division 1 and Section 15050.

B. Submit product data on all products proposed for installation under this Section, including but not limited to the following:

   1. Duct material product data.

   2. Ductwork layouts (not less than 1/4-inch scale).

   3. Duct joint installation methods.

1.04 Quality Assurance

A. Work shall be performed in a neat, proficient manner by skilled workers experienced in the fabrication and installation of ductwork systems of similar complexity.

B. The Contractor shall demonstrate experience on at least 10 projects requiring similar fabrication and installation methods.

1.05 Delivery, Storage, and Handling

A. Material shall be delivered and stored on the Project site in a manner to protect from dirt, moisture, and physical damage. The Contractor shall be responsible for providing the on-site storage facilities.

B. Do not install materials damaged prior to installation. Replace damaged materials with new materials.

1.06 Sequencing and Scheduling

A. Coordinate installation schedule of ductwork with overall building construction schedule.

B. Coordinate installation locations of ductwork with the work of other trades to maximize the accessibility and maintainability of all building systems.

Part 2 Products

2.01 Description

A. SMACNA Standards indicated shall mean standards published by the Sheet Metal and Air Conditioning Contractor's National Association, Inc. Ductwork shall be constructed in complete conformance with the latest edition of the SMACNA Manual. Duct classification shall be as follows unless shown on the Drawings otherwise:

1. All ductwork unless noted otherwise: Medium Pressure - 4-inches static pressure, Class A Seals.

B. Ductwork shall be round or rectangular as indicated on the Drawings. Sizes given shall be considered to be the minimum, and any conversion from the given shape shall be made without increasing air velocity or friction losses. All duct dimensions indicated are net clear inside dimensions. Materials of construction of ductwork shall be as follows, unless shown on the drawings otherwise:

1. Ductwork shall be constructed of G90 galvanized steel in the following systems:

   a. All ductwork in the air-conditioning systems serving the control room.

2.02 Medium Pressure Ductwork

Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards and ASHRAE Handbooks, except as indicated. Provide duct material, gauges, reinforcing, and sealing for the operating pressures indicated.

Part 3 Execution

3.01 General

A. Transitions shall be made with a slope not exceeding 1 in 4 where space permits.

B. Transverse joints shall be sealed in accordance with SMACNA HVAC Construction Standards "Duct Sealing Requirements" with UL listed mastics.

C. Round duct shall be connected to rectangular duct using spin-in fittings with scoop and damper or scoop only with no damper as indicated on the Drawings.

D. Install and support ductwork per SMACNA Standards.

3.02 Sheet Metal Work

Unless otherwise specified or shown on the Drawings construct and install all sheet metal work in accordance with the latest editions of SMACNA HVAC Duct Construction Standards, SMACNA Rectangular Industrial Duct Construction Standards, or SMACNA Round Industrial Duct Construction Standards.

3.03 Field Quality Control

A. All ductwork shall be leak tested. Ductwork leak testing shall be performed in accordance with SMACNA Air Duct Leakage Test Manual and shall be sealed to provide a system that is within the allowable leakage limits. The ductwork test report shall be submitted to the Engineer.

B. If the system is tested in sections, the leakage rates shall be added to define the performance of the whole system. Leakage concentrated at one point may result in objectionable noise, even if the system passes the leakage rate criteria. This noise source must be corrected to the satisfaction of the Engineer.

C. Ductwork shall be insulated or acoustically lined where shown on the Drawings or specified in Section 15250.

END OF SECTION

Part 1 General

1.01 Scope

A. Work specified in this Section is subject to the provisions of Section 15050.

B. Furnish and install air outlets and inlets of the size, type, capacity, and characteristics described within the Contract Documents.

1.02 References

A. This Specification references the latest edition of the publications listed below. Work shall be performed and materials shall be furnished in accordance with these publications as referenced herein:

1. Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) Standards

   HVAC Duct Construction Standards

2. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Standards

   ASHRAE 70 Methods of Testing for Rating the Performance of Outlets and Inlets

3. Air Conditioning and Refrigeration Institute (ARI) Standards

   ARI 650 Air Outlets and Inlets

4. National Fire Protection Association (NFPA) Standards

   NFPA 90A Installation of Air Conditioning and Ventilating Systems

5. Air Movement and Control Associations (AMCA) Standards

   AMCA 500 Test Method for Louvers, Dampers, and Shutters

6. Air Diffusion Council (ADC) Standards

   ADC 1062:GRD Test Code for Grilles, Registers, and Diffusers

7. American Society for Testing and Materials (ASTM Standards)

   ASTM E 90 Standard Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions

1.03 Submittals

A. Submit shop drawings and product data in accordance with the provisions of Sections 01340 and 15050.

B. Submit product data on all air inlets and outlets including actuators proposed for installation under this Section.

C. Submit charts for color selection.

D. Submit sound attenuation data for acoustical products and sound power data for all outlets.

E. Submit airflow versus pressure drop performance data.

F. Submit louver schedule indicating type and sizes to suit field verified wall openings.

Part 2 Products

2.01 Acoustical Louvers

A. Construction

1. Frame shall be welded, box style and constructed of 5005-H34 aluminum.

2. Frame depth shall be 4-inches.

3. Frame minimum thickness shall be 0.081-inch.

4. Blade minimum thickness shall be 0.081-inch.

5. Perforated aluminum interior side of blade minimum thickness shall be 22 gauge.

6. Acoustical fill shall be 6 pounds per cubic foot density fiberglass.

7. Provide with 0.081-inch thick extended sill.

8. Provide with continuous appearing stationary blades.

9. Provide with Kynar 500 finish on all exposed surfaces, color selected by the Engineer.

10. Provide with aluminum insect or bird screen, mounted on interior side of louver, as indicated on the Louver Schedule on the Drawings.

B. Performance

1. Louver shall have a free field noise reduction as follows:

Octave Band / Frequency (Hz)	Free Field Noise Reduction (dB)
2/125	10
3/250	11
4/500	18
5/1000	20
6/2000	19
7/4000	20
8/8000	21

2. Louver air flow performance shall be AMCA certified. See the Louver Schedule on the Drawings for louver air flow performance.

C. Acceptable Manufacturers: Equal to Ruskin Model ACL 445.

2.02 Grilles, Registers and Diffusers

A. Units shall be of the type, size and construction as scheduled on the Drawings.

B. Unless otherwise noted on the Drawings, all units shall be supplied with a factory finish of white baked enamel.

Part 3 Execution

3.01 Louvers

A. Louvers shall be installed according to the manufacturer's recommendations, and shall be caulked and sealed at the frame and flanges to make the installation weathertight. Install louvers plumb, level, in plane of wall, and in alignment with adjacent work.

B. Install joint sealants in accordance with the requirements of Division 7.

C. Clean louver surfaces in accordance with manufacturer's instructions.

D. Repair minor damaged surfaces as directed by the Engineer.

END OF SECTION

Part 1 General

1.01 Scope

A. All work specified in this Section is subject to the provisions of Section 15050.

B. Furnish and install components and appurtenances required for the automatic control of each HVAC system or item. Automatic control system shall be complete with all devices required for a complete working system to attain the operating sequences specified or noted in the Contract Documents.

C. All controls and control wiring shall be provided under this Division and installed according to Division 16 of these Specifications. Where control power is not available in the vicinity of mechanical equipment, a transformer shall be furnished and installed to convert power voltage to control voltage. The transformer may be an integral part of the starter.

1.02 References

A. UL - Underwriters Laboratories, Inc.

B. NEMA - National Electrical Manufacturers Association

C. NEC - National Electrical Code

D. NFPA - National Fire Protection Association

E. ASME - American Society of Mechanical Engineers

F. Standard Mechanical Code

G. Local Codes and Ordinances

1.03 Electrical Coordination

A. Electrical work provided for HVAC automatic control systems under this Section, including materials and methods, shall be subject to the requirements of Division 16. Where work does not comply with the appropriate provisions of Division 16, the work shall be removed and replaced to comply with the Contract Documents at the expense of the Contractor. To ensure that proper materials are selected and suitable installation methods are used, provide all electrical work associated with HVAC controls under this Section in accordance with the following Sections unless noted otherwise herein:

1. Section 16050 – Basic Electrical Materials and Methods.

2. Section 16111 – Conduit.

3. Section 16120 – Wire and Cable.

4. Section 16130 – Boxes.

1.04 Submittals

A. Before ordering devices and components, submit sequences of operation, control diagrams and equipment descriptions for each system or item and obtain approval.

B. Product Data: Manufacturer's technical product data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials, and including installation instructions and start-up instructions. Include panel construction details, controls, instruments, and labeling.

C. Flow Diagrams: Schematic flow diagram of system showing heating and air conditioning equipment, fans, dampers, and control devices.

D. Control Sequences: Sequences of operation shall be a narrative describing functions for start-stop, emergency shutdown, interlock, changeover and temperature-humidity control.

E. Control Diagrams: Control diagrams shall show the power supply wiring, interlock circuit wiring, remote switch and thermostat wiring, emergency shutdown wiring, control devices, control device schedules and setpoints.

F. Equipment descriptions shall comply with Section 15050.

G. Provide maintenance procedures in accordance with Sections 01740 and 15050.

1.05 As-Built Drawings

At the conclusion of Work, correct control diagrams and sequences according to "as-built" conditions.

1.06 Instruction and Adjustment

A. On completion of the job, the Contractor shall have completely adjusted the entire control system. The Contractor must demonstrate to the Owner that final calibrations and adjustments to the system are accurate

B. The Contractor shall arrange to instruct the Owner's operating personnel on operation of the control system for a period of one day (at 8 hrs/day excluding travel time) and supply Owner with three copies of the control operating and instruction manuals. The Contractor shall obtain from the Owner's representative a signed receipt that Owner has received the instruction manuals and complete instruction on the operation of the system.

1.07 Warranty

The control system designated on Drawings and herein specified shall be warranted to be free from original defects in both material and workmanship for a period of one year of normal use and service. Damages arising from other uses shall be deemed the responsibility of the system owner. This warranty shall become effective starting the date the owner accepts the system.

Part 2 Products

2.01 Acceptable Manufacturers

The acceptable manufacturers are: Johnson Controls, Inc., Staefa Control System, Honeywell.

2.02 Starters

Magnetic starters or combination starters as shown on the Drawings or specified herein, complete with running indication lights in an approved enclosure, shall be furnished and installed for mechanical equipment automatically started and stopped, or otherwise controlled by thermostats, timers, or other devices. Starters for all manually controlled equipment shall include running indication lights in an approved enclosure. Switches for starters shall be as shown on the Drawings or specified herein. All starters shall comply with the requirements of Division 16.

2.03 Thermostats

A. Split Systems

1. Provided by unit manufacturer.
2. Provide with subbase.
3. Label fan switch FAN-AUTO.
4. Label system switch OFF-HEAT-AUTO-COOL, auto position to be automatic switchover from cooling to heating.
5. Heat staging to be as scheduled.
6. Mount 5'-0" AFF unless noted otherwise.

B. Fans and Heaters

1. Snap switches permanently sealed against corrosion.
2. Coiled copper tube sensing element.

3. Single Pull Double Throw.

4. 120 Degree F maximum operating temperature.

5. Equal to Honeywell T631C for NEMA 1, 3R and 12.

6. Equal to Honeywell T631F for NEMA 4X requirements.

7. Equal to Johnson Controls A19 Series for NEMA 7 and 9 requirements.

8. The control range of the thermostat shall be 35 to 100 degrees F, adjustable, unless noted otherwise.

9. Thermostats to be wired for close upon temperature rise for fans.

10. Thermostats to be wired for close upon temperature fall for heaters.

11. Mount thermostats 5'-0" AFF unless noted otherwise.

C. Integral Thermostats: Integral thermostats shall be heater manufacturer's standard item for heavyduty operation and shall be factory installed.

2.04 Switches

A. Switch enclosures to house indicating lights and selector switches. Indicating lights shall be light emitting diode (LED) type; incandescent lamps are acceptable.

B. Selector switches to be factory sealed.

C. Selector switches to be rated 600 VAC heavy duty.

D. Unused enclosure holes to be plugged with manufacturer's closure plug.

E. Selector switches to be two or three position as required.

F. Indicator plates to be marked as appropriate:

1. OFF-AUTO

2. START-STOP

3. HAND-OFF-AUTO

G. Equal to General Electric CR104P for standard requirements.

H. Equal to Crouse-Hinds EFS/EFD for NEMA 7 and 9 requirements.

I. Equal to Crouse-Hinds NCS for NEMA 4X requirements.

J. Mount switches 5'-0" AFF unless noted otherwise.

Part 3 Execution

3.01 Inspection

Examine areas and conditions under which electric control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 Installation of Electric Control Systems

A. General. Install systems and materials in accordance with manufacturer's instructions and roughing-in drawings, and details on Drawings. Install electrical components and use electrical products complying with requirements of applicable Division 16 Sections of these Specifications. Mount controllers at convenient locations and heights.

B. Control Wiring. The term "control wiring" is defined to include provision of wire, conduit and miscellaneous materials as required for mounting and connecting electric control devices.

C. Wiring System. Install complete control wiring system for electric control systems. Conceal wiring, except in mechanical rooms and areas where other conduit and piping are exposed. Provide multi-conductor instrument harness (bundle) in place of single conductors where number of conductors can be run along common path. Fasten flexible conductors bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support conductors neatly.

D. Number-code or color-code conductors, excluding those used for local individual room controls, appropriately for future identification and servicing of control system.

3.03 Adjusting and Cleaning

A. Start-Up. Start-up, test, and adjust electric control systems in presence of manufacturer's authorized representative. Demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

B. Cleaning. Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

C. Final Adjustment. After completion of installation, adjust thermostats, damper operators, motors and similar equipment provided as work of this Section. Final adjustment shall be performed by specially trained personnel in direct employ of the manufacturer of primary temperature control system.

3.04 Fans

A. The following fans are three phase. They shall be controlled with a thermostat and HOA switch.

B. All other fans shall be controlled as described in other paragraphs of this Section.

3.05 Electric Unit Heaters

A. The following electric unit heaters shall be controlled with an integral thermostat.

1. Electric Unit Heater: EUH-101, EUH-102, EUH-201, EUH-202.

3.06 Split System Air-Conditioning Units (ACU-101/CU-101, ACU-201/CU-201)

A. The Split System Air-Conditioning Units shall operate with the following sequence of controls.

B. When the unit's ON/OFF switch is in OFF position, the unit shall be off.

C. When the switch is in ON position, the unit shall run with its own factory furnished controls to maintain the space temperature.

END OF SECTION

Part 1 General

1.01 Scope

A. All work specified in this Section is subject to the provisions of Section 15050.

B. Total system balance shall be performed by an independent agency certified by the Associated Air Balance Council (AABC) or the National Environmental Balancing Bureau (NEBB). All work done by this agency shall be by qualified technicians under the direct supervision of an AABC or NEBB certified test and balance engineer.

C. Total system balance shall be performed in accordance with the latest edition of the AABC National Standards for Total System Balance and in accordance with the scope of work defined by the Contract Documents.

D. Total system balance shall not begin until all systems are complete.

E. Upon the completion of the work, the test and balance agency shall submit four copies of the complete Test and Balance Report to the Engineer. Final test and balance report shall be required two weeks following completion of test and balance.

F. One agency will be responsible for all phases of total system balance.

G. The testing and balance agency as part of its contract shall act as an authorized inspection agency, and shall, during the test and balance, list systems that are installed incorrectly, require correction or have not been installed in accordance with Drawings and Specifications.

H. The test and balance agency shall permanently mark the settings of all valves, dampers and other adjustment devices in a manner that will allow the settings to be restored. If a balancing device is provided with a memory stop, it shall be set and locked.

1.02 References

A. Associated Air Balance Council (AABC) Standards: National Standards for Total System Balance.

B. National Environmental Balancing Bureau (NEBB) Standards: Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems

C. Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) Standards: HVAC Systems Testing, Adjusting and Balancing.

1.03 Submittals

A. The name of the test and balance agency, plus the name and registration number of the certified test and balance engineer, shall be submitted for approval within thirty days after the award of the Contract.

B. The selected test and balance agency, plus the name and registration number of certified test and balance engineer, shall be submitted to the Engineer for approval within thirty days after the award of the Contract.

1. Detailed procedures.

2. Agenda.

3. Report Forms.

4. AABC National Project Performance Guaranty.

5. Instrument List and Calibration Dates.

C. A reviewed copy of each of the above listing shall be returned to the test and balance agency before total system balance is begun.

D. If a complete submittal in accordance with Article 1.03, paragraph B. is not received within the specified time, the Engineer reserves the right to select the test and balance agency.

Part 2 Products (Not Used)

Part 3 Execution

3.01 Required Documents

The Contractor shall provide the following, in a timely fashion, to the test and balance agency: Contract Drawings and applicable Specifications; addenda; change orders; reviewed shop drawings; reviewed equipment manufacturer's submittal data; and reviewed temperature control drawings.

3.02 Cooperation

A. The Contractor shall cooperate fully with the test and balance agency and provide:

1. Completely operable systems.

2. The right to adjust the systems.

3. Access to system components.

4. Immediate labor and tools to make corrections and repairs, when required, without undue delay.

5. Balancing dampers as required by test and balance agency.

B. The Contractor shall start-up and maintain all heating, ventilating and air conditioning systems and equipment into full operation and shall continue the operation of same during each working day of testing and balancing. Start-up shall include, as a minimum, the following:

1. All equipment operable in safe and normal conditions.

2. Temperature control systems installed complete.

3. Proper thermal overload protection in place for electrical equipment.

4. Air Systems

a. Filters clean and in place.

b. Duct systems clean of debris.

c. Correct fan rotation.

d. Fire, smoke, and volume dampers in place and open.

e. Coil fins cleaned and combed.

f. Access doors closed and duct end caps in place.

g. All outlets installed and connected.

h. Duct systems leakage shall not exceed the rate specified.

C. If it is determined by the test and balance agency that drive changes are required, the Contractor shall obtain and install all necessary components.

D. The Test and Balance Agency shall cooperate with the Engineer and the Contractor to perform the work in such a manner as to meet the job schedule.

E. The test and balance agency shall leave all system components in proper working order, such as:

1. Replace belt guards.

2. Close access doors.

3. Close doors to electrical switch boxes.

4. Restore thermostats to specified settings.

F. All recorded data shall represent a true, actually measured or observed condition.

G. Any abnormal conditions in the mechanical systems of conditions which prevent total system balance, as observed by the test and balance agency, shall be reported as quickly as possible to the Engineer.

END OF SECTION

Part 1 General

1.01 Scope

A. The electrical work commences with the point of electrical service where shown on the Drawings and includes furnishing all material and labor for a complete electrical installation.

B. The requirements of Division 1 apply to all work hereunder. The General and Special Conditions are a part of this Division of the Specifications and all provisions contained therein which affect this work are as binding as though incorporated herein.

1.02 Definitions

A. Provide: Furnish, install, and connect.

B. Product Data: Catalog cuts and descriptive literature.

C. Shop Drawings: Factory prepared specific to the installation.

D. Low Voltage: 0-600 volts.

E. High Voltage: Above 600 volts.

F. Indicated: Shown on the Drawings.

G. Noted: Indicated or specified elsewhere.

1.03 Material Not Furnished

A. Unless otherwise noted, the following are furnished and installed under other Divisions:

1. Motors
2. Motor starters (except motor control centers)
3. Electric heating and air conditioning equipment
4. Building energy management systems
5. Electrical heat tracing
6. Pilot and control devices for the above equipment

B. All power wiring including associated terminations is provided under this Division. Control and signal wiring shown on the electrical drawings, including associated terminations is also provided under this Division. Control wiring for mechanical

equipment not shown on the electrical drawings is provided under Division 15. Where digital communications cables (fiber optic cables, RS-485 cables, etc.) are specified under Division 17, cable pulling and installation in raceways shall be provided under this Division with any required splices and all terminations provided under Division 17.

1.04 Local Conditions

A. Power will be supplied by the utility company distribution system as indicated. Verify and comply with all power company requirements for metering, pull sections, transformer pads. Make necessary arrangements with the power company for temporary service requirements. Have the power company review submittals on equipment containing utility metering sections.

1.05 Quality Assurance

A. Provide the complete electrical installation in accordance with the National Electrical Code (NFPA 70), Life Safety Code (NFPA 101), and in accordance with applicable local codes. Obtain all necessary permits and have all work inspected by appropriate authorities.

B. All products shall be designed, manufactured, and tested in accordance with industry standards. Where applicable, products shall be labeled or listed by third party certification agencies.

C. Industry Standards: Standards organizations and their abbreviations, as used herein, are as follows. Applicable date for industry standards is that in effect on the date of advertisement of the Project.

1. American National Standards Institute (ANSI)

2. American Society for Testing and Materials (ASTM)

3. Federal Specifications (FS)

4. Institute of Electrical and Electronics Engineers (IEEE)

5. Insulated Cable Engineers Association (ICEA)

6. National Electrical Manufacturers Association (NEMA)

7. National Fire Protection Association (NFPA)

8. Underwriters Laboratories, Inc. (UL)

1.06 Submittals

A. Make all submittals in accordance with the requirements of Section 01340. Approval drawings consist of shop drawings, product data and other information as noted in the individual equipment sections. Except as noted, submittal information is for approval

and equipment may not be installed until submittals have been returned with stamped approval.

B. Information required "for reference" such as product samples, similar unit test reports and time current curves is for the purpose of determining the suitability of a product, selecting breaker settings, etc. This information is to be submitted at the same time as approval data; however, this information will not be returned and stamped approval is not required prior to installation.

C. Except as noted, installation instructions are not required to be submitted. However, it is the Contractor's responsibility to obtain installation information from the manufacturer for all equipment prior to installing the equipment.

1.07 Record Drawings

A. Furnish record drawings in accordance with the requirements of Section 01720. Record drawings consist of submittal data as listed above, operation and maintenance data, and as-built drawings. Record drawings are to reflect the final installation, including any changes during approval, manufacturing tests, and installation.

B. In addition to other required sets, furnish one set of operation and maintenance data for all apparatus requiring service. This set is to be bound in hardback, 3-ring binder(s) located in a hinged metal cabinet in the main electrical room and shall include:

1. Title page with project name; installing contractor's name, address and telephone number; date of installation and warranty period.

2. Index sheet.

3. Complete manufacturer's operation and maintenance data with tabs (corresponding to the index) separating each item or system. Include the name, address, and phone number of the nearest sales and service organization for each item.

C. As-Built Drawings: Furnish one set of prints maintained at the job site at all times with all changes during construction marked thereon. Include on the as-built drawings sufficient dimensions to permit location of underground conduits.

D. Submit the results of any tests required in the individual equipment sections.

1.08 Delivery, Storage, and Handling

A. Ship products to the job site in their original packaging. Receive and store products in a suitable manner to prevent damage or deterioration. Keep equipment upright at all times.

B. Investigate the spaces through which equipment must pass to reach its final destination. Coordinate with the manufacturer to arrange delivery at the proper stage of construction and to provide shipping splits where necessary.

