B. Admixtures:

1. Air-Entraining Admixtures: ASTM C260.

C. Aggregates:

1. Normal weight aggregates: ASTM C33.

D. Water:

1. Potable or free from foreign materials in amount harmful to concrete and embedded steel.

E. Reinforcing Steel:

1. Bars:

a. Deformed Billet Steel: ASTM A615.

b. Deformed Rail Steel: ASTM A616.

c. Deformed Axle Steel: ASTM A617.

2. Wire:

a. Cold Drawn Steel: ASTM A82.

3. Wire Fabric:

a. Welded Steel: ASTM A185.

F. Strand:

1. Uncoated, 7-wire, stress-relieved strand: ASTM A416 - Grade 27OK.

G. Anchors and Inserts:

1. Materials:

a. Structural Steel: ASTM A36.

b. Malleable Iron.

c. Stainless Steel: ASTM A666.

2. Finish:

a. Shop primer: Manufacturer's standards.

H. Grout:

1. Normal cement grout: Three parts sand, one part Portland Cement, and water sufficient for placement and hydration.

2. Non-shrink grout: Premixed, packaged ferrous or non-ferrous aggregate shrink-resistant grout.

I. Bearing Strips:

1. High density plastic; 1/8 inch thick Korolath or equal.

2. Tempered hardboard; 1/8 inch thick Masonite or equal.

2.02 Concrete Mixes

A. Mix shall be very low in water content (zero slump), having only enough moisture for proper operation of the extruder.

B. 28-day compressive strength: Minimum of 5000 psi.

C. Release strength: Minimum of 3500 psi.

D. Use of calcium chloride, chloride ions or other salts is not permitted.

2.03 Manufacture

A. Manufacturing procedures shall be in general compliance with PCI MNL-116.

B. The products shall be made by the extrusion process. Zero slump concrete shall be deposited in the extruder within 3 minutes after completion of mixing. The mix shall be consolidated and shaped by the extruder into a long, continuous ribbon. Any discontinuities shall be discarded. After extruding, the product shall be covered and heated, if necessary, until release strength is achieved. Then it will be cut to the desired lengths, removed from the casting bed and taken to storage.

C. Manufacturing Tolerances:

1. Length: + 1/2 in.

2. Width: + 1/4 in.

3. Depth: + 1/4 in.

4. Position of voids: + 1/4 in.

5. Position of strands: + 1/4 in.

6. Position of factory-cut opening: + 2 in.

7. Size of factory-cut opening: + 1 in.

8. Camber deviation from design camber: + 1/8 in. per 10 ft., but not greater than 1/2 in.

9. Differential camber between adjacent units of the same design: 1/4 in. per 10 ft., but not greater than 5/8 in.

10. End squareness: No more than 1/2 in.

D. Finishes:

1. Standard Underside: Resulting from casting against approved forms using good industry practice in cleaning of forms, design of concrete mix, placing and curing.

2. Standard Top: Shall be generally level with some slight depression over voided areas.

3. Standard End with smooth surface.

E. Openings:

1. Openings may be made by saw cutting; removing the hardened concrete with power tools which gives a relatively smooth appearance.

2. Openings of 6 in. diameter or less are to be cut by the trade requiring them after the products have been erected. Openings shall be approved by the Architect/Engineer prior to cutting.

3. The edge along centerline of bays where plumbing holes are to be cut shall have the strand placed in the first interior web.

F. Patching: Patching will be acceptable providing the structural adequacy of the product and the appearance are not impaired.

Part 3 - Execution

3.01 Product Delivery, Storage and Handling:

A. Delivery and Handling:

1. Precast concrete members shall be lifted and supported during manufacturing, stockpiling, transporting and erection operations only at the lifting or supporting points, or both, as shown on the contract and shop drawings, and with approved lifting devices. All lifting devices shall have a minimum safety factor of 4.

2. Transportation, site handling, and erection shall be performed with acceptable equipment and methods, and by qualified personnel.

B. Storage:

1. Place stored units so that identification marks are discernible.

2. Separate stacked members by battens across full width of each bearing point.

3. Do not use upper member of stacked tier as storage area for shorter member or heavy equipment.

3.02 Erection

A. Site Access: The General Contractor shall be responsible for providing suitable access to the building and firm level bearing for the hauling and erection equipment to operate under their own power.