Part 2 Products

2.01 Materials

Provide only new products of the manufacturer's latest design.

2.02 Substitutions

A. Where the words "equal to" follow or precede the listed acceptable manufacturers, equal products of other manufacturers are acceptable and request for substitution may be made during submittal stage.

Part 3 Execution

3.01 Installation

A. The complete installation is to be accomplished by skilled electrical tradesmen, with certified or suitably qualified individuals performing all special systems installation and testing. All workmanship shall be of the highest quality, sub-standard work will be rejected.

B. Schedule the work and cooperate with all trades to avoid delays, interferences, and unnecessary work. If any conflicts occur necessitating departures from the Drawings and Specifications, details of departures and reasons therefore shall be submitted immediately for the Engineer's consideration.

C. Do not stub up conduits prior to receipt of approved shop drawings showing conduit entry locations.

D. Prior to final inspection, clean all dirt, mud and construction debris from all boxes, cabinets, manholes and equipment enclosures.

3.02 Certification and Tests

A. Prior to request for final review, test all systems and repair or replace all defective work. Submit, with request for final review, written certification that all electrical systems are complete and operational.

B. At the time of final review of electrical work, demonstrate the operation of electrical systems. Furnish labor, apparatus and equipment for systems' demonstration.

C. After final review and acceptance, turn over to the Owner all keys for electrical equipment locks. Present to the Owner or the Owner's designated representative, demonstrations and oral instructions for proper operation and maintenance of the electrical equipment and systems.

END OF SECTION

Part 1 General

1.01 Scope

This Section includes basic materials and methods common to all Sections of Division 16.

1.02 Submittals

Submit product data.

Part 2 Products

2.01 Boxes

A. Sheet Metal Boxes: NEMA OS01.

B. Cast Boxes: Galvanized with gasketed cover and threaded hubs.

C. Floor Boxes: Cast iron, adjustable.

2.02 Wiring Devices

A. Switches: FS W-S-896, 20 amp, 120-277 volt, ivory handle.

B. Receptacles: NEMA WD-1; 5-15R; nylon face; ivory. Exceptions : Provide specific use receptacles where indicated. Provide 5-20R receptacles for branch circuits serving one device.

C. Cover Plates: Ivory color, smooth finish, unbreakable nylon or noryl.

2.03 Disconnect Switches

A. Disconnect Switches: UL-98 and NEMA KS-1; heavy duty, quick make, quick break type; horsepower and i2t rated. Provide lever type operating handle directly connected to the switch mechanism; rocker types are not acceptable. Include padlocking provisions and nameplate clearly indicating “ON” and “OFF” positions. Equip all switches with a ground lug and, where neutral conductors are scheduled, provide insulated neutral lugs. Where indicated provide DPDT auxiliary contacts rated 10 amps at 120 VAC minimum.

B. Fusible Switches: Equip with rejection clips for fuse types noted.

C. Enclosure: Stainless steel meeting NEMA 3, 4X and 12 requirements.

D. Acceptable Manufacturers: Cutler-Hammer, General Electric, Square D or Siemens.

2.04 Enclosed Circuit Breakers

A. Circuit Breakers: NEMA AB-1; thermal magnetic trip with magnetic pickup adjustment above 100 amps. Where molded case switches are indicated, provide breaker as specified above with non-adjustable magnetic trip element only.

B. Enclosure: Stainless steel meeting NEMA 3, 4X and 12 requirements.

C. Interrupting Rating: As Indicated.

D. Acceptable Manufacturers: General Electric, Square D or Cutler-Hammer.

2.05 Individual Motor Starters

A. Manual Starters: NEMA ICS-2; general purpose type; trip-free mechanism; with overload relays. Provide pushbutton operation for integral horsepower sizes, and toggle switch or lever for fractional sizes.

B. Magnetic Starters: NEMA ICS-2; NEMA size 0 minimum; magnetically held contactor with field replaceable coil and contacts; bimetallic or melting alloy overload relay, manually reset. Starter shall be rated in accordance with NEMA size designations; fractional sizes and ratings per IEC recommendations are no t acceptable.

C. Magnetic Starter Controls: All controls are 120 volts. Equip each starter with a control power transformer fused on the primary and secondary. Provide starter overload relay auxiliary contacts for red run light, green stop light and amber overload light on the enclosure door. Provide one spare normally open starter auxiliary contact, and door mounted start-stop pushbuttons or hand-off-auto selector switch as indicated.

D. Combination Starters: Molded case circuit breaker rated 22,000 AIC.

E. Enclosure: Stainless steel meeting NEMA 3, 4X and 12 requirements.

F. Acceptable Manufacturers: Allen-Bradley, Cutler-Hammer, General Electric or square D.

2.06 Contactors

A. Control Relays: NEMA A600; heavy duty, machine tool type convertible contacts; electrically held 120 volt coil. Equal to Allen-Bradley Bulletin 700 Type P.

B. General Purpose Contactors: NEMA ICS-2; electrically held; 2-wire control; 120 volt coil. Size and number of contacts as indicated.

C. Enclosure: NEMA ICS-6; Type 1 unless otherwise noted.

D. Acceptable Manufacturers: General Electric, Square D, ASCO, or Cutler-Hammer.

2.07 Control Stations

A. Pushbuttons, Selectors and Pilot Lights: 600 volt, heavy duty, factory sealed.

B. Enclosure: Stainless steel meeting NEMA 4X and NEC Class I, Division 2, Group C and D requirements.

C. Acceptable Manufacturers: Equal to Allen-Bradley Bulletin 800T.

D. Hazardous Areas: Where Division 1 classified areas are indicated, provide control stations equal to Crouse-Hinds EFS/EFD series.

2.08 Individual Surge Suppressors

A. Surge Suppressor: Listed in accordance with UL 1449, Second Edition and UL 1283. Device shall provide surge current diversion paths for 120 VAC circuit application; L-N, L-G, and N-G. Device shall be fused with a surge rated fuse and incorporate a thermal cutout device. An audible alarm shall indicate protection failure. Minimum surge current capability shall be 50 kA.

B. Enclosure: NEMA 4X stainless steel.

C. Acceptable Manufacturers: Equal to Advanced Protection Technologies TE/XP Series (suppressor) and Hoffman (enclosure).

2.09 Fuses

A. Fuses: Current limiting, non-renewable type, rated 200,000 AIC, with rejection feature; Class J or as required by load for ratings 600 amp and below and Class L for ratings 601 amp and above.

B. Acceptable Manufacturers: Bussmann, Chase-Shawmut, or Littelfuse.

2.10 Plywood Backboards

Backboards: Grade BC plywood, 3/4-inch thick. Paint with two coats of flat black paint.

2.11 Supporting Devices

A. Support Channel: Galvanized or painted steel.

B. Hardware: Corrosion resistant.

2.12 Electrical Identification

A. Nameplates: Engraved three-layer laminated plastic, black letters on white background.

B. Wire and Cable Markers: Plastic, split sleeve or tubing type.

Part 3 Execution

3.01 Boxes

A. Provide boxes as shown on the Drawings and as required for splices, taps, wire pulling, and equipment connections. Support boxes independently of conduit. Provide knockout closures for unused openings.

B. Box locations shown on the Drawings are approximate unless dimensioned. Coordinate mounting heights and locations of outlets mounted above counters, benches, backsplashes, and other furnishings. Locate outlet boxes to permit handicap access per ANSI A117.1. Where receptacles are indicated 18-inches above finished floor, dimension is to the bottom of the box. At the option of the Owner's representative, any outlet may be relocated by up to ten feet before it is permanently installed, without incurring additional cost. Install adjacent devices at the same elevation in a common box with one face plate. Install adjacent devices at different elevations in one vertical line.

C. Unless otherwise noted, use only cast outlet boxes. Sheet metal boxes may be used where concealed above ceilings or in dry walls, exposed in electrical closets, and for telephone wiring.

D. Field drill conduit holes in tap, junction and pull boxes so as to afford the maximum bending radius for the conductors.

3.02 Wiring Devices

A. Secure devices to outlet boxes without depending on device plates to pull them tight. Install a bonding jumper between all devices and outlet boxes. Install receptacles with ground pole down.

B. For cord and plug connected equipment, coordinate receptacle configuration with equipment supplied.

3.03 Disconnect Switches

A. Provide switches with voltage, ampere, and number of poles as indicated on the Drawings.

B. Switches are non-fused type, unless Drawings note otherwise, or the switch is used as a disconnect for an item of equipment with a maximum fuse size designated on the nameplate. In such cases, provide fusible type with appropriate fuse. If fusible switches protect conductors with an ampacity less than the rating of the switch, provide a nameplate on the inside front cover of the switch designating the maximum allowable fusing.

C. Install switches so they are rigidly supported and readily accessible. Where mounted on stud walls, provide a plywood backboard secured to the studs with the switch secured to the backboard. Provide stainless steel mounting channel or phenolic spacers to give nominal 1/2-inch separation from concrete walls in wet or damp locations.

D. For disconnect switches serving motors with space heaters, provide lamecoid nameplate engraved “WARNING – Motor space heater energized with switch open”.

3.04 Enclosed Circuit Breakers

A. Provide breakers with voltage, ampere, number of poles, and interrupting ratings as indicated on the Drawings.

B. Install breakers so they are rigidly supported and readily accessible. Where mounted on stud walls, provide a plywood backboard secured to the studs with the breaker secured to the backboard. Provide stainless steel mounting channel or phenolic spacers to give nominal 1/2-inch separation from concrete walls in wet or damp locations.

3.05 Individual Motor Starters

A. Select and install heater elements in motor starters to match installed motor characteristics. Do not use NEC motor full load ampere data for heater selection.

B. Provide a typed label inside each motor starter enclosure door identifying the motor served and listing the motor nameplate data. Provide an engraved nameplate on the exterior of the enclosure door identifying the motor served, the horsepower, voltage and phase rating.

C. Install starters so they are rigidly supported and readily accessible. Where mounted on stud walls, provide a plywood backboard secured to the studs with the starter secured to the backboard. Provide stainless steel mounting channel or phenolic spacers to give nominal 1/2-inch separation from concrete walls in wet or damp locations.

3.06 Contactors

A. Install timer and lighting controls for contactors as indicated.

B. Install indicator lights in enclosure door as indicated.

3.07 Control Stations

Install control stations so they are rigidly supported and located so as not to impair access to equipment for maintenance.

3.08 Individual Surge Suppressors

Install suppressors so they are rigidly supported and accessible.

3.09 Fuses

Equip all fusible devices with fuses. Replace all blown fuses up to final acceptance of the Project. At the completion of the Project, turn over to the Owner spare fuses for each type and size installed; six each for ratings 60 amps and below, and three each for ratings above 60 amps.

3.10 Plywood Backboards

Provide plywood backboards for surface mounted electrical distribution equipment in areas such as mechanical rooms, electrical closets, and equipment rooms. Secure backboards to the building structure and paint with two coats of flat black paint.

3.11 Supporting Devices

A. Fasten hanger rods, support stands, conduit clamps, etc. to building structure using expansion anchors or beam clamps.

B. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit. Do not use powder actuated fastening devices. Do not drill structural steel members.

3.12 Electrical Identification

Provide nameplates for all switchboards, panhelboards, transformers, disconnect switches, individual motor starters, and other items of electrical distribution equipment. Engrave with the equipment identification as indicated; and the voltage, current and interrupting rating. Attach nameplates with screws or rivets; adhesives are not acceptable. Exception: Two-part epoxy glue may be used for NEMA 4/4X enclosures.

END OF SECTION

Part 1 General

1.01 Scope

A. Rigid metal conduit and fittings.

B. Intermediate metal conduit and fittings.

C. Flexible metal conduit and fittings.

D. Liquidtight flexible metal conduit and fittings.

E. Non-metallic conduit and fittings.

F. Electrical metallic tubing and fittings.

1.02 Submittals

Do not submit equipment specified in this Section.

Part 2 Products

2.01 Acceptable Manufacturers

A. Conduit: Allied, Republic, Triangle or Wheatland.

B. PVC Coated Conduit and Fittings: Ocal, Permacote or Robroy.

C. PVC Conduit: Amoco, Carlon or Certainteed.

D. Flexible Conduit: Anaconda, Thomas & Betts, Electric Flex or Triangle.

E. Fittings: Appleton, Crouse-Hinds, Oz or Thomas & Betts.

F. Nonmetallic Flexible Conduit and Fittings: Carlon Carflex.

G. Substitutions: Products equal to those listed.

2.02 Rigid Metal Conduit and Fittings

A. Rigid Steel Conduit: UL 6; ANSI C80.1; hot dip galvanized; minimum size 3/4-inch.

B. Rigid Aluminum Conduit: UL 6; ANSI C80.5; minimum size 3/4-inch.

Part 1 General

1.01 Scope

A. Building wire.

B. Cable.

C. Wiring connections and terminations.

1.02 Submittals

A. Submit product data.

B. Submit test results as listed in Part 3.

Part 2 Products

2.01 Acceptable Manufacturers

A. Low Voltage Conductors: Equal to Aetna, American, Cablec, Continental, Okonite, Pirelli, Southwire or Triangle.

B. Signal Circuit Conductors: Equal to Belden, Continental, Dekoron or Penn.

C. Low Voltage Connectors: Equal to Burndy, Thomas & Betts, Ideal or OZ.

D. Pulling Compounds: Water soluble, equal to Polywater J.

E. Wire and Cable Markers: Plastic, split sleeve or tubing type, equal to Brady Type XC or T & B Type SM.

2.02 Building Wire

A. Thermoplastic Insulated Building Wire: NEMA WC-5.

B. Feeder and Branch Circuits: Single conductor; 98 percent conductivity copper; 75/90 degrees C; 600 volt PVC insulated with nylon jacket; Type THWN/THHN for sizes #1 AWG and smaller. Sizes larger than #1 AWG are XLP insulation type XHHW. Minimum size #12 AWG.

C. Control Circuits: Same as specified above for feeder and branch circuits, except minimum size #14 AWG.

2.03 VFD Cables

VFD Cables: Stranded copped conductors, 100% shielding with foil tape and copper tape, oil and chemical resistant outer jacket, specifically designed for use with variable frequency drives. Cables are 4 conductor plus 2 – No. 14 signal conductors in sizes No. 12 AWG to No. 4 AWG and 4 conductor in sizes No. 2 AWG and larger. Equal to Olflex – VFD.

2.04 Remote Control and Signal Cable

A. Control Cable for Class 1 Remote Control and Signal Circuits: Copper conductor; 600 volt insulation, rated 60 degrees C; individual conductors twisted together, shielded, and covered with a PVC jacket; UL listed.

B. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, rated 60 degrees C, individual conductors twisted together, shielded, and covered with a PVC jacket; UL listed.

C. Plenum Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, individual conductors twisted together, shielded, and covered with a fluoropolymer jacket; UL listed for use in air handling ducts, hollow spaces used as ducts, and plenums.

D. Instrumentation Signal Cables: #16 AWG stranded tinned copper conductors; 600 volt polyethylene insulation; twisted pair or three conductor construction; 100 percent coverage aluminum polyester shield; #18 stranded tinned copper drain wire; vinyl outer jacket; UL listed.

Part 3 Execution

3.01 General Wiring Methods

A. Use only stranded conductors. Exception: Solid conductors size #12 and #10 AWG may be used for receptacle branch circuit wiring.

B. Use 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 75 feet, and for 20 ampere, 277 volt branch circuit home runs longer than 200 feet.

C. Place an equal number of conductors for each phase of a circuit in same raceway or cable.

D. Identification: All conductors shall be identified throughout the electrical system. For control and signal conductors use wiremarkers at all terminals and connections. Color code power circuit conductors as follows:

	120/208 Volt System	277/480 Volt System
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	Grey
Ground	Green	Green

E. For conductors larger than #6 AWG color coding may be accomplished with 1-inch wide colored tape applied at each end of the conductor or at points where conductor is accessible so as to be visible inside the enclosure.

F. Neatly train and lace wiring inside boxes, equipment and panelboards. Support to prevent conductor movement under fault conditions.

G. Provide separate pull and junction boxes to keep analog signal separate from control and power wiring.

3.02 Wiring Installation in Raceways

A. Unless otherwise indicated, install all conductors in conduit.

B. Pull all conductors into a raceway at the same time. Thoroughly swab raceway system before installing conductors. Use wire pulling lubricant for all pulls. Do not exceed the manufacturer's pulling tension.

C. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.

3.03 Installation in Manholes

A. Rack all cables; straight thru pulls are not acceptable.

B. Secure cables to rack supports with tie wraps to prevent motion under fault conditions.

C. Provide a minimum of 6 feet slack for all high voltage cables. Do not splice high voltage cables without approval by the Engineer.

3.04 Wiring Connections and Terminations

A. Avoid unnecessary splices. Splice only in accessible junction or outlet boxes.

B. Make connections to circuit breakers, disconnect switches, panel mains, etc. with solderless lugs.

C. Use mechanical connectors for low voltage splices, taps, fixture and motor connections. Exception: Square thread helical spring plastic cap (wire nut) type connectors are acceptable for solid conductor splices and taps. Provide adapters as required for terminations of multiple conductors.

D. Use insulated throat, spade type crimp on connectors for strap screw device terminals. Exception: Receptacle back wiring provisions may be used for terminating solid conductors.

E. Where possible use connectors with integral, insulating covers. Otherwise tape uninsulated conductors and connectors to 150 percent of the insulation value of conductor.

F. Thoroughly clean wires before installing lugs and connectors.

G. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.

3.05 Field Quality Control

A. Inspect wire and cable for physical damage and proper connection.

B. Torque test conductor connections and terminations to manufacturer's recommended values.

C. Continuity Tests: Ring all conductors for continuity and replace any open conductors.

D. Low Voltage Ground Fault Tests: Meggar all feeder circuits for grounds. Compile and submit a list of meggar readings. Replace all conductors measuring less than 2 megohms to ground.

END OF SECTION

C. PVC Coated Conduit: NEMA RN-1 or UL-6 rigid steel conduit with factory applied external 40 mil PVC coating and urethane interior coating. Prior to coating, treat conduit with a heat polymerizing adhesive so the bond between metal and coating is greater than the tensile strength of the coating. Minimum size 3/4-inch.

D. Fittings and Conduit Bodies: NEMA FB-1; zinc coated; taper-threaded type, material to match conduit. Where PVC coated conduits are indicated all couplings, fittings, conduit bodies, pipe straps, U bolts, beam clamps, flex connections and other accessories shall be stainless steel or shall have factory applied PVC coating. Use PVC coated hubs for connection of coated conduits - locknuts are not acceptable.

2.03 Intermediate Metal Conduit (IMC) and Fittings

A. IMC: UL 1242; hot dip galvanized; minimum size 3/4-inch.

B. Fittings and Conduit Bodies: Use fittings and conduit bodies specified above for rigid steel conduit.

2.04 Flexible Metal Conduit and Fittings

A. Conduit: UL 1; FS WW-C-566; single steel continuous strip with galvanized coating; minimum size 3/8-inch.

B. Fittings and Conduit Bodies: NEMA FB-1; malleable iron squeeze type.

2.05 Liquidtight Flexible Conduit and Fittings

A. Conduit: UL listed liquidtight consisting of an extruded thermoplastic cover over a galvanized steel core. Minimum size 3/4-inch. Exception: Where connected to devices with manufacturer supplied 1/2 or 3/8-inch hubs, match conduit size to hub size.

B. Fittings and Conduit Bodies: NEMA FB-1; galvanized steel compression type with O-ring. Where PVC coated conduits are indicated, provide PVC coated fittings for flex connections.

2.06 Rigid Nonmetallic Conduit and Fittings

A. Conduit: NEMA TC-2; Schedule 40 PVC.

B. Fittings and Conduit Bodies: NEMA TC-3.

2.07 Liquidtight Flexible Non-Metallic Conduit and Fittings

A. Conduit: UL listed, liquidtight consisting of a hand PVC spiral with flexible PVC covering. Minimum size is 3/4-inch.

B. Fittings: UL listed, molded from high-strength, glass-filled thermoplastic.

Part 3 Execution

3.01 Conduit Schedule

A. Except as noted, use only rigid steel or IMC conduits.

B. Use liquidtight flexible steel conduit for connections to motors, transformers and other vibrating equipment. Maximum length is 3 feet unless approved by the Engineer.

C. Use PVC coated conduits where conduits are in direct contact with earth. Provide 24 inches minimum cover.

D. Rigid nonmetallic conduit may be used for underground concrete encased duct banks and in or below slab on grade. Exception: Use rigid steel or IMC conduit for analog signal circuits; 4 to 20mA and AC or DC signals less than 25 volts.

E. Where PVC conduit is indicated, make a transition to rigid steel below grade or slab and continue above with rigid steel conduit. Exception: PVC may enter switchboards, motor control centers or other floor standing electrical equipment enclosures. Provide bell ends or socket end bell at enclosure entry.

F. Where aluminum conduit is indicated, conduit may not be installed in direct contact with concrete or masonry surfaces.

3.02 Conduit Arrangement and Support

A. Arrange conduit to maintain headroom and present a neat appearance. Run exposed conduits parallel or perpendicular to building surfaces and adjacent piping. Group conduit in parallel runs where practical and provide rack space for 25 percent additional conduits. Use concentric bends for parallel runs.

B. Avoid sources of heat when possible. Where unavoidable, maintain 3-inch clearance when crossing hot pipes and 12-inch clearance between parallel hot pipes, flues, heating appliances and other heat sources.

C. Support conduits to prevent distortion of alignment by wire pulling operations. Fasten single conduits with one hole malleable iron straps. For multiple runs use channel and clamps. Wire, perforated pipe straps and the like are not acceptable support means.

D. Support conduit at a maximum of seven feet on center and within three feet of each box, cabinet, or fitting. Hang trapeze assemblies with threaded rods not less than 3/8-inch diameter. Remove all temporary supports prior to pulling conductors.

E. Do not support conduits from electrical distribution equipment or control panels.

3.03 Conduit Installation

A. Cut conduit square using a saw or pipecutter and de-burr cut ends. Paint threads with zinc compound. Bring conduit to the shoulder of fittings and couplings and fasten securely. All connections are to be wrench tightened and electrically continuous. No running threads are permitted.

B. Use conduit hubs for fastening conduit to cast boxes, and for fastening conduit to sheet metal boxes in damp or wet locations. Use conduit bodies to make sharp changes in direction. For sizes 2-inches and larger, use "LBD" or similar fittings to permit a straight pull from either direction. In no case shall a fitting be used which results in bending radius too small for the cable.

C. The maximum length between pull points is 400 feet. This length shall be reduced by one foot for each degree of bend.

D. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2-inch size. Crushed or deformed conduits may not be installed.

E. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.

F. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture. Install threaded PVC end caps on conduits stubbed up for future use.

G. Provide a 200 pound tensile strength polyolefin line pulled through and tied off at each end of all empty conduits.

H. Install expansion joints equal to Crouse Hinds type XJ where conduit crosses building expansion joints and for straight runs in excess of 100 feet. For seismic joints use expansion joints equal to Crouse Hinds type XD.

I. Where conduit penetrates fire-rated walls and floors, provide mechanical fire-stop fittings with UL listed fire rating equal to wall or floor rating.

J. Provide watertight seals, equal to OZ type WSK, FSK, or CSM, where conduit penetrates exterior walls and where conduit passes between spaces normally at different temperatures. Seal duct bank and underground conduit entry with GE or Dow silicone sealant. Stub duct bank and underground conduits up a minimum of 2-inches above equipment pads and provide bushing.

K. Obtain approved shop Drawings showing conduit entry space before stubbing conduits in floor standing electrical gear.

L. In locations where the conduit cannot be turned, provide three-piece threaded rigid couplings.

M. Provide clamp backs for conduits on exterior or damp surfaces to prevent the raceway from bearing directly on the damp surface.

N. Route conduits in slabs above grade above the bottom reinforcing and below the top reinforcing. Maximum size for conduits in slabs above grade is 1-inch and minimum cover is 2-inches. Route so conduits in slabs above grade do not cross. For slab on grade route conduits in a trench below slab at sufficient depth to permit vertical exit from slab. Home runs shall not be routed in slabs except where indicated.

O. Protect conduit threads from rust and damage during construction.

P. PVC Conduit Bends: Do not use methods which will deform or change the physical characteristics of the conduit. Use PVC-coated rigid steel factory elbows for bends in runs longer than 100 feet, and in runs which have more than two bends, regardless of length. Exception: Where concrete encased in slab or ductbank, GRS elbows may be used in lieu of PVC coated.

Q. Wipe plastic conduit clean and dry before joining. Apply full even coat of cement to entire area that will be inserted into fitting. Let joint cure for 20 minutes minimum.

R. PVC Coated Conduit: Exercise care not to damage the coating during cutting, threading, bending, and assembly. Follow the manufacturer's installation instructions. Use vise jaws, bending equipment, strap wrenches, and other tools which are specifically designed for coated conduits. Do not use chain vise, pipe wrench, channel locks or the like. Nicks or small damaged areas (1/2-inch maximum) may be repaired with a manufacturer approved compound. Replace items if coating is damaged in excess of 1/2-inch. Fill space between PVC coating and reducing fittings with silicone sealant.

S. Conductor Protection: Provide bushings on metallic and bell ends on PVC conduits unless conduit terminates in a hub or similar fitting.

3.04 Underground Duct Bank Installation

A. Install top of duct bank minimum 18-inches below finished grade with plastic warning tape 12-inches below finished grade.

B. Install conduit with minimum grade of 4-inches per 100 feet.

C. Terminate conduit in end bell at manhole entries.

D. Stagger conduit joints in concrete encasement 6-inches minimum.

E. Provide minimum 3-inch concrete cover at bottom, top, and sides of duct bank. Use suitable separators and chairs installed not greater than four feet on centers to provide conduit spacing as indicated. Securely anchor conduit to prevent movement during concrete placement.

F. Construct duct banks with 3,000 psi concrete. Provide reinforcing as indicated.

G. Where duct bank passes beneath footings or slabs resting on grade excavate to provide a minimum of 6-inch clearance between the conduits and the structure. Backfill to the base of the structure with concrete.

END OF SECTION

Part 1 General

1.01 Scope

Squirrel cage induction motors.

1.02 Related Work

All motor driven equipment sections except hermetic refrigerant motor-compressors and submersible motors.

1.03 Work Specified Elsewhere

Except as noted, equipment specified in this Section is provided under other Divisions. Include, under this Section, receiving, storage, handling and wiring.

1.04 Quality Assurance

A. Equipment Standards: NEMA MG-1.

B. Efficiency: Premium design; guaranteed minimum values determined in accordance with IEEE Standard 112, Test Method B including stray load loss as follows:

HP	Synchronous RPM			
	3,600	1,800	1,200	900 & Less
20 - 49	91%	92.4%	92.4%	90.2%
50 - 99	92.4%	93.6%	93%	93%
100 & Above	94.1%	95%	94.1%	93%

C. For motors rated 1 to 19 HP, provide efficiency in accordance with ASHRAE Standard 90.1 - 1989, Table 5-1.

1.05 Submittals

A. Submit shop drawings showing certified dimensions and nameplate data.

B. Submit expected and guaranteed minimum efficiency values for operation at 100, 75, 50 and 25 percent load.

Part 2 Products

2.01 Acceptable Manufacturers

Motors shall be manufactured by General Electric, Reliance, Toshiba, Siemens, or Teco-Westinghouse.

2.02 Ratings

A. Horsepower (HP): As noted. Where no value is noted, match the requirements of the driven equipment.

B. Phase

1. Less than 1/2 HP: Single phase.

2. 1/2 HP and Larger: Three phase.

C. Voltage

1. Single Phase Motors: 115/200/230 volt reconnectable. Exception: Single voltage motors will be permitted if the voltage matches the supply characteristics shown on the Electrical Drawings.

2. Three-Phase Motors: 200/230/460 volt reconnectable. Exception: Single voltage motors will be permitted if the voltage matches the supply characteristics shown on the Electrical Drawings.

D. Speed, Revolutions Per Minute (RPM): As noted. Where no value is noted, match the requirements of the driven equipment.

E. Torque and Starting Current: NEMA design B unless otherwise noted. Exceptions: Provide NEMA design C or D where required by the driven equipment. Unless specifically noted NEMA design A motors are not acceptable.

F. Service Factor: 1.15. Exception: See below for inverter-fed motors.

G. Insulation and Temperature Rise: Except as noted, Class B or Class F insulation with temperature rise, measured by resistance, corresponding to the insulation class in accordance with NEMA standards for operation in a 40 degree C ambient. Exception: See below for inverter-fed motors.

2.03 Construction

A. Enclosure: Totally enclosed fan cooled (TEFC) unless otherwise noted.

B. Windings: Copper. Exception: Aluminum windings are acceptable where the aluminum to copper transition is done by the manufacturer with copper leads brought out to the motor conduit box.

C. Bearings: Minimum 100,000 hours for direct coupled and 40,000 hours for belted applications B-10 life rating per AFBMA standards.

D. Multispeed Motors: Two-winding type.

E. Starting: Suitable for full voltage starting.

2.04 Accessories

A. Provide lifting eyes for 182 and larger frame size. Provide oversized conduit box for 250 and larger frame size.

B. Where noted provide normally closed thermostat for winding protection.

C. Where noted provide 120 volt, single phase space heater. Size heater to increase motor temperature approximately 10 degrees C above ambient.

D. Nameplate: Permanently affixed and stamped so as to permit recovery of the nameplate data in the event the nameplate is painted over.

2.05 Inverter-Fed Motors

A. Equipment Standards: Inverter duty and in accordance with NEMA MG-1, Part 31, "Definite-Purpose Inverter-Fed Motors". Usual service conditions per MG-1 31.10.2 apply unless otherwise noted.

B. Service Factor: 1.0.

C. Insulation and Temperature Rise: Class F insulation with temperature rise in accordance with Class B limits.

D. Peak Voltage and Rise Time: In accordance with MG-1 31.40.4.2.

E. Provide shaft grounding or insulated bearings for motors larger than 320 frame size. If insulated bearings are used, provide insulated coupling if the driven equipment bearings are susceptible to damage by current flow.

Part 3 Execution

3.01 Installation

A. Verify clearances and alignment prior to operation.

B. Lubricate in accordance with the manufacturer's instructions.

C. Check rotation and correct as necessary. Make correction to preserve conductor color coding.

END OF SECTION

Part 1 General

1.01 Scope

Automatic transfer switches.

1.02 System Description

A. System consists of a double throw, electrically operated breaker pair to automatically transfer and re-transfer load to and from a standby power source.

B. When voltage on any phase drops below 85 percent of normal for a time period of three seconds, a set of engine starting contacts close. Transfer occurs when voltage and frequency on the alternate source have reached 95 percent of normal.

C. Re-transfer to normal occurs when the normal source has reached 95 percent of normal voltage for a period of 20 minutes. However, should the alternate source fail during the 20 minute timing period, re-transfer shall occur immediately.

D. After re-transfer the engine start contacts shall remain closed for a five minute cool down period.

1.03 Quality Assurance

Provide switches conforming to NEMA ICS-2-447 and UL 1008.

1.04 Submittals

Shop Drawings: Include dimensions, complete ratings, and sequence of operation.

1.05 Record Drawings

A. Shop Drawings: As listed under Article 1.04 above, corrected to reflect the equipment as-built.

B. Operation and Maintenance Data: Include recommended maintenance procedures and intervals, spare parts listing and instruction books for all components.

Part 2 Products

2.01 Acceptable Manufacturers

Automatic transfer switches shall be equal to Cutler-Hammer.

2.02 Ratings

A. Continuous Current Rating: As indicated.

B. Short Circuit: 42,000 Withstand RMS Symmetrical Amps.

2.03 Transfer Switch

A. Circuit Breaker Mechanism: Linear actuator mechanism with normal and standby molded case circuit breakers interlocked mechanically and electrically to prevent simultaneous closing. Neutral contacts shall be identical to power contacts and enclosed in common assemblies.

B. Enclosure: NEMA 12.

C. Controls: Arrange so that all components are accessible from the front without major disassembly or disconnecting power conductors. Provide normal and emergency position indication lights on the front of the enclosure and dry contacts (in addition to engine start contacts) for remote position indication. Provide adjustments for all voltage and transfer time delays, and a test switch to simulate normal source failure.

D. Provide a UL listed manual operator to permit operation under load without opening the enclosure door.

E. Provide a UL service entrance label.

Part 3 Execution

3.01 Installation

Install in accordance with the manufacturer's instructions. Verify available floor/wall space and conduit entrances prior to installation.

3.02 Tests

A. Adjust voltage and transfer time settings to the values listed above in Article 1.03.

B. Functionally test the completed installation by tripping the utility source main breaker. The Engineer reserves the right to witness this test and 10 days notice shall be provided.

END OF SECTION

Part 1 General

1.01 Scope

A. Power system grounding.

B. Communication system grounding.

C. Electrical equipment and raceway grounding and bonding.

1.02 System Description

A. The system consists of a ground grid for building grounding; ground clusters for supplemental electrodes; and connections thereto of structures, equipment and electrical systems.

B. This Section is intended to supplement the requirements of the NEC, particularly Article 250, and to differentiate among options allowed by the NEC. This Section is not intended to reiterate explicit requirements of the NEC.

C. Within this Section the following definitions apply:

1. Ground Grid: A horizontal loop, electrically and mechanically continuous; routed approximately three feet inside the building perimeter. Where any building dimension exceeds 100 feet provide cross ties spaced not farther than 50 feet apart connected to the perimeter loop and to each other at all points of intersection to form a grid.

2. Ground Cluster: An assembly of three or more driven ground rods; spaced not closer than eight feet apart; each rod connected to the others in a closed delta configuration; and providing a resistance to ground of not more than 10 ohms.

3. Connect or Bond: For underground or otherwise inaccessible locations - a permanent connection made by exothermic welding, brazing, or similar process. For exposed and accessible locations - a connection made with clamps, bolts or similar fittings approved for the purpose.

1.03 Submittals

A. Submit product data.

B. Indicate layout of ground grid and routing of grounding electrode conductors.

Part 2 Products

2.01 Materials

A. Bare Conductors: ASTM B-8; stranded; hard drawn copper. Size unless otherwise noted is #4/0 AWG.

B. Ground Rods: UL 425H; 5/8-inch x 8 feet; high strength steel core with metallically bonded copper jacket.

Part 3 Execution

3.01 Installation

A. Except as noted, use insulated ground conductors only where installed in a raceway. Use bare conductors for the ground grid, ground rod connections, and bonding of buildings, structures etc. Where a bare conductor is installed in a raceway use only non-metallic raceways; do not install bare conductors in metallic raceways.

B. Either embed the ground grid in the concrete building foundation 2 to 4-inches from the bottom or bury the grid three feet deep in the earth. For each 100 feet or fraction thereof of ground grid conductor provide connections to earth by one of the following:

1. Where deep column footings (more than eight feet below grade) are used provide a vertical tap from the grid to the bottom of the footing.

2. Where only shallow footings are available connect the ground grid to a driven ground rod.

C. Drive ground rods so the top is 3 to 6-inches below finished grade. If rock is encountered then rods may be driven at an angle or grounding plates, as approved by the Engineer, may be used.

D. Construct ground clusters as follows: Start with three driven ground rods and measure the resistance to ground of each rod. If the parallel combination exceeds 10 ohms then add sections and drive the rods deeper, or drive additional rods until the specified value is obtained. Connect each rod to every other rod in the cluster. Exception: not more than three additional rods or sections (six total) are required for any one cluster.

E. Where bare conductors emerge from concrete encasement, provide a 4-inch length of Schedule 40 PVC conduit set in the concrete to protect the conductor.

3.02 Service Entrance Equipment

A. Bond service entrance equipment ground bus to the ground grid as indicated.

B. Provide one ground cluster outside the building at the closest practical location to the service entrance equipment and bond to ground bus as indicated.

C. If a metallic cold water pipe is available for a grounding electrode make connection on the street side and bond around the water meter.

D. Prior to energizing the system remove the neutral link and meggar the system neutral. Repair any grounds then replace the neutral link.

3.03 Buildings

A. Bond all steel building columns to the ground grid.

B. Provide outside access to the ground grid every 100 feet (two locations minimum) or as indicated by means of a test well. Note locations on the as-built drawings.

3.04 Separately Derived Systems

A. Ground transformer enclosures and, where solidly grounded systems are indicated, the secondary neutral to the ground grid.

B. Ground generator frame and neutral to the ground grid.

3.05 Underground Distribution Systems

A. Route a bare conductor through each duct bank. Connect to building ground grid, equipment frame or ground pad as applicable.

B. Provide a driven ground rod at each electrical manhole. Connect to duct bank ground conductor accessible in the manhole.

C. Provide two ground clusters at opposite corners of pad transformers. Connect to transformer secondary compartment grounding lug. Bond primary and secondary ground lugs and duct bank grounding conductor.

3.06 Field Quality Control

A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

B. Notify the Owner's representative at least one week in advance that the ground grid for each building is ready for inspection. Obtain written notice to proceed before filling trenches, pouring slabs, or otherwise covering the work.

C. Compile and submit a list of ground resistance measurements for each ground rod in ground clusters. Measure and submit resistance to ground of service equipment ground bus.

D. Make resistance to ground measurements in normal, dry weather conditions not less than 24 hours after rainfall. Make measurements using the fall of potential method per IEEE Standard No. 142.

END OF SECTION

Part 1 General

1.01 Scope

A. Dry type two winding transformers.

1.02 Submittals

Submit product data. Include outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, and impedance ratings and characteristics, loss data, efficiency at 25, 50, 75 and 100 percent rated load, sound level, tap configurations, insulation system type, and rated temperature rise.

1.03 Delivery, Storage and Handling

A. Store in a warm, dry location with uniform temperature. Cover ventilating openings to keep out dust.

B. Handle transformers using only lifting eyes and brackets provided for that purpose. Protect units against entrance of rain, sleet, or snow if handled in inclement weather.

Part 2 Products

2.01 Acceptable Manufacturers

Dry type transformers shall be equal to General Electric, Hevi-Duty, Square D, or Cutler-Hammer.

2.02 Dry Type Transformers

A. Dry Type Transformers: NEMA ST-20; factory-assembled, air cooled dry type transformers; ratings as indicated. Transformers are two winding power type. Three phase units are connected delta primary and wye secondary. Scott or Tee connections and autotransformers are not acceptable.

B. Insulation: 220 degrees C, 150 degree C rise for ratings 30 kVA and larger; 185 degrees C, 115 degree C rise for ratings below 30 kVA.

C. Taps: Two, 5 percent below rated primary for ratings 15 kVA and smaller; six, 2-1/2 percent two above and four below rated primary for ratings larger than 15 kVA.

D. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

E. Mounting: Transformers 75 kVA and less shall be suitable for wall, floor, or trapeze mounting; transformers larger than 75 kVA shall be suitable for floor or trapeze mounting.

F. Isolate core and coil from enclosure using vibration-absorbing mounts.

Part 3 Execution

3.01 Installation

A. Set transformer plumb and level. Clear walls and ceilings by at least 6-inches to allow for air circulation.

B. Use flexible conduit, two foot minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

C. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.

D. Provide seismic restraints.

3.02 Field Quality Control

A. Check for damage and tight connections prior to energizing transformer.

B. Measure secondary voltage under normal load conditions and make appropriate tap adjustments.

END OF SECTION

Part 1 General

1.01 Scope

Panelboards.

1.02 Submittals

Submit shop drawings.

Part 2 Products

2.01 Acceptable Manufacturers

Equipment shall be manufactured by General Electric, Square D, or Cutler-Hammer.

2.02 Panelboards

A. Panelboards: NEMA PB-1; UL 67.

B. Rating: Voltage and ampere ratings are shown on the Drawings. Unless otherwise indicated interrupting ratings (RMS symmetrical) are 14,000 amps for 480 volt panelboards and 10,000 amps for 240 and 208 volt panelboards.

C. Boxes: Code gauge galvanized steel; sized to accommodate devices indicated and afford wire bending space in accordance with NEC requirements.

D. Fronts: Surface or flush as indicated, door-in-door construction, finished in light grey enamel over a rust inhibitor. Furnish flush lock for fronts less than 48-inches high and vault type handle with three point catch for fronts 48-inches and higher. Key all locks alike.

E. Bus: Copper, arranged for bolt-on circuit breakers. Furnish insulated neutral bus and ground bus with main lug bonded to the box.

F. Circuit Breakers: NEMA AB-1; molded case type, thermal-magnetic trip with internal common trip on multipole breakers. Provide breaker fully rated for interrupting ratings noted; series ratings are not acceptable.

G. Provide engraved nameplates giving the voltage rating and panel designation as indicated. Provide a UL service entrance label for panelboards used as service entrance equipment.

H. Two Section Panels: Box and front same height each section.

I. Surge Protection: Where indicated provide transient voltage surge suppressor, UL listed in accordance with UL 1449 (2nd Edition); suitable for medium exposure level ANSI/IEEE C62.41 Cat. C3 environments; total surge current shall not be less than 80

kA per phase or 40 kA per mode in accordance with NEMA LS-1. Provide surge suppressor with standard overcurrent protection (no fuses), integral disconnect and diagnostic indicating lights. Suppressor shall be installed either in the panelboard gutter unless space does not permit or panelboard UL label is voided – in which case furnish loose for field installation adjacent (less than five feet) to the panelboard. Suppressor shall be connected on the load side of the main disconnect device, as close as possible to the phase/neutral/ground conductors per manufacturer's recommendations.

Part 3 Execution

3.01 Installation

A. Install boxes so they are rigidly supported and correctly aligned. Select mounting height so that operating handles are not higher than 6 feet 6-inches nor lower than 24-inches above the floor.

B. For flush mounted panels provide a 3/4-inch empty raceway for each three unused spaces and spare poles. Terminate in a junction box located above the ceiling or other approved accessible location for future extension.

C. Prior to energizing panelboards clean out construction dirt and debris. Paint any scratches on the trims or dead front barriers. Meggar each phase to phase and ground to insure that no short circuits exist.

D. Adjust panel barriers so that no openings occur between them and the panel front. Provide filler plates and plugs as necessary to maintain dead front integrity.

E. Type directory cards with circuit loads and/or area served. Note spare circuits in pencil.

3.02 Field Quality Control

Measure steady state load currents at each panelboard feeder. Should the difference at any panelboard between phases exceed 20 percent, rearrange circuits in the panelboard to balance the phase loads within 20 percent. Take care to maintain proper phasing for multi-wire branch circuits.

END OF SECTION

Part 1 General

1.01 Work Specified Elsewhere

Except as noted, equipment specified in this Section is provided under other Divisions. Include under this Division, receiving, storage and handling; wall or floor mounting of drive control panels (including equipment pads); and wiring.

1.02 Submittals

A. Submit shop drawings.

B. Submit installation instructions.

Part 2 Products

2.01 Acceptable Manufacturers

AC Drives: Equal to Allen-Bradley.

2.02 AC Drive Controllers

A. Type: Variable frequency consisting of an input full wave rectifier and output inverter capable of producing a constant volts per hertz output suitable for operating a standard squirrel cage induction motor. Drives are pulse width modulated (PWM) 2-circuit board design with power components on one board and control components on another board. Drives shall be 18-pulse design.

B. Ratings

1. Speed Range: 6 to 60 Hertz with a constant torque load. Variable torque drives are permitted only where specifically noted.

2. Efficiency: 95 percent minimum at 100 percent speed.

3. Service Factor: 1.0 continuous; 1.5 for one minute.

4. Speed Regulation: 3 percent.

C. Equip drive with adjustments for minimum speed, maximum speed, acceleration-deceleration rate and current limit.

D. Protective Features

1. Input circuit breaker or fused disconnect switch to disconnect drive and control circuits. The variable speed drive package (VFD, circuit breaker, bypass and output contactors, controls and any other equipment associated with the drive or internal to the drive enclosure) shall have a withstand rating of 42,000 amps.

This withstand rating shall be stamped on a UL 508C nameplate attached to the VFD enclosure.

2. Output contactor to disconnect the motor when the drive is off. Interlock contactor with drive to prevent starting unless the drive is at zero volts and hertz. Provide restart delay to allow equipment to coast to rest before restarting. Output contactor may be rated in accordance with NEMA or IEC standards. Where constant speed bypass is noted, provide bypass contactor rated in accordance with NEMA standards; IEC ratings are not acceptable.

3. Solid state protective circuits with diagnostic capabilities for over/under voltage, loss of voltage, inverse time and instantaneous overcurrent, phase loss, phase unbalance, and thermal overload. Activation of all protective functions shall be accomplished without damage to the drive and without need to replace any components. Over/under voltage and loss of voltage are to reset automatically when voltage returns to normal; all other conditions are to be manually reset.

4. Provide protective circuitry, if not inherent in the drive design, to shut down without damage to the drive if an out of synch condition occurs, i.e., running drive connected to a stopped motor, plug reversal or motor stall.

5. Where motor temperature switches are specified, provide circuitry to shut down the drive if the switch opens.

E. Input Voltage and Phase

1. Less than 3 HP: 208 volt, single phase.

2. 3 HP and Above: 480 volt, three phase.

F. Indoor Enclosures: Individual wall mounted or free standing. Enclosure shall meet NEMA 1 requirements.

2.03 Controls

A. Provide the following door mounted operator control devices:

1. Local-Off-Remote selector switch for remote start/stop and remote speed control.

2. Manual start stop selector and speed adjustment knob.

3. Where constant speed bypass is noted, provide a Constant-Variable speed mode selector switch. Provide either start stop or hand off automatic selector switch as indicated for on-off control in the constant speed mode.

4. Speed indicating meter.

5. Elapsed time meter for drives 5 HP and larger. Elapsed time meter may be included in drive diagnostic module or may be a separate six digit, non reset, 3-1/2-inch square case meter equal to GE type 236.