B. Installation: Installation of precast prestressed concrete shall be performed by the manufacturer or a competent erector. Members shall be lifted by means of suitable lifting devices at points provided by the manufacturer. Temporary shoring and bracing, if necessary, shall comply with manufacturer's recommendations. Install bearings strips as required.

C. Alignment: Members shall be properly aligned and leveled as required by the approved shop drawings. Variations between adjacent members shall be reasonably leveled out by jacking, loading, or any other feasible method as recommended by the manufacturer acceptable to the Architect/Engineer.

D. Grouting: Fill grout keys and slab end joints as required, placing any reinforcing as shown on plans or approved shop drawings. Strike off flush with top surface. Remove any grout that may seep through to the bottom surface before it hardens.

3.03 Attachments

A. Subject to approval of the Architect/Engineer, precast prestressed products may be drilled or "shot" provided no contact is made with the prestressing steel. Should spalling occur, it shall be repaired by the trade doing the drilling or the shooting.

3.04 Inspection and Acceptance

A. Final inspection and acceptance of erected precast prestressed concrete shall be made by Architect/Engineer to verify conformance with plans and specifications.

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 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. 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 veneer shall be colored. Colors shall be selected by the Engineer in conjunction with the selection of the brick veneers.

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
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

2. Mortar Uses

   a. Use Type M for all load bearing masonry and in foundation walls where masonry materials occur.

   b. Use Type N for all interior non-load bearing masonry.

   c. Use Type S for all face brick work, backup and parging.

   d. Type M may be used in lieu of Type N or S.

   e. Type S may be used in lieu of Type N.

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 placement of all brickwork and related work as described herein and/or shown on the Drawings.

1.02 Submittals

A. Certificates: Submit two copies of the brick manufacturer's specifications and other data for each type of brick required, including certification that each type complies with the specified requirements.

B. Samples: Submit samples of each type of exposed brick required. Include in each set the full range of exposed color and texture to be expected in the completed work. Engineer's review will be for color and texture only. Compliance with all other requirements is the exclusive responsibility of the Contractor.

1.03 Sample Panels

A. After approval of masonry units, mortar and color of mortar used in unpainted masonry exposed to view, construct a sample panel facing south of each type of masonry work required. Masonry sample panel shall be 48 x 48-inches; return ends 16-inches long x 48-inches high. Sample panel shall be typical of work as it will appear in the completed Project.

B. Protect approved sample panel with suitable covering from damage or deterioration by weather and construction traffic, until late in the Project when approval to destroy and remove the sample panel is given. Destroy and remove debris resulting from rejected sample panels at once.

C. Where brick work is required to match existing buildings, construct a sample panel of the size as specified, located adjacent to an existing wall to verify match. The Engineer will approve the match.

1.04 Storage and Protection

A. Store brick off ground on level platforms to prevent contamination by mud, dust or materials likely to cause staining or other defects. Allow air circulation under stacked units. Cover materials as necessary to protect from elements. Protect anchors, ties and reinforcement from weather with suitable coverings.

B. Handle units on pallets or flat bed borrows. Do not permit free discharge from conveyor units or transporting in mortar trays.

1.05 Protection Requirements

A. Cover top of walls with nonstaining, waterproof coverings at end of each day or shutdown. Cover partially completed walls with nonstaining, waterproof membrane when work is not in progress. Provide a minimum two foot overhang of securely anchored protective covering each side of wall.

B. Protect masonry construction from direct exposure to wind and sun when erected in an ambient air temperature of 99 degrees F (37 degrees C) in the shade with relative humidity of less than 50 percent.

C. Do not apply uniform floor or roof loading for at least 12 hours after completing masonry columns or walls.

D. Do not apply concentrated loads for at least three days after completing masonry columns or walls.

Part 2 Products

2.01 Brick

A. Obtain from a single manufacturer, brick of uniform texture and color or uniform blend in the variation thereof, for each continuous area and for visually related area.

B. Size: Unless otherwise shown or specified, provide modular size brick (7-5/8-inches long x 2-1/4-inches high x 3-5/8-inches wide) for exposed vertical brickwork.

C. Coring: At Contractor's option, provide solid or cored brick for vertical brickwork. Do not use cored brick with net cross-sectional area less than 75 percent of gross area in the same plane or with core holes less than 3/4-inch from any edge.

D. Face brick units shall be made of clay or shale material, conforming to the latest specification of ASTM C 216, shall be grade SW, type FBS (normal variations) as established therein.

E. Color and texture of brick units used shall be selected by the Owner from sample panels submitted by the Contractor from the proposed supplier, except when matching existing buildings.