6. Power on indicating light.

B. Provide the following for remote control interface:

1. Remote (auto) speed command, isolated 4-20 mA DC.

2. Remote start stop command, maintained dry contact, close to run. (Two contacts if constant speed bypass with H-O-A or L-O-R constant speed on off control).

3. Isolated 4-20 output signal for remote speed indication.

4. 120 volt, 10 amp dry contact for remote run indication; closed when running.

5. 120 volt, 10 amp dry contact for remote alarm indication; closed on occurrence of any fault condition.

6. Two 120 volt powered contacts, one closed when motor operates and one open when motor operates, for accessories (motor space heater, pump seal water solenoid, etc.) Provide 750 VA spare capacity in drive control power transformer for accessories.

2.04 Service Conditions

A. Operating Temperature: 0 to 40 degrees C.

B. Altitude: Up to 3,300 feet above sea level.

C. Relative Humidity: 0 to 90 percent.

D. Voltage Variation: +5 percent to -10 percent.

Part 3 Execution

3.01 Installation

A. Install in accordance with the manufacturer's instructions.

B. Verify motor alignment prior to operation.

C. Insure adequate space for air circulation around drive ventilation openings.

END OF SECTION

Part 1 General

1.01 Scope

A. Interior luminaires and accessories.

B. Exterior luminaires and accessories.

C. Lamps.

D. Ballasts.

E. Poles.

1.02 Submittals

Submit product data. Include dimensions, accessories, installation and construction details, and photometric data.

1.03 Delivery, Storage, and Handling

A. Ship laminated finish wood poles individually wrapped in moisture-resistant paper.

B. Handle metal poles carefully to prevent breakage and damage to finish.

Part 2 Products

2.01 Acceptable Manufacturers

A. Fixtures: Equal to fixtures shown on Fixture Schedule on the Drawings.

B. Lamps: Equal to General Electric, Sylvania, Phillips Lighting.

C. Ballasts: Equal to General Electric, Advance, Universal.

D. Poles

1. Steel: Equal to KW Industries, Valmont, US Pole Co.
2. Aluminum: Equal to Union Metal, US Pole, Hapco.
3. Concrete: Equal to Union Metal, Hughes, Centrecon.
4. Fiberglass: Equal to Shakesphere, Whatley, Engineered Fiberglass Products.
5. Wood: Equal to Koppers, Ryther-Purdy, Weyerhauser.

2.02 Interior Luminaires and Accessories

A. Provide fixtures as shown in the Lighting Fixture Schedule on the Drawings.

B. Where flat acrylic lenses are specified in fluorescent fixtures, use 100 percent virgin acrylic, pattern 12; 0.125-inch thickness.

C. Provide fixture housings and frames to match the ceilings called for on the Architectural Drawings.

D. Recessed Incandescent Luminaires: Prewired type with thermal protection.

E. HID Luminarres: Pre-wired, with integral ballast.

2.03 Exterior Luminaires and Accessories

Provide low temperature ballasts, with reliable starting to -20 degrees F.

2.04 Lamps

A. General Use Incandescent Lamps: Inside frosted type, rated 130 volts.

B. Incandescent Reflector Lamps: Shape as scheduled, rated 130 volts.

C. Fluorescent Lamps: Cool white; all by same manufacturer.

D. Fluorescent PL Lamps: 2,700 degrees K, all by same manufacturer.

E. Metal Halide HID Lamps: Phosphor coated.

F. High Pressure Sodium HID Lamps: Clear, suitable for all burning positions.

2.05 Ballasts

A. Use ballasts designed to operate on the voltage to which they are connected.

B. Fluorescent Ballasts: UL 935, ANSI C82.1; labeled Certified Ballast Manufacturers (CBM) certified by Electrical Testing Laboratories (ETL); high power factor type (unless indicated otherwise). Use Class P ballast with sound rating "A" (unless otherwise noted). Use fixtures and ballasts designed and constructed to limit the ballast case temperature to 90 degrees C when installed in an ambient temperature of 40 degrees C.

C. HID Ballasts: UL 1029 and ANSI C82.4; constant wattage autotransformer (CWA) or regulator, high power factor type, (unless otherwise indicated). Use single-lamp ballasts with a minimum starting temperature of minus 30 degrees C and designed for installation in a normal ambient temperature of 40 degrees C. Use ballasts constructed so that open circuit operation will not reduce the average life. Provide High Pressure Sodium (HPS) ballasts with a solid-state igniter/starter with an average

life in the pulsing mode of 10,000 hours at an igniter/starter case temperature of 90 degrees C. Average life is defined as the time after which 50 percent will have failed and 50 percent will have survived under normal conditions.

2.06 Lighting Poles

A. Hand Hole: 4 x 6.5-inch (round poles) and 2.5 x 5-inch (square poles) with removable weatherproof cover installed 18-inches above bottom of pole. Provide matching gasketed cover plate.

B. Anchor Bolts: As recommended by pole manufacturer. Provide template, flat washers, lock washers, and hex nuts for each pole.

Part 3 Execution

3.01 Installation

A. Install lamps in luminaires and lampholders.

B. Install fixtures to center or replace acoustical tile sections. Support fixtures from the building structure through the use of the ceiling support system, where the ceiling support system is designed for the lighting fixture's weight. Fluorescent lighting fixtures installed in exposed ceiling grid ceilings: provide two "safety clips" or "safety hooks" for securing fixture to ceiling grid, and located at opposite corners of fixture.

C. Where fluorescent fixtures are installed in exposed grid ceilings provide a 14 gauge galvanized safety hanger wire which attaches the fixture to the building structural system to prevent the fixture from falling due to movements in ceiling suspension channels. Attach the safety wire to fixture at a point other than where safety clips are attached.

D. Provide suspended fixtures with swivel hangers and threaded rod. For single-unit suspended fluorescent fixtures, provide twin suspension hangers.

E. Support surface lighting fixtures of more than 10 pounds in weight with threaded rods from the building structure.

F. Install plaster frames for lighting fixtures recessed in plastered ceilings.

G. HID Luminaires: Use power hook hangers rated 500 pounds minimum or provide safety chain between ballast and structure. Provide safety chain between reflector and ballast.

H. Luminaire Pole Bases: Size and constructed as indicated on Drawings. Project anchor bolts 2-inches minimum above base. Install poles on bases plumb; provide double nuts for adjustment. Grout around pole base.

I. Embedded Luminaire Poles: Depth as indicated. Install plumb.

J. Use belt slings or non-chafing ropes to raise and set pre-finished luminaire poles.

3.02 Relamping

Relamp luminaires at completion of work.

3.03 Adjusting and Cleaning

A. Clean lenses and diffusers at completion of work. Clean paint splatters, dirt and debris from installed luminaires.

B. Touch up luminaire and pole finish at completion of work.

C. Mount continuous rows of luminaires in straight line. Utilize alignment clips between reflectors, where applicable.

END OF SECTION

Part 1 General

1.01 Scope

A. Package engine generator.

1.02 Work Specified Elsewhere

A. Fuel storage tank and associated fuel piping is specified in Division 15.

B. Except as noted piping and ductwork for cooling and exhaust equipment, and support foundation are provided under other Divisions.

1.03 System Description

A. Provide a standby power system for supply of power in event of failure of the normal supply, consisting of a liquid cooled, natural gas fueled engine directly coupled to an AC generator complete with fittings, connections, auxiliaries, control panels, safety devices, and meters necessary for a complete operating system.

B. Provide fully automatic operation so that unit takes full load within 10 seconds after power failure.

1.04 Submittals

A. Shop drawings: Complete rating and dimensional data including continuous and standby KW rating, generator subtransient reactance, RPM, number of cylinders, fuel consumption rates, piston displacement and piston speed.

B. Submit installation instructions.

1.05 Record Drawings

Provide record drawings as listed in Article 1.05 plus operation and maintenance instructions, spare parts listing, service facilities and record of start-up tests.

Part 2 Products

2.01 Acceptable Manufacturers

A. Engine/Generator: Caterpillar, Cummins, Detroit Diesel, Kohler, Generac, Olympian.

B. Governor and Voltage Regulator: Equal to Basler or Woodward.

2.02 Rating

A. KW: 150 standby; capable of full load pickup in a single step.

B. Power Factor: 80 percent.

C. Maximum RPM: 1,800.

D. Altitude: 1,000 feet above mean sea level.

E. Ambient Temperature: 38 degrees C (100 degrees F).

2.03 Generator

A. Output: 480 volts, 3 phase, 4 wire, 60 Hertz.

B. Construction: NEMA MG-1; revolving field type; brushless static or permanent magnet exciter; directly coupled to the engine flywheel through a flexible driving disc for positive alignment. Dynamically balance the rotor for up to 25 percent overspeed. Equip with Class F insulation with temperature rise not to exceed insulation temperature rating in accordance with NEMA standards for operation in a 40 degree C ambient.

C. Voltage Regulator: Solid state construction with steady state regulation of one percent and transient regulation of 25 percent maximum from no load to full load with recovery to two percent or better within one second. Provide a minimum of 300 percent of rated current for 10 seconds under fault conditions.

D. Non-linear load generator shall be capable of supplying 90 KW of non-linear (VFD) load.

2.04 Engine

A. Fuel: Natural gas.

B. Construction: Heavy duty industrial type; water cooled; spark ignition engine. Engine shall be 4 cycle, vertical in-line or V-type, 8 cylinders maximum. Provide single piece alloy cast iron block; single piece drop forge steel crankshaft; precision insert, steel backed tri-metal bearings; forged connecting rods; cast pistons with positive pressure oil cooling.

C. Governor: Solid state isochronous type with steady state speed regulation of 0.5 percent and transient speed regulation of three cycles maximum from no load to full load with two second maximum recovery to steady state.

D. Lubricating Oil System: Gear type lubricating oil pump for supplying oil under pressure to the bearings, pistons, timing gears and valve rocker mechanism.

E. Accessories: Provide replaceable automotive type oil filters, dry type air cleaners, automatic choke, lubricating oils, greases, and coolant. Provide tools required for normal maintenance of the unit in a metal box complete with lock and keys.

2.05 Cooling Equipment

A. Engine: Self-contained liquid cooling complete with unit mounted radiator, pusher type fan, water pump and thermostat.

B. Coolant: Corrosion inhibited glycol base anti-freeze good to -30 degrees C.

C. Provide thermostatically controlled 120 or 208 volt coolant heater, wattage as required to maintain coolant temperature of 80 degrees F. Where heater rating exceeds 2 KW provide multiple units to balance phase loads on the auxiliary circuit breaker.

2.06 Exhaust Equipment

A. Muffler and Piping: Residential-grade silencer, completely sealed, metal primed finish, sized so as not to exceed allowable engine backpressure.

B. Connection: Provide 18-inch minimum length flexible stainless steel connection from manifold to muffler.

C. Provide damper to close off exhaust when not in use.

2.07 Controls and Alarms

A. Engine Control Panel: Mounted on the unit frame complete with oil pressure gauge, low oil pressure alarm contacts, low oil pressure shutdown contacts, water temperature gauge, high water temperature shutdown contacts, overspeed shutdown contacts and overcrank shutdown contacts.

B. Generator Control Panel: Mounted on the unit complete with ammeter, ammeter selector switch, voltmeter, voltmeter selector switch, frequency meter, voltage adjusting rheostat, elapsed time meter, and current and potential transformers as required. Provide a test-normal selector for manual operation of the unit. Provide numbered terminal strip for connection of accessory controls, incoming start command (from the automatic transfer switch), outgoing master alarm, and outgoing individual alarms as noted. Accessory controls (dampers, solenoids and other items not mounted on the unit and prewired) are powered contacts, rating as required. Outgoing alarms are normally open dry contacts, 10 amp, 120 volt.

C. Starting Control Panel: Mounted on the unit complete with battery charger, charging ammeter, and alarm contacts. Equip with required cables to separate unit mounted starting batteries.

D. Output Circuit Breaker: NEMA AB-1; molded case type; NEMA 1 unit mounted enclosure; current rating as recommended by the manufacturer for protection of the generator, 22,000 AIC.

E. Auxiliary Circuit Breaker: NEMA AB-1; molded case type; NEMA 1 unit mounted enclosure; 30 amp; 3 pole; 10,000 AIC. Breaker shall disconnect 120/208 volt, 3 phase, 4 wire incoming power for coolant heater, battery charger and other auxiliary devices.

2.08 Batteries

A. Type: Lead acid.

B. Size batteries to provide cycle cranking of 10 seconds crank, and 10 seconds rest for 5 cycles at 32 degrees F.

2.09 Fuel System

A. Equip with complete engine fuel system including regulators, strainers and control valves.

2.10 Fabrication

A. Mount on common steel rail base with all electrical equipment completely prewired.

B. Provide steel spring vibration isolators between rail base and concrete base. Provide protective guards over moving parts.

C. Machine enamel finish to be selected by Engineer.

D. Provide weather protective, sound attenuated, outdoor enclosure. Sound attenuation is 25 dBA at 7 meters.

Part 3 Execution

3.01 Preparation

Coordinate with ventilation, fuel supply, and exhaust, to provide an efficient and well coordinated layout.

3.02 Installation

A. Install unit complete and make operational.

B. Provide 1/2-inch copper drain line with draincock from bottom of muffler for periodic draining of muffler.

C. Install engine at sufficient height above base to permit dropping oil pan without removing unit.

D. Provide vibration isolation of exhaust equipment to prevent transfer of vibration into enclosure.

3.03 Wiring and Connections

A. Provide conduit, wiring and connections required and recommended by unit supplier.

B. Install all control and alarm wiring in rigid steel conduit.

C. Connect neutral point of generator and generator frame to ground as indicated.

D. Connect motorized dampers in cooling and exhaust equipment to open dampers when unit is started.

3.04 Field Quality Control

A. Provide full load test utilizing portable test bank for four hours minimum.

B. Record in 20 minute intervals during four hour test:

1. Kilowatts
2. Amps
3. Voltage
4. Coolant temperature
5. Ambient temperature
6. Frequency
7. Oil pressure

C. Test alarm and shutdown circuits by simulating conditions.

D. Simulate power failure including operation of transfer switch, automatic starting cycle, and automatic shutdown and return to normal.

E. Provide fuel for all tests.

F. Provide factory representative to demonstrate and train the Owner's personnel on complete operation of the unit.

END OF SECTION

Part 1 General

1.01 Scope

Lightning protection system.

1.02 Related Work

Section 16455 - Grounding.

1.03 System Description

A. Provide lightning protection system consisting of lightning points mounted on building and penthouse roofs, interconnecting cable, ground drops and ground grid.

B. Provide ground drops as indicated, in 1-inch plastic pipe with cable supports every second floor and connect to ground grid.

1.04 Quality Assurance

A. Conform to UL 96 and NFPA 78.

B. Provide UL master label on completed installation.

1.05 Submittals

Submit shop drawings. Include air terminal locations, cable routings, grounding electrode locations and bonding locations.

Part 2 Products

2.01 Acceptable Manufacturers

Lightning protection system shall be equal to Thompson Lightning Protection, Inc., Robbins Lightning, Inc., Independent Protection Company, Inc., or Harger Lightning Protection, Inc.

2.02 Materials

A. Air Terminals: 18-inch solid copper, pin type, 1/2-inch diameter above 75 feet above finished grade (AFG) and 3/8-inch diameter below 75 feet AFG.

B. Lightning Cable: Braided copper, 28 strand 14 gauge for vertical risers and 29 strand 17 gauge for horizontal rings below 75 feet AFG.

C. Ground Grid: 5/8-inch by 10 feet copperweld ground rods with two-bolt cast bronze clamps having a minimum length of 1-1/2-inch and employing stainless steel screw caps.

D. Cable fasteners shall be substantial in construction, electrolytically compatible with the conductor and mounting surface and shall be spaced according to UL 96 and NFPA Code requirements.

E. Bonding devices, cable splicers and miscellaneous connectors shall be of cast bronze with bolt pressure connections to cable. Cast or stamped crimp fittings are not acceptable.

F. All miscellaneous bolts, nuts and screws shall be brass, bronze, or stainless steel.

Part 3 Execution

3.01 Installation

A. The installation shall be accomplished by an experienced listed master installer of lightning protection equipment who is in good standing with Underwriters Laboratories.

B. All equipment shall be installed in a neat workmanlike manner in the most inconspicuous manner possible. The system shall consist of a complete cable network on the roof involving all air terminals, splices, and bonds with cable downleads routed concealed either directly in the building construction or in conduit to ground.

C. Downlead cables shall not be brought directly through the roof. Thru-roof connectors with solid rods or conduit through boot flashing shall be utilized for this purpose.

D. Copper equipment shall not be connected to aluminum surfaces except by means of an LPI approved bimetal transition fitting. Lead coating is not to be accepted as a bimetal transition.

3.02 Coordination

A. The lightning protection installer will work with other trades to insure a correct, neat and unobtrusive installation.

B. It shall be the responsibility of the lightning protection installer to assure a sound bond to the main water service and to assure interconnection with other building ground systems, including both telephone and electrical.

END OF SECTION

Part 1 General

1.01 Scope

A. Work provided under this Division includes final system design implementation, furnishing all components, system programming and configuration, system installation services, required support services, and complete documentation for the Plant Control System (PCS). This work shall include all materials, labor, and tools required to fabricate, deliver, unload, handle, erect, adjust, field calibrate, and test a complete and operable PCS as indicated on the Drawings and Specifications. Install all panels and designated instrumentation devices and provide all mechanical and pneumatic interconnections between the various components and their local sources of supply.

B. The intent of these Specifications is for the System Manufacturer to provide a complete and operational PCS. Additional items of equipment, materials, or labor not specifically called for by these Specifications, which may reasonably be considered to make the system complete and operational, shall be supplied as part of this work.

1.02 Definitions

A. Provide: Furnish, install, and connect.

B. Product Data: Catalog cuts and descriptive literature.

C. Shop Drawings: Factory prepared documentation, specific to the installation.

D. Indicated: Shown on the Drawings.

E. Noted: Indicated or specified elsewhere.

1.03 Work Specified Elsewhere

A. Installation of Inline Instruments: Instruments such as venturi tubes, magmeters, and control valves, which are specified in this Division and mounted in process piping, are installed under other Divisions.

B. Vendor-Supplied Devices: Field instrumentation and panels supplied as part of mechanical equipment or equipment packages shall be furnished, installed, and calibrated under other Divisions.

C. Conductors: Discrete signal conductors, twisted pair analog signal conductors, and RTD conductors are furnished and installed under Division 16. All other instrumentation and signal conductors, including digital data conductors and fiber optic cables are furnished under this Division and installed under Division 16. Special cables for a particular instrument device which are specified in this Section are installed under Division 16.

D. Raceways: All raceways and pulling of conductors (including placement in cable trays) are furnished under Division 16.

E. Terminations: All control and signal conductor terminations are provided under this Section. This shall include, but not be limited to, terminations for all control panels and termination of the RS-485 data connections to motor protection relays, power monitoring units, and particle counters. Exceptions: HVAC control terminations are provided under Division 15. Interconnections between equipment and integral equipment control panels (i.e., package air compressors) are provided under the applicable equipment Section. Terminations to motor control centers and all power wiring terminations for new equipment are provided under Division 16.

1.04 Plant Control System Description

A. The PCS consists of programming and configuration, operator interface, radio telemetry, local control panels, field instruments and control devices, and other appurtenances noted in these Specifications.

B. Major components of the PCS are as follows:

Panel	Location	Area Controlled	New/Existing
LCP-1	Mansell Road BPS	Mansell Road BPS	New
LCP-2	Providence Road BPS	Providence Road BPS	New
SCADA	Main Office	All Areas	Existing
SCADA CTU	Main Office	All Areas	Existing
SCADA RTU-A	Mansell Road BPS	Mansell Road BPS	New
SCADA RTU-B	Providence Road BPS	Providence Road BPS	New
Water Security RTU-A	Mansell Road BPS	Mansell Road BPS	New
Water Security RTU-B	Providence Road BPS	Providence Road BPS	New
Water Security Trunking Radio System	911 Center	All Areas	Existing
Water Security Workstation	911 Center	All Areas	Existing

C. Main Office SCADA: The System Manufacturer shall modify the Main Office SCADA to implement the additional points described for this Project. Additions shall follow existing SCADA standards and shall provide an identical operator interface.

D. Main Office SCADA CTU: The System Manufacturer shall modify the Main Office SCADA CTU to implement the additional points described for this Project. Additions shall follow existing SCADA CTU standards.

E. Water Security Workstation: The System Manufacturer shall modify the Water Security Workstation to implement the additional points described for this Project. Additions shall follow existing Water Security Workstation standards and shall provide an identical operator interface.

F. Water Security Trunking Radio System: The System Manufacturer shall modify the Water Security Trunking Radio System to implement the additional points described for this Project. Additions shall follow existing Water Security Trunking Radio System standards.

G. SCADA RTU-A: The System Manufacturer shall provide a new RTU to implement the points described for this Project. The RTU shall match the existing RTUs used in the county's other pump stations on the existing SCADA system. The RTU shall communicate over the existing SCADA radio system. Points communicated shall be as described in Specification Section 17400.

H. Water Security RTU-B: The System Manufacturer shall provide a new RTU to implement the points described for this Project. The RTU shall match the existing RTUs used in the county's other pump stations on the existing Water Security system. The RTU shall communicate over the existing Water Security radio system. Points communicated shall be as described in Specification Section 17400.

I. SCADA RTU-C: The System Manufacturer shall provide a new RTU to implement the points described for this Project. The RTU shall match the existing RTUs used in the county's other pump stations on the existing SCADA system. The RTU shall communicate over the existing SCADA radio system. Points communicated shall be as described in Specification Section 17400.

J. Water Security RTU-D: The System Manufacturer shall provide a new RTU to implement the points described for this Project. The RTU shall match the existing RTUs used in the county's other pump stations on the existing Water Security system. The RTU shall communicate over the existing Water Security radio system. Points communicated shall be as described in Specification Section 17400.

K. LCP-1: The System Manufacturer shall furnish the Pump Control Panel. The panel shall be as described in these Specifications.

L. LCP-2: The System Manufacturer shall furnish the Pump Control Panel. The panel shall be as described in these Specifications.

M. SCADA RTU-A and RTU-C Antenna System: The System Manufacturer shall furnish two yagi directional antennas, one for each RTU. Each antenna shall be mounted atop a System Manufacturer-furnished 50' wooden antenna pole. The antenna poles shall be located as shown on the plans. The System Manufacturer shall furnish the coaxial cable from the RTU to the antenna. The coaxial cable shall be selected to optimize the radio/cable/antenna performance.

N. Water Security RTU-B and RTU-D Antenna System: The System Manufacturer shall furnish two omni antennas, one for each RTU. Each antenna shall be mounted atop a System Manufacturer-furnished 8' antenna pole. The antenna poles shall be located as shown on the plans. The System Manufacturer shall furnish the coaxial cable from the RTU to the antenna. The coaxial cable shall be selected to optimize the radio/cable/antenna performance.

O. The pump control panel at each station, LCP-1 and LCP-2, shall be shipped to the Pump System Vendor for complete system factory testing. The System Manufacturer shall coordinate with the Pump System Vendor so that the panel is available when needed for factory testing.

1.05 Quality Assurance

A. The Contractor shall ensure that the PCS is an integrated system furnished by the System Manufacturer who shall provide all of the equipment and appurtenances, regardless of manufacture and be responsible to the Contractor for correct operation of the entire system.

B. The System Manufacturer shall be responsible for the detailed design implementation and the proper functioning of the PCS, programming and/or configuration of all digital hardware, preparation of required submittal data including operations and maintenance manuals, preparation of test procedures, factory and field tests, start-up including field calibration, operational demonstrations, providing technical supervision for installation and connections to equipment, and training of the Owner's operating personnel.

C. The System Manufacturer shall be regularly engaged in the type of work called for under these Specifications and must have capital facilities, personnel, plant, and service capabilities required to successfully perform the work. The System Manufacturer shall employ competent personnel experienced in the design, manufacture, and programming of equipment and systems required. The System Manufacturer shall assign an experienced person who shall act as Project Manager. This person shall have responsible project experience on similar systems of a comparable complexity to that specified herein.

D. The System Manufacturer shall have in employment, a permanent field service organization capable of providing service and maintenance of the system.

E. The System Manufacturer shall have installed similar systems which have been in satisfactory operation to establish the reliability of the equipment proposed to be furnished.

F. Acceptable Manufacturers

1. M/R Systems, Inc., Norcross, Georgia

2. Revere Control Systems, Birmingham, Alabama

3. Control Instruments, Inc., Smyrna, Georgia

1.06 Submittals

A. The System Manufacturer shall make submittals in accordance with the requirements of Section 01340. The submittal shall be divided into separate sections as listed below. Refer to related work sections for additional requirements.

B. Field Devices: This Section shall include primary elements, transmitters, switches, analytical instruments, etc. List all dimensions, power requirements, enclosure types, ranges, and signal form or value. Provide data, including proposed length, on special cables required between sensing elements and electronics units and data on any special equipment used for calibration or maintenance of a particular device. Field device submittals shall also include specific data sheets for each device which shall contain the following information:

1. Tag number per Specifications and Drawings.

2. Manufacturer's complete model number with complete model number breakdown.

3. Input – output characteristics.

4. Range, size, and graduations.

5. Physical size with dimensions, NEMA enclosure classification and mounting details.

6. Materials of construction of all components.

7. Instrument or control device sizing calculations where applicable.

8. Certified calibration data on all flow metering devices.

9. Environmental requirements during storage and operation.

10. Power requirements.

C. Digital System Hardware: This Section shall include computer hardware complete with printers, magnetic storage devices, cables, UPS systems, and other peripherals. Include PLC hardware, communications hardware, and LAN and data highway conductors.

D. Digital System Software: This Section shall include documentation on system software, standard software packages supplied, and custom software developed for reports, process control, and graphic displays. Include software developed for both the operator interface and PLC system.

E. Control Panels: This Section shall include dimensions, terminal block designations, front panel arrangement, back panel layout, and ladder logic diagrams for both PLC-based and discrete component type control panels, etc. Provide catalog sheets for all panel components, indicate ranges, and provide nameplate schedules. All connections for new instruments terminating in the System Manufacturer's panels shall be clearly shown. All devices installed in each panel or connected to each panel, shall

be identified on the panel drawings by the tag number included in the Specifications and Drawings. Any miscellaneous equipment not clearly falling into one of the above volumes, including recommended spare parts list shall be included in the control panel volume.

F. Loop Diagrams: This Section includes no more than 10 typical loop diagrams for approval of format only. The submitted loop diagrams shall represent different types of process measurements.

G. Factory Test: This Section shall include the witness test and final checkout procedural outline detailed in Article 3.04 – B.

1.07 Construction Documentation

The System Manufacturer shall provide loop diagrams to the Contractor. The Contractor shall provide loop diagrams to the electrical subcontractor. Loop diagrams shall be issued as a group with the delivery of their respective control panel or area instrumentation. Two sets of loop diagrams shall be issued to the electrical contractor and one set to the Engineer.

1.08 Record Documentation

A. General: Record documentation shall be provided in accordance with Section 01720. Additionally, provide all information listed in Article 1.06 above, corrected to reflect the system as installed. Include also any instruction books, operation manuals, and other information pertaining to service and maintenance. Bind record documents in 3-ring, hardback notebooks complete with tabs and index. Include name, address, and telephone number for each manufacturer's service contact. For all major components, provide a recommended spare parts list.

B. Loop Diagrams

1. Provide an individual wiring diagram for each analog and discrete loop showing all terminations, terminal numbers, conductor numbers, cable numbers, the location of the DC power supply, power panel, and circuit numbers for all 120 VAC power to field instruments, MCC and bucket numbers for all 480 VAC power to motor operated valves, signal polarity, the location of any dropping resistors, surge protectors, shielding, grounding, etc. Devices shall be identified by the tag number included in the Specifications and Drawings. Cabling between sensors/elements and associated transmitter shall be included. The loop diagrams shall meet the minimum requirements of ISA S5.4 plus the requirements below.

2. Each loop diagram shall be divided into areas for identification of device locations (e.g. panel face, back-of-panel, field, etc.) Loop diagrams shall be on 11 x 17-inch drawings.

3. The loop number shall be incorporated into the loop diagram drawing number. If the System Manufacturer does not have any specific loop diagram drawing

number requirements, the drawing number shall be the loop number (the drawing number for loop F-1004 would be 1004). If a requirement exists (one requirement may be to incorporate the project number XXXXXX), the loop number shall be included as the suffix. The drawing number for loop F-1004 would be XXXXXX-1004.

C. Instrument Hardware: Record documents shall include bills of material, front views, assembly drawings, component layout drawings and schematics, nameplates, schedules, electrical schematics, electrical connection diagrams, and tubing/piping connection diagrams. Electrical and piping connection diagrams shall show all terminations of equipment, complete with instrumentation, wire, equipment, and cable designations. Interconnecting diagrams shall be prepared in a neat and legible manner on 11 x 17-inch or 24 x 36-inch sheets.

D. Software Documentation: In addition to the hard copies of drawings, programming and literature generated specifically for the project, two sets of compact disks shall be provided to the Owner with copies of all custom files specifically created for the project, including all panel drawings, I/O drawings, termination drawings, communication architecture drawings, data sheets, bills of material, operating procedures, etc. Additional files included in this set shall be PLC programs and copies of the operator interface software application program. Drawing format shall be AutoCAD 2000. All Drawings shall also be furnished as Acrobat *.pdf files. Include copies of all *.shp and *.shx files used in the AutoCAD drawings. Compact discs shall have a complete listing of their contents along with the names and version numbers of the software used to generate each file. Discs shall be clearly identified by the following:

1. Project Name

2. Volume Number

3. Labeled “AS-INSTALLED”

E. Configuration Documentation: Instrument Configuration and Calibration sheets shall be generated for all instruments requiring configuration and/or calibration. The intent of the Instrument Configuration and Calibration sheets is to provide all necessary information required to enable the Owner to calibrate and/or configure a replacement instrument identical to the original instrument. One sheet shall be provided for each instrument. The sheets shall be 8-1/2 x 11 inch size and shall be included in the O&M Manual. Each sheet shall list the instrument tag number (as depicted on the Drawings and Specifications), the date, the System Manufacturer company name and phone number, the name of the individual who filled out the sheet, the instrument manufacturer’s name and phone number, the complete model number, the calibrated range, and all configuration information.

F. System Documentation: Generate a System software document containing the following information for each System related software product purchased.

a. The facility/plant name where the software is installed.

b. The computer name that the software is installed on (master SCADA workstation, historical data computer, etc.)

c. The computer manufacturer and model, processor speed, and installed RAM.

d. The computer operating system (model and version).

e. The product name, version, and serial number.

f. The name and quantity of client licenses (if applicable).

g. The product name and version of all supporting software installed.

h. The date purchased and the company name it was purchased from.

i. The name of the person purchasing the software, and the person's company name.

j. The date the software was installed.

1.09 Environment

A. Local Control Panels: Local control panels shall be capable of operating between 32 degrees and 120 degrees F and 5 to 95 percent relative humidity without condensation. A 120 VAC single-phase, three-wire grounded power source will be supplied.

B. Field Devices: Field devices shall be housed in NEMA 4X enclosures. Ambient temperature rating shall be suitable for the project locale. All enclosures, including field instruments and control panels, which are located out-of-doors shall be provided with adequate sunscreens.

1.10 Deliver, Storage, and Handling

A. After completion of shop assembly and tests, control panels shall be enclosed in heavy polyethylene envelopes to provide complete protection from dust and moisture. Desiccant materials shall be placed inside the envelope prior to sealing. The equipment shall then be mounted on skids, enclosed in protective boxes, and braced for final transport. Removable lifting rings shall be provided on all sections weighing more than 150 pounds to permit moving without removal of protective covering. Shipping weights shall be shown on shipping tags together with instructions for unloading, transporting, storing, and handling on the job site. If practical, termination cabinets shall be delivered first to permit field wiring to be complete and checked out before receipt of remainder of equipment. None of the control room equipment shall be delivered until the environmental services required by the Specifications and Drawings are available and operating in accordance with manufacturer's specifications.

B. The Contractor shall be fully responsible for moving the equipment through new and existing facilities and setting it in the proper location.

1.11 Warranty

A. Warranty Period: In accordance with Division 1 and the following:

1. Corrective hardware maintenance shall be performed by a trained service technician specifically trained to service the equipment involved. The technician shall be available, on-site, within 24 hours after notification by the Owner.

2. Software maintenance shall be performed by suitably qualified individuals from the System Manufacturer's software service staff. Representatives from third party software sources may additionally be involved, but the System Manufacturer shall be represented at all times during on-site services. Software service representative shall be available for consultation within four hours and, if required, on-site within 16 hours after notification by the Owner.

3. Deliver a copy of all service reports to the Owner on the day the work is performed.

Part 2 Products

2.01 Equipment

A. Quality Standards: It is not the intention of these Specifications to detail every component, accessory, signal conditioning device, etc. that is required to provide a complete system. The System Manufacturer shall provide all required components, using equipment from established manufacturers with a proven history of service and support.

B. Electronic Equipment: All solid state, printed circuit boards and components shall be suitable for the specified environment. Provide complete circuit diagrams for troubleshooting and repair. All parts shall be replaceable with standard commercial components without degrading the performance of the completed assembly.

2.02 Spare Parts

A. The System Manufacturer shall supply spare parts for the Plant Control System.

B. The System Manufacturer shall provide a list of all spare parts being provided under this Division. The spare parts list shall be included in the documents to be reviewed by the Engineer during the shop drawing review process. The spare parts shall include, but shall not be limited to, the items included in the list below.

1. Two of each type PLC processor.

2. Two each type of PLC I/O card.

3. Two each type of PLC power supply.

4. One lot of PLC I/O Card Fuses, 10 spare fuses for each type of fuse used in PLC I/O cards.

5. One lot of PLC Fuses, 5 spare fuses for each type of fuse used in PLC hardware (excluding I/O cards).

6. One Plant Control Network backbone Fast Ethernet switch.

7. One spare for each different type of media converter (fiber-to-copper, etc.)

8. Five fiber optic patch cards with connectors.

9. One lot of Terminals, 10 spare terminals for each type of terminal used in local control panels.

10. One lot of Terminal Fuses, 5 spare fuses for each type of miscellaneous fuse used in local control panels.

11. One heavy-duty relay.

12. Two ice-cube relays.

13. One spare for each different type of timing relay.

14. One lot of surge protectors, including 5 spare of each type used.

15. One 24 VDC power supply.

16. Two of each type of Intrinsic Safety Barrier provided.

17. One lot of Zener type Intrinsic Safety Barrier Fuses, standard lot cartons equal to 10 percent of the number of furnished IS Barrier fuses provided, two cartons of each type size and type of fuse minimum.

18. Other spares as noted in other Division 17 Sections.

2.03 Substitutions

See Section 01630.

Part 3 Execution

3.01 Installation

A. The System Manufacturer shall assign a full time representative to provide coordination and supervision of on-site PCS construction work. The individual is to be on-site during all times when PCS work is being done.

B. The system, peripherals, and accessory equipment shall be installed in accordance with the manufacturer's instructions and located as shown on the Drawings unless otherwise approved by the Engineer.

C. All work shall be executed in full accordance with all applicable codes and local rulings. Should any work be performed contrary to said rulings, ordinances, or regulations, the System Manufacturer shall bear the full responsibility for such violations and assume all costs arising therefrom.

D. The Contractor shall investigate each space in the building through which equipment must pass to reach its final location. If necessary, the manufacturer shall ship the equipment in sections sized to permit passage through such areas.

3.02 System Noise Rejection

A. Electrical isolation shall be provided between input systems and the processor units. Noise rejection for common mode shall be at least 100 decibels from 0 to 100 Hertz, and up to 175 volts. Normal voltage rejection shall be not less than 35 decibels at 60 Hertz.

B. All instrument signal wiring, control wiring, and AC control power wiring shall be protected against lightning, spikes, and other transient surges at all field and control panel termination points per the requirements of Section 17120.

3.03 Grounding

A. Bond all instrument and control panel enclosures to the power system ground.

B. Ground analog signal conductor shields at the control panel end only.

3.04 Tests and Acceptance

A. The equipment and programs shall be factory-tested prior to shipment for compliance with the conditions of this Section, these Specifications, and for environmental conditions.

B. Factory Testing: Factory-test setup shall demonstrate peripheral performance, including all displays and graphics. All discrete and analog points shall be verified. A 100-hour burn-in test shall be performed on all solid-state devices. The Owner

reserves the right to witness the factory tests. At least 20 days written notice shall be given to the Owner and the Engineer by the Contractor prior to the date of starting factory tests. Submit detailed witness test and final checkout procedural outlines for approval to the Engineer not less than 60 days prior to starting factory tests. Testing shall include the complete system with all cabinet doors in place and peripherals attached, for an agreed to period time, with documentation via periodic printouts.

C. After installation of the complete system, the System Manufacturer shall provide the services of a qualified systems engineer to test the complete system under the observation of the Owner or Owner's representative to verify that all functions specified are performed without error or malfunction. As a part of the test procedure, Contractor's personnel, when requested by the system supplier, shall cause each remote process to change state or value three times to verify all functions during the checkout period. This shall be repeated until the system performs correctly to the satisfaction of the Owner or Owner's representative.

3.05 Start-Up Assistance

The System Manufacturer shall provide the on-site services of a project engineer for a minimum of one week (5 days at 8-hours per day) per pump station for start-up assistance. The individual provided shall be familiar with the Project and with all software packages and supplied hardware. This individual shall be capable of modifying PLC programming or operator interface configuration during the start-up period.

3.06 Training

A. The cost of training programs shall be included in the Control Price. The training and instruction shall be directly related to the PCS being supplied.

B. The System Manufacturer shall provide the following training courses for designated Owner's personnel. The courses shall be taught by professional, full-time instructors. All course materials required to adequately support the material presented shall be included. The System Manufacturer shall bear the cost of student transportation, meals, and lodging for any courses taught away from the Owner's facility. The System Manufacturer shall set the schedule for all courses with the Owner at least 20 days prior to the proposed date.

1. Operator Familiarization

   a. Length: Four hours

   b. Number of Students: 5

   c. Location: Owner's plant site

d. This course will be taught on-site to ensure that plant operating personnel will be thoroughly familiar with the SCADA and RTUs as delivered. The students will be instructed in start-up and operating procedures, and all system features.

END OF SECTION

Part 1 General

1.01 Scope

A. In general, simple analog and discrete control, logic and indication requirements are depicted on the Process and Instrumentation Diagrams (P&ID's) supplied as part of this package. Where additional information is necessary, it is included in the descriptions that follow.

B. The items described in paragraph 1.02 are general loop requirements for typical plan unit operations. It is intended that these general requirements shall be followed where applicable.

C. The items described in paragraph 1.03 are loop descriptions for typical plant unit operations. It is intended that these description, in conjunction with the P&ID's, provide sufficient system configuration information for the majority of simple control systems. Where additional descriptions are necessary or where control logic deviates from the general and typical descriptions, it is described in paragraph 1.04.

D. Software Alarms

1. All analog inputs to the Plant Control System (PCS) shall have low and high software alarms. Where low and/or high software alarms are not specified elsewhere in this Specification, they shall initially be turned off or set for 0% (low alarm) and 100% (high alarm) of the signal range. This will help eliminate nuisance alarms during checkout and start-up.

2. All software alarms shall be reviewed with the plant superintendent, or his designee, during programming or panel checkout and again during filed checkout or start-up. The System Manufacturer shall change all software alarm setpoint values as instructed by the plant superintendent. For critical alarms, the System Manufacturer shall configure the associated graphic symbol to flash or change color when in an alarm condition.

1.02 Loop Descriptions – General

A. Equipment protection interlocks and safety interlocks (motor temperature and moisture switches, emergency stops, low-low level shutdowns, etc.) shall be hardwired and shall not reside in the PCS. Hardwired equipment protection interlocks and safety interlocks shall be function at all times, regardless of operating mode (HAND, AUTO, LOCAL, REMOTE, etc.) Equipment protection circuits shall be fail-safe, the circuit shall open to stop equipment.

B. All motor control logic in the PCS shall include COMMAND DISAGREE logic. The system shall generate a COMMAND DISAGREE alarm to alert the operator that a fault has occurred for any of the following conditions:

1. When a motor is called to run and no run feedback is received within a preset, adjustable period of time. This shall only be applied to those motors which have run feedback.

2. When a motor is running based on a manual command, or based on an automated sequence, and run feedback is lost for a preset, adjustable period of time. This shall only be applied to those motors which have run feedback.

3. When a motor is called to run based on a manual command, or based on an automated sequence, and the feedback from a HAND/OFF/AUTO or similar field-mounted switch indicates that the unit is not in the AUTO mode. This shall only be applied to those motors which have UNIT IN AUTO feedback.

C. All control valve logic in the PCS shall include COMMAND DISAGREE logic. The system shall generate a COMMAND DISAGREE alarm to alert the operator that a fault has occurred for any of the following conditions:

1. When a valve is called to open and the open feedback is not received within a preset, adjustable period of time.

2. When a valve is called to close and the closed feedback is not received within a preset, adjustable period of time.

D. All analog inputs shall be monitored by the PCS to identify out of range signals (less than 4 mADC or more than 20 mADC). When the system detects an out of range signal which continues for more than five minutes, an alarm shall be generated. The alarm shall identify the particular analog signal which is out of range.

E. In general, all analog input scaling shall be performed in the PLC.

1.03 Loop Descriptions – Typical

A. Typical Motor Status Monitoring – Constant Speed Motors

1. Motor run (typically designated XI and annotated RUN) and overload (typically designated XA and annotated OL) status will be indicated in the control system.

2. Where conditions other than motor overload are sensed in the MCC (e.g., motor temperature or moisture switch activated), the fault condition is combined with motor overload and the resulting fault (typically designated XA and annotated FAULT) status will be indicated in the control system.

3. Total unit run time (typically designated KQI and annotated RUNTIME) will be provided for the motor in the control system.

B. Typical Motor Status Monitoring – Variable Speed Motors

1. Motor run (typically designated XI and annotated RUN) and combination VFD fault and motor overload (typically designated XA and annotated FAULT) status will be indicated in the control system.

2. Where conditions other than VFD fault and motor overload are sensed in the MCC (e.g., motor temperature or moisture switch activated), the fault condition is combined with motor overload and VFD fault and the resulting fault (typically designated XA and annotated FAULT) status will be indicated in the control system.

3. Total unit run time (typically designated KQI and annotated RUNTIME) will be provided for the motor in the control system.

4. Variable speed drives generally have a LOCAL-OFF-REMOTE switch mounted on the drive cabinet for starting or stopping the drive and a LOCAL-REMOTE switch for speed control. Unless otherwise stated in the project specific loop descriptions, a REMOTE contact from each switch shall be wired in series to provide an indication in the control system. Where UNIT IN REMOTE feedback (typically designated XI and annotated UNIT IN REMOTE) is required for a control loop, it will be shown on the P&ID's.

C. Typical Motor Control Loop – Local/MCC HAND-OFF-AUTO Switch

1. When the HAND-OFF-AUTO switch is in the HAND mode, the equipment will run continuously regardless of the automatic control logic. In the HAND mode, personnel protective and equipment protective interlocks shall be enabled to shut down the equipment. In the HAND mode, the equipment will run even in the event of PLC or control system failure.

2. When the HAND-OFF-AUTO switch is in the OFF mode, the equipment will not run under any circumstances.

3. When the HAND-OFF-AUTO switch is in the AUTO mode, the equipment will run in response to a single automatic contact from PLC or hardwired logic functions.

4. Where UNIT IN AUTO feedback (typically designated XI and annotated UNIT IN AUTO) is required, it will be shown on the P&ID's.

D. Typical Motor Control Loop – Local/MCC LOCAL-OFF-REMOTE Switch

1. When the LOCAL-OFF-REMOTE switch is in the LOCAL mode, the equipment will run continuously regardless of the remote control logic. In the LOCAL mode, personnel protective and equipment protective interlocks shall be enabled to shut down the equipment. In the LOCAL mode, the equipment will run even in the event of PLC or control system failure.

2. When the LOCAL-OFF-REMOTE switch is in the OFF mode, the equipment will not run under any circumstances.

3. When the LOCAL-OFF-REMOTE switch is in the REMOTE mode, the equipment will run in response to a single remote contact from PLC or hardwired logic functions.

4. Where UNIT IN REMOTE feedback (typically designated XI and annotated UNIT IN REMOTE) is required for a control loop, it will be shown on the P&ID's.

E. Typical Motor Control Loop – Logic START-STOP Switch

1. The START-STOP switch is typically set up for three- wire momentary control logic.

2. In the event of loss of power, the motor must be manually restarted.

3. Hardwired START-STOP switches shall operate equipment even in the event of PLC or control system failure.

F. Typical Software Control Switches

1. Where an automatic control strategy is implemented in software and it is necessary to disable the automatic operation, a software HAND-OFF-AUTO switch (typically designated HS and annotated HAND-OFF-AUTO) may be provided on the P&ID's. In the AUTO mode, the automatic control logic operates the control system output. In the OFF mode, the control system output remains open. In the HAND mode, the output contact remains closed or is controlled by a software START-STOP switch.

2. Where no automatic control strategy is implemented in software, but it is necessary to disable the automatic operation elsewhere, a software ENABLE-OFF switch (typically designated HS and annotated ENABLE OFF) may be provided on the P&ID's. In the OFF mode, the output contact from the control system remains open. In the ENABLE mode, the output contact remains closed.

3. Where a software START-STOP switch (typically designated HS and annotated START-STOP) is shown on the P&ID's, the control system shall provide one normally open contact which closes for an adjustable time period to start the equipment and one normally closed contact which opens for an adjustable time period to stop the equipment. Where an automatic control sequence interfaces with a hardwired START-STOP momentary logic circuit, the control system shall provide one normally open contact which closes for an adjustable time period to start the equipment and one normally closed contact which opens for an adjustable time period to stop the equipment.

4. When a software RUN-STOP switch (typically designated HS and annotated RUN-STOP) is shown on the P&ID's, the control system shall provide one normally open contact which closes for as long as the control system logic calls for the equipment to run.

5. Where a software OPEN-CLOSE switch (typically designated HS and annotated OPEN-CLOSE) is shown on the P&ID's, the control system shall provide one normally open contact which closes when the control system logic calls for the valve to open and another normally open contact that closes when the control system logic calls for the valve to close. The outputs remain closed until the valve has reached its new position, as confirmed by the valve limit switches.

   a. When the valve is fully closed or is traveling, the valve closed indicator in the plant control system, ZIC, shall be on. When the valve is fully open, the valve closed indicator in the plant control system, ZIC, shall be off.

   b. When the valve is fully open or is traveling, the valve open indicator in the plant control system, ZIO, shall be on. When the valve is fully closed, the valve open indicator in the plant control system, ZIO shall be off.

G. Typical Analog Loop – Indication and Alarm

1. Analog values (designated LI, PI, etc.) will be indicated in the control system. Readouts for pressure, temperature, flow, and analytical loops shall be in engineering units based on the field transmitter range. Readouts for level loops shall be in units consistent with the field transmitter range. Readouts for special analog loops, analog signals from equipment not supplied under Division 17, etc. will be listed in the Initial Software Settings list attached to this Section or described in the project specific loop descriptions.

2. Required software alarm functions (designated LAL, TAH, AAL, etc.) derived from analog variables are shown on the P&ID's. Initial setpoints for software switches will be listed in the Initial Software Settings list attached to this Section or described in the project specific loop descriptions.

H. Typical Analog Loop – Control and Alarm

1. All software PID (proportional, integral, derivative) controllers (designated LIC, PIC, FIC, AIC, PDIC) must show setpoint, process variable, and manipulated variable and allow access to tuning parameters from the operator interface software package. Any software controller shall have the capability of being placed in MANUAL mode and have the capability of manually adjusting the output in MANUAL mode from the operator interface software package. Indicator readouts for software PID controllers shall conform to the requirements given in the Typical Analog Loop – Indication and Alarm description above.

2. Required software alarm functions (designated LALL, TAH, AAL, etc.) derived from analog variables are shown on the P&ID's. Initial setpoints for software switches will be listed in the Initial Software Settings list attached to this Section or described in the project specific loop descriptions.

I. Manual Analog Control Setting: Software manual analog control inputs (designated HIC) are shown on the P&ID's. Initial control ranges will be listed in the Initial Software Settings list attached to this Section or described in the project specific loop descriptions.

J. Timer Control

1. Software time control functions (designated KIC or KC) are shown on the P&ID's. Initial time settings will be listed in the Initial Software Settings list attached to this Section or described in the project specific loop descriptions.

2. Where times are used for cycle/duration control logic, the controlled unit will remain off for a preset, adjustable cycle time (designated KIC or KC and annotated CYCLE). At the end of the cycle time, the controlled unit will turn on for an adjustable duration time (designated KIC or KC and annotated DURATION). At the end of the duration time, the cycle timer resets and starts again.

1.04 Loop Description – Project Specific

101	Mansell Road Booster Pump No. 1	I0.3
102	Mansell Road Booster Pump No. 2	I0.3
103	Mansell Road Booster Pump No. 3	I0.3

The new pump shall be controlled from a new vendor-furnished VFD. The VFD shall be wired to the Pump Control Panel, LCP-1. The following signals shall be wired between LCP-1 and the VFD:

Pump SPEED command, 4 to 20 mADC, to the VFD.
Pump SPEED feedback, 4 to 20 mADC, to the LCP.
Pump CALL-TO-RUN command, discrete, to the VFD.
Pump RUN status, discrete, to the LCP.
Pump FAULT alarm, discrete, to the LCP.

The following functions shall be provided on the Pump Control Panel, LCP-1:

Pump mode, HAND / OFF / AUTO, selector.
Pump SPEED command setpoint station.
Pump actual SPEED indicator.
Pump RUN status indicator.
Pump FAULT alarm.
Pump RUN TIME indicator.

LCP-1 shall be wired to the RTU, LCP-A, for interface with the County control system. The following signals shall be wired between LCP-1 and the RTU:

Pump RUN status, discrete, to the RTU.
Pump FAULT alarm, discrete, to the RTU.

104	Position-Pump No. 1 Discharge Motorized Valve	I0.3
105	Position-Pump No. 2 Discharge Motorized Valve	I0.3
106	Position-Pump No. 3 Discharge Motorized Valve	I0.3

The motorized valve shall be controlled from LCP-1. The valve motor actuator shall be wired to LCP-1. Valve OPEN / CLOSE shall be selected on LCP-1. Valve OPEN / CLOSED shall be indicated on LCP-1.

126 Intrusion Alarm-Mansell Road Booster Pump Station I0.3

There shall be a proximity switch mounted on each door. The switches shall be wired in series to the Water Security RTU. BUILDING INTRUSION shall be alarmed on the Water Security System.

127 Temperature-Mansell Road Booster Pump Station I0.3

The wall-mounted HIGH TEMPERATURE switch shall be wired to the Water Security RTU. HIGH TEMPERATURE shall be alarmed on the Water Security System.

128 Motion Detection-Mansell Road Booster Pump Station I0.3

There shall be two motion detectors mounted inside the pump station. The detectors shall be wired in series to the Water Security RTU. MOTION DETECTED shall be alarmed on the Water Security System.

130 Select-Mansell Road Booster Pump Station Lead Pump I0.3

The following functions shall be provided on the Pump Control Panel, LCP-1:

Lead pump, PUMP 1 / PUMP 2 / PUMP 3, selector.

140 Pressure-Mansell Road Booster Pump Station Pump Suction I0.3

The new pressure transmitter shall be wired to the Pump Control Panel, LCP-1.

The following front-of-panel functions shall be provided on the Pump Control Panel, LCP-1:

Pump suction PRESSURE controller.
Pump suction LOW PRESSURE alarm.

LCP-1 shall be wired to the RTU, LCP-A, for interface with the County control system. The following signals shall be wired between LCP-1 and the RTU:

Pump suction PRESSURE, 4 to 20 mADC, to the RTU.
Pump suction LOW PRESSURE alarm, discrete, to the RTU.

150 Select-Mansell Road Booster Pump Station Tank Mode I0.3

The following functions shall be provided on the Pump Control Panel, LCP-1:

Tank mode, FILL / DRAIN, selector.
Tank FILL setpoint station.
Tank DRAIN setpoint station.

160 Pressure-Mansell Road Booster Pump Station Discharge Header I0.3

The new pressure transmitter shall be wired to the Pump Control Panel, LCP-1.

The following front-of-panel functions shall be provided on the Pump Control Panel, LCP-1:

Pump discharge PRESSURE controller.
Pump discharge HIGH PRESSURE alarm.
Pump discharge LOW PRESSURE alarm.

LCP-1 shall be wired to the RTU, LCP-A, for interface with the County control system. The following signals shall be wired between LCP-1 and the RTU:

Pump discharge PRESSURE, 4 to 20 mADC, to the RTU.
Pump discharge HIGH PRESSURE alarm, discrete, to the RTU.
Pump discharge LOW PRESSURE alarm, discrete, to the RTU.

170 Flow-Mansell Road Booster Pump Station I0.3

The new magnetic flow transmitter shall be wired to the Pump Control Panel, LCP-1.

The following front-of-panel functions shall be provided on the Pump Control Panel, LCP-1:

Station FLOW indicator.
Station TOTAL FLOW indicator.

LCP-1 shall be wired to the RTU, LCP-A, for interface with the County control system. The following signals shall be wired between LCP-1 and the RTU:

Station FLOW, 4 to 20 mADC, to the RTU.

Mansell Road Booster Pump Station Pump Control Logic: I0.3

<u>PUMP HOA</u>: When the pump HAND / OFF / AUTO selector is in the HAND position, the pump shall run. When the pump HAND / OFF / AUTO selector is in

the OFF position, the pump shall not run. When the pump HAND / OFF / AUTO selector is in the AUTO position, the pump shall run based on the pump control logic.

Tank Mode Select: The tank FILL setpoint shall be entered on the pump control panel. The tank DRAIN setpoint shall be entered on the pump control panel. The position of the tank operation mode selector, FILL / DRAIN, shall send the appropriate setpoint to the pump DISCHARGE PRESSURE controller remote setpoint.

Discharge Pressure Controller (reverse acting): The PV for the DISCHARGE PRESSURE controller shall be from the DISCHARGE PRESSURE transmitter. The remote setpoint shall be from the Tank Mode selector switch. The output shall be sent to the LOW SELECT relay.

Suction Pressure Controller (direct acting): The PV for the SUCTION PRESSURE controller shall be from the SUCTION PRESSURE transmitter. The output of the SUCTION PRESSURE controller shall be an input to the LOW SELECT relay.

Low Select Relay: The LOW SELECT relay shall pass the lower of the two input signals, DISCHARGE PRESSURE controller output OR SUCTION PRESSURE controller output, as the output to the SPEED command setpoint.

Pump Sequencer Logic: Normal operation shall be with two duty pumps and one standby pump. The sequence of operation of the three pumps shall be as follows:

Lead Pump: The Lead pump, PUMP 1 / PUMP 2 / PUMP 3 / AUTO, shall be selected on the Pump Control Panel. When PUMP 1, PUMP 2, or PUMP 3 is selected, the respective pump remains as the Lead Pump. When AUTO is selected, the assignment of the Lead Pump is controlled by the Pump Sequencer Logic.

Single Pump Operation: When the SPEED command setpoint signal (the output of the Low Select Relay) increases to a point that would cause the pump to run at 20% above the MINIMUM EFFECTIVE SPEED, the Lead Pump shall start and ramp up to the SPEED command setpoint. When the pump is running and the SPEED command setpoint decreases to a point equal to 10% above the MINIMUM EFFECTIVE SPEED and does not rise above 10% above the MINIMUM EFFECTIVE SPEED for 1 minute, the pump shall ramp down and stop, ending the cycle.

Two Pump Operation: When a single pump is running and the SPEED command setpoint increases to 98% of MAXIMUM SPEED for 30 seconds, the Lag Pump shall be started and the setpoint shall ramp up to the SPEED command setpoint. Thus two pumps shall be running at the SPEED command setpoint. When the SPEED command setpoint

decreases to less than 20% above the MINIMUM EFFECTIVE SPEED for 1 minute, the Lag Pump shall be ramped down and stopped. At this point Single Pump Operation shall be resumed.

Pump Alternation: At the end of each cycle, when all pumps have shut down. The assignment of Lead Pump and Lag Pump shall be rotated.

Providence Road Booster Pump Station Pump Control Logic: I0.4

Identical to Mansell Road Booster Pump Station.

END OF SECTION

Part 1 General

1.01 Scope

Control panels.

1.02 Submittals

A. The Contractor shall furnish the following items from the System Manufacturer for approval prior to fabrication:

1. Layout drawings of the front of the panel showing mounting dimensions for all instruments and associated hardware.

2. Assembly drawings shall include:

   a. Details of panel fabrication including outline dimensions and locations of rear of panel mounted equipment.

   b. Wiring layout.

   c. Wiring and tubing interconnection diagrams.

3. Electrical wiring and termination drawings.

4. Complete bill of materials describing all panel components, including manufacturer ands complete model number for all components.

5. Catalog cut sheets for all panel components.

1.03 Record Drawings

Submit shop drawings as listed under Article 1.02 above plus operation and maintenance information.

1.04 Delivery, Storage, and Handling

A. Wrap the completed panel in polyethylene plastic and crate in a wooden shipping crate with sufficient packing to avoid damage in shipment.

B. Support the base of the shipping crate with the cross members of sufficient strength and clearance to allow movement of the entire crated panel by fork-lift truck.

Part 2 Products

2.01 Enclosure

A. Provide wall mounted, stanchion mounted, free-standing, or walk-in enclosures as scheduled.

B. Provide NEMA 12 enclosures for control panels located indoors and NEMA 4X stainless steel for outdoor locations (except walk-in) unless otherwise noted.

C. In all NEMA 4X enclosures, provide a thermostat controlled space heater and corrosion inhibitor blocks. Provide NEMA 4X rated devices on front of enclosure or mount devices on interior panel and provide door mounted tempered glass or polycarbonate viewing window.

D. Free-standing enclosures are a minimum of 20-inches deep.

E. NEMA 12 and general purpose enclosures shall be fabricated from a minimum 14 gauge steel, unless noted otherwise, with all seams ground smooth, all corners rounded, and all flat surfaces smooth with no ripples, dimples, or surface imperfections and no screws, bolts, or nuts visible from outside. Provide panel stiffeners as required to provide a rigid, non-bowing surface. Thoroughly clean and degrease the steel shell before painting. Apply one coat of a rust inhibiting primer and two coats of air dry enamel or acrylic with flattening agent to produce a smooth semi-gloss finish. Colors are to be chosen by the Engineer.

F. Install a continuous hinged front access door. For freestanding enclosures, furnish a three point latch. A single point latch is acceptable for wall-mounted enclosures. Wire door mounted instruments and controls to stationary components with suitable flexible connections and protection where wiring crosses the hinge. Provide double or multiple doors as required for stability and smooth mechanical operation.

G. Terminate all tubing and electrical connections at the bottom of the panel to bulkhead fittings and terminal strips, with all external connections properly identified for field connections. Space shall be provided at the bottom of the panel for excess wiring to be laid out before landing on the associated field terminal strip. Space shall also be provided at the top and sides of the panel for routing cables entering from the top of the panel.

H. For panels with 120 VAC power supply, provide appropriately sized circuit breaker, single pole, 22,000 AIC, mounted in the rear of the panel to disconnect power. Mount an engraved nameplate (white letters, red background) to read “WARNING – This panel energized by foreign control power sources. Equipment will be live with panel disconnect in either on or off position”.

I. Internal panel sub-feeds of 120 VAC power shall be divided into separate circuits protected by properly sized circuit breakers or fuses. The following separate circuit divisions shall be provided:

1. Panel light(s) and panel fans (where used).

2. Each receptacle.

3. Power to the panel UPS (where supplied).

4. Thermostatically controlled heaters (where supplied).

5. Each power supply (including 24-volt power supplies, power supplies for PLCs, power supplies for fiber optic transceivers, etc.)

6. 120-volt power to field mounted instruments (each instrument shall be provided with a separate circuit).

J. Provide 1/4 x 12-inch copper ground bus bar in the rear of the panel. All bus bars shall be bonded together. Ground bus shall be capable of accepting System Ground Grid connection and Power System Ground connection.

K. Provide 20 percent spare, contiguous panel/sub-panel mounting area to accommodate future panel expansion, unless noted otherwise.

L. The System Manufacturer shall investigate the space allocated for control panels on the accompanying drawings and inform the Engineer of any potential problems.

M. If indicated in the control panel schedule, control panels shall be provided with a drip shield or heat shield.

1. A 304 stainless steel drip shield shall be provided to prevent ice buildup on the panel door, door hinges, and front of panel-mounted devices. Minimum overhang shall be one inch on the front and side of the panel.

2. 304 stainless steel heat shields shall be provided to prevent excess heat inside the panel. Shields shall be provided for the top, front, back, and both sides of the panel. Shields shall be mounted to provide one-inch air space between the shield and the panel. Each shield shall have the same height and width as the panel side being protected. Cutouts shall be provided for access to front of panel-mounted devices.

N. All indicator lights shall be push-to-test. In cases where it is not practical to use push-to-test indicator lights (Engineer's approval required), then a lamp test circuit with a lamp test pushbutton mounted on the front-of-panel shall be provided. Pressing the lamp test pushbutton shall illuminate all indicator lights without interrupting control circuits.

Lamp Colors:	Red	Running, Open
	Green	Stopped, Off, Closed
	Amber	Alarm

O. Provide one 120 VAC duplex receptacle and fluorescent light(s) as scheduled. Incandescent lights may be used where panel size prohibits the use of fluorescent lights. Provide one standard on/off light switch for the lights. Receptacles and lights shall be provided with a separate circuit breaker and shall be fed from the 120 VAC power supply to the panel. Receptacles and lights shall be fed from uninterruptible power supplies.

P. All PLC discrete outputs shall have interposing relays installed in the control panel.

Q. Where Intrinsic Safety (IS) barriers have been supplied as a means of providing electrical hazardous area protection for the associated field device, all IS barriers and associated IS wiring shall be separated by at least two inches of air space from all regular non-hazardous wiring inside the control panel. Per NEC Article 504-30, grounded metal or other insulated partitions with lesser distance requirements shall be permitted. IS wiring entering the control panel shall be located in dedicated conduits, which also shall be separated from any non-hazardous wiring. IS Barriers shall be located in electrical non-hazardous areas.

R. Conduits containing IS wiring where entering enclosures containing regular, non-IS wiring shall be externally sealed to prevent transmission of gases from hazardous areas. Conduit installation and sealing is to be provided under Division 16.

S. All FRP panels located in direct sunlight shall be provided with at least two coats of UV protective coating to prevent discoloration and cracking.

T. All control panels shall be either padlockable or have a lock installed in the door handle. All Contractor provided locks shall be keyed alike – consult with the Owner for preferred keying system.

U. Front of panel devices, such as analog controllers or annunciators, that have rear mounted terminal strips shall be accessible without standing inside the control panel (i.e. mounted on panel door or swing-out panels). Walk-in control panels are excepted.

2.02 Wiring

A. Install a minimum of #16 AWG copper stranded, 600 volt, extra flexible type for all control wiring 50 volts and above, and a minimum of #18 AWG twisted, shielded pair for analog signal conductors. Color code wires as follows:

1. Ground: Green.

2. Neutral: White.

3. Line Conductor (150 volts or less to ground): Black.

4. Control (150 volts AC or less): Red.

5. Control (150 volts DC or less): Blue.

6. Interlock control circuits supplied from external power source: Yellow or pink.

7. Intrinsic Safety Conductors: Light blue.

8. Signal, Shielded and Special Cables: Identify with wire markers.

B. Mark all wires with approved wire markers at all terminations, per Section 16195. Clearly mark all terminal blocks with typewritten or ink markings. Label all devices mounted on the steel sub-panel. All instrument and control devices (current switches, MiniCAS II relay modules, etc.) located inside control panels shall have engraved lamacoid nametag affixed on or near the device and shall bear the tag number and service description. Label all devices mounted on the panel front with engraved lamacoid nameplates, fastened with screws. Nameplates shall be three-layer laminated plastic, black letters on a white background. Letter height to be 1/8-inch for individual devices and 1/4-inch for panel designation.

C. Neatly bundle and secure all wiring with plastic ties. Route back-of-panel wiring in slotted plastic wireways with snap-on covers.

D. Terminal blocks shall be provided for all field wiring connections to the panel. This includes shield terminals for shielded cables. Terminal blocks may be mounted horizontally or vertically and shall be easily accessed from panel door(s). Terminal blocks shall be DIN rail mounted, screw clamp, feed-through type with 600 volt minimum rating. A minimum of 20 percent extra terminals shall be provided on the terminal blocks. Each terminal shall be clearly and permanently marked. Provide fused terminal blocks for all 120 VAC discrete inputs and outputs. All terminal blocks shall be suitably sized for #12 AWG (minimum) stranded wire. All terminal blocks shall be grouped apart, depending upon type of signal per Paragraph E. below.

E. AC or DC power wiring shall not run in any raceway with any type of instrument wiring. Wiring is to be divided into categories and shall be carried in separate raceways. The minimum acceptable groupings are:

1. 120 VAC, 60 Hz AC power wiring and chart drive power wiring.

2. DC power to electronic instruments (does not include loop powered instruments), contact closure input and output wiring.

3. All wiring carrying pulsed information.

4. Standard range analog DC signals, thermocouple and up to 200 mV DC signals.

5. All intrinsic safe wiring.

F. It is the responsibility of the System Manufacturer to provide appropriate protection against transients and surges for all field wiring, interfacing with the control panels.

This protection equipment shall reside in the appropriate control panel. All instrument analog signal wiring, data transmission wiring, and 120 VAC power supply wiring shall be protected against lightning strikes, and other transient surges at all control panel termination points. All control power wiring, AC control power wiring, I/O cabinet discrete input wiring and discrete output wiring which is routed outside of buildings shall be protected against lightning strikes, and other transient surges at all control panel termination points. Lightning and surge devices shall protect the system from induced surges in analog, discrete and control circuitry and power supply lines. The protective devices shall not interfere with the normal operation of the panel hardware and shall be designed not to have a maximum clamping voltage in excess of what the protected device is capable of withstanding. Protection devices for all internally mounted power supplies shall be installed on individual 120 VAC supply wiring. Each surge/lighting protector shall be independently grounded to the panel ground bus. Protector mounting rail shall not be used to ground the protector.

G. The System Manufacturer shall provide required hardware and labor for termination of new signals in existing termination cabinets where required. This hardware and workmanship shall match existing work with respect to method, materials, and workmanship.

H. All control panels furnished under this Section shall carry a UL label which certifies the control panel meets the requirements of UL-508A (latest version).

2.03 Drawings

A. Panel Construction Drawings

1. Shop Drawings and Catalog Cuts: Provide detailed shop drawings and catalog cuts for all panels, instrument racks, and enclosures. Drawings shall show the location of all front panel and internal sub-panel mounted devices to scale and shall include a panel legend and bill of materials. Layout drawings shall show all major dimensions as well as elevations, in inches from the base up, of all rows of components.

2. The panel legend shall list and identify all front of panel devices by their assigned tag numbers, all nameplate inscriptions, service legends, and annunciator inscriptions. Tag number shall be as listed in the Specifications and Drawings.

3. The bill of materials shall include all devices, including those mounted within the panel that are not listed in the panel legend, and shall include the device tag number, description, manufacturer, and complete model number.

B. Panel Wiring Diagram

1. Provide complete terminal identification of all external primary elements, panels, and junction boxes that interface directly to the panel wiring being shown. Polarity of analog signals shall be shown at each terminal.

2. All external wiring that the electrical contractor must provide and install shall be shown as a dashed line. Special cables that are provided with the instrument shall be clearly identified.

3. Panel wiring diagrams shall identify wire numbers and types, terminal numbers, and tag numbers. Wiring diagrams shall show all circuits individually; no common diagrams will be allowed.

4. Provide panel power wiring diagrams for all panels. The diagrams shall include the grounding requirements.

C. Interconnecting Wiring Diagrams: Diagrams shall show all component and termination cabinet identification numbers and external wire, fiber, and cable numbers. This diagram shall be coordinated with the electrical supplier and shall bear its mark showing that this has been done.

2.04 Control Panel Schedule

Panel No.	Mounting Type	Enclosure Rating	Light/Receptacle	Heat Shield/ Drip Shield
LCP-1	Free-Standing	NEMA 12	Yes/Yes	No / No
LCP-2	Free-Standing	NEMA 12	Yes/Yes	No / No
SCADA RTU-A	Free-Standing	NEMA 12	Yes/Yes	No / No
SCADA RTU-C	Free-Standing	NEMA 12	Yes/Yes	No / No
Water Security RTU-B	Free-Standing	NEMA 12	Yes/Yes	No / No
Water Security RTU-D	Free-Standing	NEMA 12	Yes/Yes	No / No

Part 3 Execution

3.01 Testing and Calibration

A. Thoroughly shop test the completed panel. Confirm that all lamps burn. Remove, box, and label all parts that may come loose or detached in shipment, so that after installation they may be easily replaced.

B. Perform preliminary calibrations in the fabricator's shop, and final calibrations at start-up by qualified personnel.

END OF SECTION

Part 1 General

1.01 Scope

Comprehensive surge protection for all instrumentation devices supplied as part of these Specifications.

1.02 General

A. It is the responsibility of the System Manufacturer to provide appropriate protection against transients and surges for all field instruments, field wiring, and devices interfacing with control panels. All instrument signal wiring, control wiring, telephone wiring, and data transmission wiring which enters or exits buildings shall be protected against lightning strikes, and other transient surges at all control panel termination points. All instrument signal wiring, control wiring, telephone wiring, and data transmission wiring which terminates out-of-doors shall be protected against lightning strikes, and other transient surges at all termination points. All AC control power wiring shall be protected against lightning strikes, and other transient surges at all control panel termination points. Lightning and surge devices shall protect the system from induced surges in analog, discrete, and control circuitry and power supply lines. The protective devices shall not interfere with the normal operation of the panel hardware and shall be designed not to have a maximum clamping voltage in excess of what the protected device is capable of withstanding.

B. All field instruments located indoors or out-of-doors provided by the System Manufacturer under this contract shall be supplied with surge protection for 120 VAC power to the instrument.

C. Surge protectors shall include a combination of surge suppression technologies including metal oxide varistors, gas discharge tubes, diodes, and 3AG size fuses for line-to-line and line-to-ground protection.

1.03 Submittals

Submit detailed product data.

Part 2 Products

2.01 Field Instruments – Analog Signals

A. Loop Powered Analog Instruments: All signal powered analog field instruments located outside shall be equipped with direct mounted surge protectors which screw directly into the unused conduit entry hub or a conduit tee. Acceptable Manufacturer: Phoenix Contact Model S-PT1-2PE-24VDC

B. Field Powered Analog Instruments: All field powered analog instruments located outside shall be equipped with surge protectors for both signal and power, mounted in a NEMA 4X enclosure. Acceptable Manufacturer: Phoenix Contact BOXTRAB with individual protection for signal and power circuits.

2.02 Control Panels

A. All instrument analog signal wiring which enters or exits buildings or which terminates out-of-doors shall be individually protected against lightning strikes and other transient surges at all control panel termination points. Acceptable Manufacturer: Phoenix Contact PT 1X2 Series.

B. All instrument discrete signal wiring which enters or exits buildings or which terminates out-of-doors shall be individually protected against lightning strikes and other transient surges at all control panel termination points. Acceptable Manufacturer: Phoenix Contact PT 2X1 Series (Inputs) and PT 2-PE/S Series (Outputs).

C. All data transmission wiring which enters or exits buildings or which terminates out-of-doors shall be individually protected against lightning strikes and other transient surges at all control panel termination points. Acceptable Manufacturer: Phoenix Contact PT HF Series and D-UFB Series.

D. All 120 VAC power wiring to control panels whether located indoors or out-of-doors shall be individually protected against lightning strikes and other transient surges at all control panel termination points. Acceptable Manufacturer: Phoenix Contact PT 2-PE/S Series.

E. Surge protection shall be provided for all telephone connections. Acceptable Manufacturer: Phoenix Contact MT-2FM-RJ12 Series.

2.03 Antennas

RF Surge protection shall be provided for all antennas. Acceptable Manufacturer: Phoenix Contact COAXTRAB Series.

2.04 Ethernet

Surge protection shall be provided for all Ethernet connections. Acceptable Manufacturer: Phoenix Contact D-LAN Series.

2.05 Miscellaneous Digital Equipment

Provide surge protection for all computers, printers, uninterruptible power supplies, digital equipment power supplies, PLCs, fiber optic modems, telephone modems, digital signal converters, and other miscellaneous digital hardware to include communications wiring and 120 VAC power supply wiring for each device. Acceptable Manufacturer: Phoenix Contact.

Part 3 Execution

3.01 Installation

A. Install all surge protection equipment in strict accordance with manufacturer's guidelines.

B. For surge protectors located out-of-doors and for antenna surge protectors, surge protector grounding shall use individual ground rods located as close to the surge protector as possible. The grounding conductor shall be sized in accordance with manufacturer's recommendations and be routed via the shortest path possible. Bends in the grounding conductor shall be avoided. If bends in the grounding conductor are unavoidable then the number of bends shall be kept to an absolute minimum.

C. Provide installation for all field mounted surge protection equipment. Provide for all wiring terminations for surge protection equipment.

D. If a particular piece of equipment is protected by two surge protectors in series, ensure that the resulting equipment protection is not diminished.

END OF SECTION

Part 1 General

1.01 Scope

This Section includes a detailed listing of instrument products associated with this Project. Other devices may be required, based on System Manufacturer design.

THIS SECTION INCLUDES ATTACHED INSTRUMENT INDEX

END OF SECTION

Client: FCBC

Project: Water Syst Improv

Project No.: 2016-028

Jordan, Jones and Goulding, Inc.

Instrument Index

Date: 15 Nov 2007

Issue: Initial Issue

Revision: 0

Rev	Tag			Loc	Spec	Inst Detail	ElecDwg	Furnish By	Inst Code	Remarks
	Loop:	101				**Service:**	Mansell Road Pump No. 1			**P and ID:** I0.3
0	HIC	101	.	LP	17300	N/A	N/A	Sys. Manuf.	N	
0	HS	101	.	LP	17200	N/A	N/A	Sys. Manuf.	N	
0	KQI	101	.	LP	17200	N/A	N/A	Sys. Manuf.	N	
0	SI	101	.	LP	17300	N/A	N/A	Sys. Manuf.	N	
0	TSH	101	.	F	N/A	N/A		Vendor	N	
0	XA	101	.	SD	N/A	N/A	N/A	Sys. Manuf.	N	
0	XA	101	A	LP	17200	N/A	N/A	Sys. Manuf.	N	
0	XI	101	.	SD	N/A	N/A	N/A	Sys. Manuf.	N	
0	XI	101	A	LP	17200	N/A	N/A	Sys. Manuf.	N	
	Loop:	102				**Service:**	Mansell Road Pump No. 2			**P and ID:** I0.3
0	HIC	102	.	LP	17300	N/A	N/A	Sys. Manuf.	N	
0	HS	102	.	LP	17200	N/A	N/A	Sys. Manuf.	N	
0	KQI	102	.	LP	17200	N/A	N/A	Sys. Manuf.	N	
0	SI	102	.	LP	17300	N/A	N/A	Sys. Manuf.	N	
0	TSH	102	.	F	N/A	N/A		Vendor	N	
0	XA	102	.	SD	N/A	N/A	N/A	Sys. Manuf.	N	
0	XA	102	A	LP	17200	N/A	N/A	Sys. Manuf.	N	
0	XI	102	.	SD	N/A	N/A	N/A	Sys. Manuf.	N	
0	XI	102	A	LP	17200	N/A	N/A	Sys. Manuf.	N	

Location Abbreviations

F- Indicates field mounted device
LP- Indicates local panel mounted device or terminal point
P- Indicates main panel device
SD- Indicates software device
MC- Indicates motor control center mounted device

Instr. Code Abbreviations

E- Existing device
EO- Existing device, relocated
N- New device
NO- New device, owner supplied, contractor installed
F- Future device

Jordan, Jones and Goulding, Inc.

Instrument Index

Rev	Tag			Loc	Spec	Inst Detail	ElecDwg	Furnish By	Inst Code	Remarks
	Loop:	103				**Service:**	Mansell Road Pump No. 3			**P and ID:** I0.3
0	HIC	103	.	LP	17300	N/A	N/A	Sys. Manuf.	N	
0	HS	103	.	LP	17200	N/A	N/A	Sys. Manuf.	N	
0	KQI	103	.	LP	17200	N/A	N/A	Sys. Manuf.	N	
0	SI	103	.	LP	17300	N/A	N/A	Sys. Manuf.	N	
0	TSH	103	.	F	N/A	N/A		Vendor	N	
0	XA	103	.	SD	N/A	N/A	N/A	Sys. Manuf.	N	
0	XA	103	A	LP	17200	N/A	N/A	Sys. Manuf.	N	
0	XI	103	.	SD	N/A	N/A	N/A	Sys. Manuf.	N	
0	XI	103	A	LP	17200	N/A	N/A	Sys. Manuf.	N	
	Loop:	104				**Service:**	Position-Pump No. 1 Discharge Valve			**P and ID:** I0.3
0	HS	104	.	LP	17200	N/A	N/A	Sys. Manuf.	N	
	Loop:	105				**Service:**	Position-Pump No. 2 Discharge Valve			**P and ID:** I0.3
0	HS	105	.	LP	17200	N/A	N/A	Sys. Manuf.	N	
	Loop:	106				**Service:**	Position-Pump No. 3 Discharge Valve			**P and ID:** I0.3
0	HS	106	.	LP	17200	N/A	N/A	Sys. Manuf.	N	
	Loop:	125				**Service:**	Power-Mansell Road ATS/Generator			**P and ID:** I0.3
0	JA	125	.	SD	N/A	N/A	N/A	Sys. Manuf.	N	
0	XA	125	.	SD	N/A	N/A	N/A	Sys. Manuf.	N	

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Rev	Tag		Loc	Spec	Inst Detail	ElecDwg	Furnish By	Inst Code	Remarks
	Loop:	126			**Service:**	Intrusion-Mansell Road Pump Station			**P and ID:** I0.3
0	XA	126 .	SD	N/A	N/A	N/A	Sys. Manuf.	N	
0	XS	126 A	F	17300	N/A		Sys. Manuf.	N	
0	XS	126 B	F	17300	N/A		Sys. Manuf.	N	
0	XS	126 C	F	17300	N/A		Sys. Manuf.	N	
0	XS	126 D	F	17300	N/A		Sys. Manuf.	N	
	Loop:	127			**Service:**	Temperature-Mansell Road Pump Station			**P and ID:** I0.3
0	TAH	127 .	SD	N/A	N/A	N/A	Sys. Manuf.	N	
0	TSH	127 .	F	17300	N/A	N/A	Sys. Manuf.	N	
	Loop:	128			**Service:**	Motion-Mansell Road Pump Station			**P and ID:** I0.3
0	QA	128 .	SD	N/A	N/A	N/A	Sys. Manuf.	N	
0	QS	128 A	F	17300	N/A		Sys. Manuf.	N	
0	QS	128 B	F	17300	N/A		Sys. Manuf.	N	
	Loop:	130			**Service:**	Select-Mansell Road Lead Pump			**P and ID:** I0.3
0	HS	130 .	LP	N/A	N/A	N/A	Sys. Manuf.	N	
	Loop:	140			**Service:**	Pressure-Mansell Road Pump Suction			**P and ID:** I0.3
0	PAL	140 .	SD	N/A	N/A	N/A	Sys. Manuf.	N	
0	PAL	140 A	LP	17200	N/A	N/A	Sys. Manuf.	N	
0	PI	140 .	SD	N/A	N/A	N/A	Sys. Manuf.	N	
0	PIC	140 .	LP	17300	N/A	N/A	Sys. Manuf.	N	
0	PIT	140 .	F	N/A	N/A		Vendor	N	

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Rev	Tag		Loc	Spec	Inst Detail	ElecDwg	Furnish By	Inst Code	Remarks
	Loop:	150			**Service:**	Tank Mode-Mansell Road			**P and ID:** I0.3
0	HIK	150	A	LP	17300	N/A	N/A	Sys. Manuf.	N
0	HIK	150	B	LP	17300	N/A	N/A	Sys. Manuf.	N
0	HS	150	.	LP	17200	N/A	N/A	Sys. Manuf.	N
	Loop:	160			**Service:**	Pressure-Mansell Road Pump Discharge			**P and ID:** I0.3
0	PAH	160	.	SD	N/A	N/A	N/A	Sys. Manuf.	N
0	PAH	160	A	LP	17200	N/A	N/A	Sys. Manuf.	N
0	PAL	160	.	SD	N/A	N/A	N/A	Sys. Manuf.	N
0	PAL	160	A	LP	17200	N/A	N/A	Sys. Manuf.	N
0	PI	160	.	SD	N/A	N/A	N/A	Sys. Manuf.	N
0	PIC	160	.	LP	17300	N/A	N/A	Sys. Manuf.	N
0	PIT	160	.	F	N/A	N/A		Vendor	N
	Loop:	170			**Service:**	Flow-Mansell Road Pump Station			**P and ID:** I0.3
0	FE	170	.	F	N/A	N/A		Vendor	N
0	FI	170	.	SD	N/A	N/A	N/A	Sys. Manuf.	N
0	FI	170	A	LP	17300	N/A	N/A	Sys. Manuf.	N
0	FIT	170	.	F	N/A	N/A		Vendor	N
0	FQI	170	.	SD	N/A	N/A	N/A	Sys. Manuf.	N
0	FQI	170	A	LP	17200	N/A	N/A	Sys. Manuf.	N
	Loop:	180			**Service:**	Pressure-Mansell Road Low Select			**P and ID:** I0.3
0	PY	180	.	SD	17300	N/A	N/A	Sys. Manuf.	N	Low Select Relay

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Rev	Tag			Loc	Spec	Inst Detail	ElecDwg	Furnish By	Inst Code	Remarks
	Loop:	201				**Service:**	Providence Road Pump No. 1			**P and ID:** I0.4
0	HIC	201	.	LP	17300	N/A	N/A	Sys. Manuf.	N	
0	HS	201	.	LP	17200	N/A	N/A	Sys. Manuf.	N	
0	KQI	201	.	LP	17200	N/A	N/A	Sys. Manuf.	N	
0	SI	201	.	LP	17300	N/A	N/A	Sys. Manuf.	N	
0	TSH	201	.	F	N/A	N/A		Vendor	N	
0	XA	201	.	SD	N/A	N/A	N/A	Sys. Manuf.	N	
0	XA	201	A	LP	17200	N/A	N/A	Sys. Manuf.	N	
0	XI	201	.	SD	N/A	N/A	N/A	Sys. Manuf.	N	
0	XI	201	A	LP	17200	N/A	N/A	Sys. Manuf.	N	
	Loop:	202				**Service:**	Providence Road Pump No. 2			**P and ID:** I0.4
0	HIC	202	.	LP	17300	N/A	N/A	Sys. Manuf.	N	
0	HS	202	.	LP	17200	N/A	N/A	Sys. Manuf.	N	
0	KQI	202	.	LP	17200	N/A	N/A	Sys. Manuf.	N	
0	SI	202	.	LP	17300	N/A	N/A	Sys. Manuf.	N	
0	TSH	202	.	F	N/A	N/A		Vendor	N	
0	XA	202	.	SD	N/A	N/A	N/A	Sys. Manuf.	N	
0	XA	202	A	LP	17200	N/A	N/A	Sys. Manuf.	N	
0	XI	202	.	SD	N/A	N/A	N/A	Sys. Manuf.	N	
0	XI	202	A	LP	17200	N/A	N/A	Sys. Manuf.	N	

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Rev	Tag			Loc	Spec	Inst Detail	ElecDwg	Furnish By	Inst Code	Remarks
	Loop:	203				**Service:**	Providence Road Pump No. 3			**P and ID:** I0.4
0	HIC	203	.	LP	17300	N/A	N/A	Sys. Manuf.	N	
0	HS	203	.	LP	17200	N/A	N/A	Sys. Manuf.	N	
0	KQI	203	.	LP	17200	N/A	N/A	Sys. Manuf.	N	
0	SI	203	.	LP	17300	N/A	N/A	Sys. Manuf.	N	
0	TSH	203	.	F	N/A	N/A		Vendor	N	
0	XA	203	.	SD	N/A	N/A	N/A	Sys. Manuf.	N	
0	XA	203	A	LP	17200	N/A	N/A	Sys. Manuf.	N	
0	XI	203	.	SD	N/A	N/A	N/A	Sys. Manuf.	N	
0	XI	203	A	LP	17200	N/A	N/A	Sys. Manuf.	N	
	Loop:	204				**Service:**	Position-Pump No. 1 Discharge Valve			**P and ID:** I0.4
0	HS	204	.	LP	17200	N/A	N/A	Sys. Manuf.	N	
	Loop:	205				**Service:**	Position-Pump No. 2 Discharge Valve			**P and ID:** I0.4
0	HS	205	.	LP	17200	N/A	N/A	Sys. Manuf.	N	
	Loop:	206				**Service:**	Position-Pump No. 3 Discharge Valve			**P and ID:** I0.4
0	HS	206	.	LP	17200	N/A	N/A	Sys. Manuf.	N	
	Loop:	225				**Service:**	Power-Providence Rd ATS/Generator			**P and ID:** I0.4
0	JA	225	.	SD	N/A	N/A	N/A	Sys. Manuf.	N	
0	XA	225	.	SD	N/A	N/A	N/A	Sys. Manuf.	N	

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Rev	Tag		Loc	Spec	Inst Detail	ElecDwg	Furnish By	Inst Code	Remarks
	Loop:	226			**Service:**	Intrusion-Providence Road Pump Station			**P and ID:** I0.4
0	XA	226 .	SD	N/A	N/A	N/A	Sys. Manuf.	N	
0	XS	226 A	F	17300	N/A		Sys. Manuf.	N	
0	XS	226 B	F	17300	N/A		Sys. Manuf.	N	
0	XS	226 C	F	17300	N/A		Sys. Manuf.	N	
0	XS	226 D	F	17300	N/A		Sys. Manuf.	N	
	Loop:	227			**Service:**	Temperature-Providence Road Pump Station			**P and ID:** I0.4
0	TAH	227 .	SD	N/A	N/A	N/A	Sys. Manuf.	N	
0	TSH	227 .	F	17300	N/A	N/A	Sys. Manuf.	N	
	Loop:	228			**Service:**	Motion-Providence Road Pump Station			**P and ID:** I0.4
0	QA	228 .	SD	N/A	N/A	N/A	Sys. Manuf.	N	
0	QS	228 A	F	17300	N/A		Sys. Manuf.	N	
0	QS	228 B	F	17300	N/A		Sys. Manuf.	N	
	Loop:	230			**Service:**	Select-Providence Road Lead Pump			**P and ID:** I0.4
0	HS	230 .	LP	N/A	N/A	N/A	Sys. Manuf.	N	
	Loop:	240			**Service:**	Pressure-Providence Road Pump Suction			**P and ID:** I0.4
0	PAL	240 .	SD	N/A	N/A	N/A	Sys. Manuf.	N	
0	PAL	240 A	LP	17200	N/A	N/A	Sys. Manuf.	N	
0	PI	240 .	SD	N/A	N/A	N/A	Sys. Manuf.	N	
0	PIC	240 .	LP	17300	N/A	N/A	Sys. Manuf.	N	
0	PIT	240 .	F	N/A	N/A		Vendor	N	

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Rev	Tag			Loc	Spec	Inst Detail	ElecDwg	Furnish By	Inst Code	Remarks
	Loop:	250				Service:	Tank Mode-Providence Road			P and ID: I0.4
0	HIK	250	A	LP	17300	N/A	N/A	Sys. Manuf.	N	
0	HIK	250	B	LP	17300	N/A	N/A	Sys. Manuf.	N	
0	HS	250	.	LP	17200	N/A	N/A	Sys. Manuf.	N	
	Loop:	260				Service:	Pressure-Providence Road Pump Discharge			P and ID: I0.4
0	PAH	260	.	SD	N/A	N/A	N/A	Sys. Manuf.	N	
0	PAH	260	A	LP	17200	N/A	N/A	Sys. Manuf.	N	
0	PAL	260	.	SD	N/A	N/A	N/A	Sys. Manuf.	N	
0	PAL	260	A	LP	17200	N/A	N/A	Sys. Manuf.	N	
0	PI	260	.	SD	N/A	N/A	N/A	Sys. Manuf.	N	
0	PIC	260	.	LP	17300	N/A	N/A	Sys. Manuf.	N	
0	PIT	260	.	F	N/A	N/A		Vendor	N	
	Loop:	270				Service:	Flow-Providence Road Pump Station			P and ID: I0.4
0	FE	270	.	F	N/A	N/A		Vendor	N	
0	FI	270	.	SD	N/A	N/A	N/A	Sys. Manuf.	N	
0	FI	270	A	LP	17300	N/A	N/A	Sys. Manuf.	N	
0	FIT	270	.	F	N/A	N/A		Vendor	N	
0	FQI	270	.	SD	N/A	N/A	N/A	Sys. Manuf.	N	
0	FQI	270	A	LP	17200	N/A	N/A	Sys. Manuf.	N	
	Loop:	280				Service:	Pressure-Providence Road Low Select			P and ID: I0.4
0	PY	280	.	SD	17300	N/A	N/A	Sys. Manuf.	N	Low Select Relay

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Part 1 General

1.01 Scope

General purpose control components for control panels.

1.02 Submittals

Submit product data.

Part 2 Products

2.01 General Purpose Control Components

A. Manual Operators: 30.5 mm, heavy duty, oil tight; industrial grade pushbuttons and selector switches with octagonal ring; contacts rated 10 amps continuous, 6 amps break at 120 VAC. Provide flush head for “start” pushbuttons, extended head for “stop” pushbuttons, and spring return for “jog” selector switches.

B. Pilot Lights: 30.5 mm, heavy duty, oil tight, push-to-test; industrial grade transformer type pilot light with octagonal ring; 6 volt LED lamp.

C. Elapsed Time Indicators: Six-digit, hour, non-reset, 3-1/2-inch square case; equal to Yokogawa Type 240.

D. Acceptable Manufacturers: Allen-Bradley, Cutler-Hammer, General Electric, or Square D.

2.02 Relays

A. Relays which interface with motor controls shall be heavy duty industrial grade; 600 volt; contacts rated 10 amps continuous, 6 amps break (5 and 3 amps respectively for time delay forms); 120 VAC; convertible contacts; coils suitable for continuous duty. Relays shall be manufactured by Allen Bradley, General Electric, or Square D.

B. Non-motor control relays shall be double pole relay contacts, rated 10 amps at 120 VAC. Interposing relays for PLC discrete outputs may be single pole. Coil duty shall be continuous, with coil voltage suitable for application. Open contact breakdown voltage shall be 500 volts rms. Provide with polycarbonate dust cover, DIN rail mount socket and holddown spring. The unit shall have a minimum expected life of 100,000 operations at rated loads. Relays shall be equal to Potter & Brumfield, Type KAP or KUP.

END OF SECTION

Part 1 General

1.01 Scope

Programmable logic controllers (PLC).

1.02 System Description

A. This Section covers the technical requirements for programmable logic controllers (PLC) that will receive discrete and analog inputs, and through the use of an internal ladder logic program, control output relay operations and perform data handling functions.

B. The capabilities of the individual PLC's shall be as required to perform the control functions associated with the particular control panel or system.

C. The System Manufacturer shall determine the actual amount of memory and I/O requirements necessary for each control panel to function as specified or shown on the Drawings. Each processor shall have 50 percent spare memory capacity (not less than 1K). Where rack type PLCs are used, each rack shall have a minimum of 10 percent spare I/O points per type (but not less than four discrete inputs, four discrete outputs, two analog inputs, and two analog outputs) and a minimum of 25 percent spare slots (not less than two).

1.03 Submittals

A. For each individual PLC, the following record documentation shall be furnished in addition to documentation requirements in other Sections:

1. Complete software documentation, including annotated ladder logic diagram printout. Printout shall include a complete set of comments identifying relays, function of logic blocks, I/O points, etc.

2. Narrative description of the sequence of operation. Description shall reference, as applicable, the ladder diagram.

B. For the PLC system, documentation shall consist of descriptive literature and installation, operation, and instruction manuals, and shall be included in prints for approval and prints for record. In addition, record drawings shall include PLC manufacturer's recommended list of spare parts with prices, and availability/cost of maintenance contracts and similar support services available.

Part 2 Products

2.01 Acceptable Manufacturers

A. Programmable logic controllers shall be manufactured by Allen-Bradley (Control Logix 5555), Modicon (TSX Quantum or TSX Momentum), GE Fanuc.

B. Program development software shall be as distributed by the PLC manufacturer.

2.02 General Requirements

A. All components in the PLC system shall be the product of a company who regularly manufactures and services this type of equipment. Wherever possible, all assemblies and sub-assemblies performing similar functions in separate controllers purchased under this Section shall be interchangeable.

B. Components: In compliance with normally recognized industry standards and regularly sold to heavy industry installations. All connecting cables shall be constructed so as to withstand, without damage, all normal use and handling.

C. The PLC system shall be of a modular design with a plug-in processing unit, input/output frames or assemblies, and plug-in peripherals. All necessary cables shall be included.

D. Mark all major assemblies, sub-assemblies, circuit cards, and devices with the manufacturer's part or identification number.

E. All components of the PLC system shall be capable of continuous operation at temperatures of 0-60 degrees C, and humidity levels of 5-95 percent.

F. Electrical supply voltage to the individual controllers shall be 115 VAC ± 10 percent 48-63 Hz. Controller system power supplies shall have circuit breakers or fuses for overload protection.

G. Each controller, including output devices, shall orderly shut down and alarm in the event of a disruption of program execution or scan, a loss of logic power, loss of communication between controller essential devices, or a memory error. A failure of one controller shall not disrupt operation of other controllers in the system.

2.03 Central Processing Unit (CPU)

A. The CPU shall contain the program memory in static RAM, PROM, or a combination of both.

1. CMOS or RAM shall have a battery backup system capable of retaining all memory for a minimum of six months and shall require no external cooling or special vents. The backup batter shall be capable of being replaced without interruption of memory integrity with AC power off.

2. Provide visual indication of backup battery status with alarm in the event of low battery voltage before battery failure.

3. Provisions shall be made for connecting an external DC voltage to the system to provide auxiliary protection for CMOS RAM memories.

B. The program memory shall be capable of being expanded in the field by card exchange.

C. At least 1,024 internal storage registers shall be available for data storage. These registers shall be independent of and in addition to program storage memory.

D. Provisions shall be made for the processor to check all logic words for parity when read from memory. A parity error shall cause an immediate shutdown with alarm and visual indication.

E. Nominal memory scan time shall be no longer than 4 milli-seconds per 1K of ladder logic memory. Only the portion of memory being used shall be scanned, and the memory shall be automatically repositioned up or down when contacts and rungs are added or deleted. Service each input on every scan.

F. The system shall have the capability of servicing the I/O at any point in the user program as many times as desired during a scan. Provide the capability of not servicing the I/O during a scan if the user so chooses.

G. Software or key locking arrangement at the CPU shall prevent memory modification by unauthorized personnel.

H. The processor unit shall be expandable to a minimum of 256 I/O points. Any number of normally open or normally closed contacts shall then be available from these references for use in the program. Any internal coil shall be capable of assuming a relay, latch relay, one-shot, timer, or counter function.

I. The system software timers and counters shall be capable of the following:

1. Timers shall have a selectable time base of 0.01, 0.1, and 1.0 second, or 0.1 minutes. Each timer shall be capable of the maximum time preset.

2. Both up-counters and down-counters shall be available. Each counter shall be capable of a fixed preset of at least 0-999 and at least a register preset of 0-65535.

3. Presets shall be from internal constants and internal storage registers. Timers and counters shall have the capability of being reprogrammed from the keyboard, as specified below, at anytime without halting system operation.

4. Timers and counters shall be capable of causing an output relay operation, and display of the time or count through programming software.

5. Timers and counters shall be capable of using the same contact for enable and reset functions.

J. The system shall have math capability available.

1. Math functions shall be a minimum of four digit (0-9999) addition, subtraction, multiplication, division, equality, greater than, and less than. In addition, signed addition and subtraction, and floating point addition and subtraction shall be available.

2. Include capability to handle data in lists or tables. These lists shall be a minimum of 16 bits wide, with capability of a length of 255. Include a sort function with a sort capability of 192 items, and the ability to generate FIFO and LIFO stacks.

3. The system shall have matrix logic capability up to 16 x 255. Matrix logic functions shall include AND, OR, XOR, and Compare.

4. The numerical data for a math function, data list, or matrix shall be input from timers, counters, keyboard entry, and other math functions, data lists, or matrices.

5. The system shall be capable of using the results from math functions, data handling functions, and matrix functions for presets to timers and counters, and for operating system outputs and CRT displays.

K. The status of latch relays and one-shots, and all data from timers, counters, and math functions shall be retained during any power outage as specified above.

L. The system shall have the capability to conditionally skip execution of all or part of the user program.

M. The system shall be capable of performing a minimum of 16 sub-routines. These sub-routines shall be called up by a programmed instruction at any time during the main body user program.

N. The system shall have a minimum of 16 priority interrupt inputs which will cause an immediate jump to the associated sub-routine of the main body user program.

2.04 Input/Output (I/O) Devices

A. Discrete Inputs/Outputs

1. Discrete inputs shall be available in 24 and 115 VAC/DC. Discrete outputs shall be available in 24 VDC and 115 VAC.

2. Discrete inputs shall be guaranteed “on” if at least 78 percent of nominal voltage is present. Discrete inputs shall be guaranteed “off” if 20 percent or less of the nominal voltage is present.

3. Minimum isolation between input/output and logic voltage shall be 1,500 V RMS per NEMA standards via optoisolation.

4. AC discrete outputs shall be rated at 20 amps inrush, 2 amps continuous. DC discrete outputs shall have a 2 amp rating. All outputs shall have 3 amp normal fuse protection.

5. Each discrete input and output shall have an LED or other visible indication of on/off status.

B. Analog Inputs/Outputs

1. Analog inputs shall be available in 4-20 mADC, 1-5 VDC, and 0-10 VDC. Analog outputs shall be available in 4-20 mADC, 0-10 VDC, and –10 to +10 VDC.

2. All of the above inputs and outputs shall have at least 11 bit resolution with an accuracy of ± 1 percent over the rated temperature range.

3. Minimum isolation between input/output and logic voltage shall be 1,500 VDC per NEMA standards via optoisolation.

4. All analog inputs interfacing with 120 VAC or 24 VDC (non-loop) powered devices shall be provided with isolated analog input modules.

5. All analog outputs shall be isolated.

C. Frames or racks for mounting all types of inputs and outputs shall be interchangeable, and inputs and outputs shall be interchangeable within the same frame.

D. All PLC terminal blocks shall be 300 V minimum NEMA rated, and accommodate no fewer than two #14 gauge wires.

E. Marker strips shall be attached adjacent to the field wiring and the status indicating lights to allow easy identification of inputs and outputs by the user. These markers shall not change when devices are replaced during repair or maintenance. Color code marker strips according to voltage.

F. Field wiring shall not have to be removed in order to replace an I/O device during repair or maintenance.

2.05 Data Processing

A. The controller system shall have the ability to perform the following data processing functions without significantly slowing down or interrupting the logic processing:

1. The controller system shall be capable of storing, displaying, and printing messages containing numerical information, including information from timers, counters, math functions, and analog functions. These messages shall contain the full range of alphanumeric characters and shall be capable of assuming user required formats. A minimum storage capacity of 64,000 characters in addition to program memory and storage registers shall be available for these messages.

2. Provide proportional, integral, derivative (PID) fixed point control with ability to solve 32 PID loops with a repetition rate of one second.

3. The controller system shall have data storage capability which will allow the storage of recipes or other information in a structured file system. The file system shall be accessible from the user program.

2.06 Program Development Software

A. Provide Windows XP Professional-based programming software.

B. Programming capabilities shall include the ability to alert the programmer to errors in order to prevent not closing logic circuits, entering non-allowable addresses, or missing addresses.

C. Programming field for each rung shall be 70 elements minimum. Program changes shall be allowed element by element such as adding, deleting, or reversing (NO to NC) contacts without replacing an entire rung. It shall be possible to delete or insert entire rungs inside the program.

D. A search feature shall allow the operator to call up any contact or coil in the program by reference. The search feature shall be provided by a special pushbutton on the keyboard.

E. The controller system shall allow an operator to override inputs and outputs on or off from the development software. The override function shall be provided by a special pushbutton on the keyboard.

F. The programming software shall have off-line, on-line, and monitor modes of operation, controlled by password to provide an additional tier of security.

1. Normal programming shall be in the off-line mode. The PC shall not need to be connected to the control system for off-line programming.

2. In the on-line mode, the programming device shall be connected to the control system, and the two-way communications shall exist between individual CPU's and the programming device. On-line programming shall include the ability to make program edits, upload data and download data while the CPU is running. The status of contacts and coils in the ladder logic program shall be displayed on the PC. The PC shall be able to display the current values of

timers, counters, and internal registers, and the operator shall be able to modify these values through the development software while in the program display mode.

3. In the monitor mode the programming device shall be connected to the control system, and disabled communication shall exist from the CPU to the programming device. The programming device shall be able to read from but not write to the CPU. The status of contacts, coils, timers, counters, and registers shall be displayed on the PC, but an operator shall not be able to modify them.

2.07 Program Development PC

A program development PC is not included in the Project. It shall be the responsibility of the System Manufacturer to supply a PC for their own use for the development of the PLC program.

Part 3 Execution

3.01 Installation

A. PLC equipment is to be mounted on the back panel of the local control panels, unless otherwise noted, and incorporated in the panel design by the System Manufacturer.

B. The Contractor is responsible for furnishing required footage for the data highway to the System Manufacturer. Data highway conductors shall be furnished by the System Manufacturer for installation by the Contractor.

C. Data highway routing shown on the Drawings is based on a loop feed system. Dual radial or other configurations which meet the redundancy requirements specified above will be permitted so long as the Contractor provides any additional raceways or conductors required and coordinates all clearances, at no cost to the Owner.

END OF SECTION

Part 1 General

1.01 Scope

A. Primary elements.

B. Transmitters.

C. Receivers.

D. Analytical instruments.

1.02 System Description

A. System consists of all field and panel mounted instrumentation devices as noted, complete with all necessary signal converters, isolators, amplifiers, power supplies, and other appurtenances necessary for interfacing with other components.

B. Except as noted, scale all indicators in engineering units.

1.03 Submittals

Submit product data.

Part 2 Products

2.01 Controller - Single-Loop

A. Type: Microprocessor-based, configurable loop controller with the following capabilities:

1. Proportional, integral and derivative (PID) linear controller, ratio controller or manual loading station as scheduled.

2. Adaptive gain functionality (PID controller).

3. Auto/manual control, cascade control (PID controller).

4. Setpoint deviation alarm (PID controller).

B. Inputs: Two, 4-20 mADC, 250 ohms maximum.

C. Output: Isolated 4-20 mADC.

D. Power Supply: 120 VAC.

E. Enclosure: Semi-flush mounting chassis with front panel indication of process variable, setpoint and manipulated variable.

F. Schedule:

Tag	Type	Options
PIC-140	PID	None
PIC-160	PID	None
PIC-240	PID	None
PIC-260	PID	None
HIK-150A	Manual Loader	None
HIK-150B	Manual Loader	None
HIK-250A	Manual Loader	None
HIK-250B	Manual Loader	None

G. Acceptable Manufacturers: Honeywell, Moore, Yokogawa.

2.02 Indicator - Digital - Panel Mounted

A. Type: Digital, microprocessor-based, configurable panel indicator for single analog input.

B. Display: LED, 3-1/2 digit, 1/2-inch display height. Engineering units with provision to scale input and place decimal point.

C. Enclosure: NEMA 4X for panel mounting.

D. Input: 4-20 mADC.

E. Power Supply: 120 VAC.

F. Read Rate: 2.5 per second.

G. Accuracy: ±0.1 percent of reading, ± 1 count.

H. Schedule:

Tag	Range	Units
SI-101	0 to 100	%
SI-102	0 to 100	%
SI-103	0 to 100	%
SI-201	0 to 100	%

Tag	Range	Units
SI-202	0 to 100	%
SI-203	0 to 100	%
FI-170		MGD
FI-270		MGD

I. Acceptable Manufacturer: Action Instruments, Precision Digital, Red Lion.

2.03 Intrusion Switch - Magnetic

A. Provide magnetic door switches and magnets (contact sets) for man door intrusion as scheduled below. Switches shall have N. O. and N. C. contacts.

B. Switches and magnets shall be configured for surface-mounting with hermetically sealed in brushed aluminum casings with a minimum of 4 holes each for mounting screws. Switches shall have minimum 3-foot stainless steel armored leads.

C. Provide stainless-steel mounting screws for switches and associated magnets.

D. Spare Parts: Provide four [4] spare switches and magnets.

E. Schedule: XS-126A, XS-126B, XS-126C, XS-126D, XS-226A, XS-226B, XS-226C, and XS-226D.

F. Acceptable Manufacturers: ntrol Model 2707AD.

2.04 Motion Detector - PIR and Doppler Microwave

A. Provide dual technology motion detectors for pump stations as scheduled below. Shall combine passive infrared technology with stereo doppler microwave technology.

B. Relay Output: Solid state, Form C.

C. Housing: Hooded, weather-proof.

D. Power: 12 VDC.

E. Schedule: QS-128A, QS-128B, QS-228A, and QS-228B.

F. Acceptable Manufacturer: Protection Technologies Inc. Model SDI-76XL2.

2.05 Potentiometer Transmitter

A. Potentiometer Type: Single-turn, linear 1 K ohm potentiometer, front panel mounted. Provided with dial pointer and 0-100 percent scale plate, equal to Allen-Bradley Series 800H.

B. Transmitter Type: Three-wire potentiometer input, 0-1,000 ohms. 4-20 mADC DC isolated output into a 0-500 ohm minimum load. Output scale shall be linear with resistance input.

C. Power Supply: 120 VAC, single phase, +10 percent.

D. Housing: General purpose, single unit, NEMA 1, subpanel mounted.

E. Accuracy: +0.1 percent span.

F. Schedule:

Tag	Range	Location
HIC-101	0 to 100 %	Front-of-Panel
HIC-102	0 to 100 %	Front-of-Panel
HIC-103	0 to 100 %	Front-of-Panel
HIC-201	0 to 100 %	Front-of-Panel
HIC-202	0 to 100 %	Front-of-Panel
HIC-203	0 to 100 %	Front-of-Panel

G. Acceptable Manufacturers: Moore Industries, Action Instruments, Acromag.

2.06 Signal Auxiliary - Computational Device

A. Type: Math function module. Function as listed in schedule.

B. Mounting (as listed in schedule):

1. Panel: DIN rail, track mount or individual metal bracket mount.

2. Field: NEMA 4X enclosure.

C. Input: 4-20 mADC.

D. Output: Isolated 4-20 mADC.

E. Power: 120 VAC or 24 VDC (loop powered).

F. Accuracy: Manufacturer's standard.

G. Schedule:

Tag	Function	Mounting
PY-180	Low Select	Rear-of-Panel
PY-280	Low Select	Rear-of-Panel

H. Acceptable Manufacturers: Action Instruments, Acromag, Moore Industries, Phoenix Contact.

2.07 Temperature Switch

A. Type: Electronic switch with integrally-mounted, 3-wire, 100 ohm platinum RTD element.

B. Accuracy: ± 0.20 percent of calibrated span.

C. Output: SPDT.

D. Power Supply: 120 VAC.

E. Enclosure: NEMA 4X, low copper aluminum with epoxy polyester or polyurethane coating.

F. Accessories: Bracket for wall mounting of switch.

G. "U" Length: Two and a half inches.

H. Schedule

Tag	Alarm Setpoint	Location / Area Class.
TSH-127	110 °F	Unclassified
TSH-227	110 °F	Unclassified

I. Acceptable Manufacturers: Rosemount, Honeywell, ABB, Endress+Hauser.

Part 3 Execution

3.01 Installation

A. Locate field instruments so they are accessible for maintenance and orient so that indicators are readily visible. Unless otherwise indicated, mount instruments 36 to 60-inches above work surface. Provide 2-inch diameter, 304 stainless steel, Schedule 10 pipe welded to a 10-inch square by 1/4-inch thick stainless steel base plate for support unless wall or other mounting arrangement is indicated. Space instruments at least 1/2-inch off concrete walls by stainless steel channels or phenolic spacers.

B. Provide stainless steel or aluminum sun screens or shades for all electronic instruments located outdoors.

C. Provide stainless steel identification tags attached with stainless steel wire or screws for all field instruments.

3.02 Tests and Calibration

A. Perform continuity and insulation resistance tests on instrumentation conductors.

B. Calibrate each instrument to its published accuracy. Submit calibration sheets including the instrument tag number or name, the date, name of individual performing calibration, procedures and equipment used, and results obtained.

END OF SECTION

Part 1 General

1.01 Scope

Radio telemetry systems and antenna systems for SCADA System communication and Water Security System communication.

1.02 System Description

A. Provide radio telemetry systems to match and integrate with the existing systems.

B. The SCADA system is existing. The new RTUs shall match the existing RTUs. The System Manufacturer shall verify with the Owner prior to purchase to ensure compatibility.

C. The Water Security system is existing. The new RTUs shall match the existing RTUs. The System Manufacturer shall verify with the Owner prior to purchase to ensure compatibility.

1.03 Submittals

A. Submit shop drawings including block diagrams, equipment layout, product data on all components, manufacturer's installation instructions and start-up instructions.

B. Submit evidence that all Federal Communication Commission (FCC) radio licenses required for the installation have been applied for.

Part 2 Products

2.01 SCADA Central Terminal Unit (CTU):

Existing.

2.02 SCADA Remote Terminal Unit (RTU):

To match and be compatible with the existing system.

2.03 SCADA RTU Radio:

To match and be compatible with the existing system.

2.04 SCADA Antenna and Transmission Line

A. SCADA CTU Antenna System: Existing.

B. SCADA RTU Antenna System: Heavy-duty YAGI antenna with a front-to-back ratio of 20dB and forward gain of 10dB at frequency of 928-952 MHz; VSWR of 1.5 to 1.0 with nominal impedance of 50 ohms; a maximum input power of 100 watts. Constructed of welded aluminum alloys protected by a gold anodized finish. Mounting hardware shall be galvanized steel with a fixed type N connector mounted on the boom.

C. Transmission Line: Matching type N transmission assemblies; coupling the antenna and the radio transceivers; 50 ohm ½-inch weatherproof, low loss foam dielectric, solid copper corrugated outer conductor coaxial cable.

D. Acceptable Manufacturers: Antennas equal to Decibel. Transmission line equal to Andrew Heliax.

2.05 SCADA Antenna Pole:

Provide a 55 foot wooden utility pole. Mount the SCADA Antenna on top of the utility pole at the pump station.

2.06 Water Security Central Terminal Unit (CTU):

Existing.

2.07 Water Security Remote Terminal Unit (RTU):

To match and be compatible with the existing system.

2.08 Water Security RTU Radio:

To match and be compatible with the existing system.

2.09 Water Security Antenna and Transmission Line

A. Water Security CTU Antenna System: Existing.

B. Water Security RTU Antenna System: Heavy-duty OMNI antenna with a front-to-back ratio of 20dB and forward gain of 10dB at frequency of 928-952 MHz; VSWR of 1.5 to 1.0 with nominal impedance of 50 ohms; a maximum input power of 100 watts. Constructed of welded aluminum alloys protected by a gold anodized finish. Mounting hardware shall be galvanized steel with a fixed type N connector mounted on the boom.

C. Transmission Line: Matching type N transmission assemblies; coupling the antenna and the radio transceivers; 50 ohm ½-inch weatherproof, low loss foam dielectric, solid copper corrugated outer conductor coaxial cable.

D. Acceptable Manufacturers: Antennas equal to Decibel. Transmission line equal to Andrew Heliax.

2.10 Water Security Antenna Pole:

Provide an 8 foot antenna pole. Mount the Water Security Antenna on top of the antenna pole at the pump station.

END OF SECTION

Part 1 General

1.01 Scope

This Section includes details of fabrication and installation for certain instrumentation hardware items.

Part 2 Products

2.01 Instrumentation Hardware

Refer to Instrument Installation Details.

Part 3 Execution

3.01 Installation

A. Install and align instruments in accordance with vendor instruction manuals and the Installation Details. Locate all field instruments to be accessible for maintenance.

B. Install all field mounted instruments having indicators or recording charts to make the scale or chart visible from the adjacent operating area. Rotate indicating portions of instrumentation to improve visibility from operating area.

C. Provide sufficient clearances for access and instrument servicing to include dismantling of the instrument.

D. Space instruments at least 1-inch off walls using stainless steel channels.

E. Mount all field instruments securely, using manufacturer mounting yoke, when furnished, on a pipe stand to ensure a rigid, vibrant-free installation.

F. Locations of instruments shown on the Drawings are approximate. The Contractor may, at the Contractor's discretion, relocate instruments to more appropriate positions within five feet of the location shown on the Drawings. If the Contractor needs to move a particular instrument more than five feet from its designated location, the Contractor shall obtain prior approval from the Owner.

G. Provide and install any necessary tubing raceways, supports, and tie downs. Tubing raceways and supports shall be of stainless steel construction.

H. Install tubing and fittings necessary to assure proper instrument operation in a neat, professional manner.

I. Provide all electronic transmitters which are located out-of-doors with adequate sunscreens.

END OF SECTION