2.02 Weephole Material

Weepholes shall be manufactured of PVC, rubber tube or sash cord.

2.03 Joint Reinforcement

Joint reinforcement shall comply with "Specification for Cold-Drawn Steel Wire for Concrete Reinforcement", ASTM A 82 and shall be galvanized steel of trussed design

with nine gauge cross rods welded to 3/16-inch deformed side rods. Reinforcement shall be 2-inches less in width than nominal wall thickness.

2.04 Dovetail Anchors

Dovetail anchors shall be 26 gauge galvanized steel. Lengths, spacings and locations as per standard construction practice where required.

2.05 Cleaning Agent

As recommended by brick manufacturer.

Part 3 Execution

3.01 Scaffolding

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.

3.02 Inspection

A. Inspect foundations to assure surfaces to support brickwork are to proper grades and elevations, free of dirt and other deleterious material. Surfaces not properly prepared shall be satisfactory corrected.

B. Verify initial absorption rate of brick is within acceptable limits.

3.03 Preparation

Reduce initial absorption of brick by thoroughly wetting brick with clean water 24 hours prior to placement. Remove all dirt, loose rust and scale from anchors, ties and reinforcement prior to installation.

3.04 Allowable Tolerances

Maximum variation from plumb in lines and surfaces shall not exceed 3/8-inch in any story or 20 foot maximum or 1/2-inch in 40 feet.

3.05 Installation

A. General: Masonry shall not be laid when temperature is below 40 degrees F. Do not install cracked, broken or chipped brick units exceeding ASTM allowance. Use masonry saws to cut and fit exposed units. In no case shall less than 1/2 brick be present at jambs and at exterior and interior corners. Adjust shelf angles to keep work level and at proper elevation. Provide pressure relieving joints by placing a continuous 1/8-inch foam neoprene pad under the shelf angle.

B. Protection: Protect sills, ledges and offsets from mortar drippings and face materials against staining.

C. Mortar Beds: Brick units shall be laid in running bond unless noted otherwise, with full mortar coverage on horizontal and vertical joints in all courses.

D. Joints: Unless shown or specified otherwise, all joints shall be 3/8-inch nominal thickness. Exterior or exposed joints shall be finished with smooth concave contour. Interior joints shall be tooled flush. Trowel point exterior joints below grade. Fill horizontal joints between top of masonry partition and underside of concrete beams with mortar. 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.

E. Tuck Point Joints: Rake mortar joints to a depth of 1/2 to 3/4-inch, saturate exposed joints with clear water, fill joints solidly with pointing mortar and tool to match existing work.

F. Flashings: Clean surface of masonry smooth and free from projections which might puncture or otherwise damage flashing material. Place through wall flashing on bed of mortar. Cover flashing with mortar.

G. Weepholes: Provide weepholes in head joints in first course immediately above all flashing. Space weepholes 24-inches on center, unless shown otherwise.

H. Sealant Joints: Retain sealant joints around outside perimeters of exterior doors, window frames and other wall openings. Uniform depth shall be 1/2-inch and 1/4-inch width.

I. Anchoring: Anchor exterior brick walls facing or abutting concrete or steel members with dovetail, flatbar or wire anchors inserted in slots built into the member. Maximum anchor spacing shall be 16-inches vertically and 16-inches horizontally. Maintain a space of not less than 1/2-inch wide between masonry wall and concrete members to permit differential movement.

J. Brick Veneer Anchoring: Attach brick veneer to backing with metal ties. Maximum spacing shall be 16-inches vertically and 16-inches horizontally. Imbed ties at least 2-inches in horizontal joint of facing.

K. Wall Reinforcement: Place wall reinforcement in first masonry bed joint above finished floor and in alternate bed joints (16-inch on centers) thereafter. Place wall reinforcement in first and second bed joints (8-inch on centers) above and below openings. Lap splices 6-inch minimum, or per supplier's recommendation. Corner reinforcement detail shall be in accordance with manufacturer's recommendations.

3.06 Pointing and Cleaning

A. Cut out any defective joints and holes in exposed masonry and repoint with mortar.

B. Dry brush masonry surface after mortar has set at end of each day's work and after final pointing.

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

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 crushed stone aggregate.

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 as shown on the Drawings.

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 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.

1.03 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.

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

vii. 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.

viii. 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.

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

x. 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.

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

xii. 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.

xiii. 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

Furnish and install all the structural steel work as shown on the Drawings and specified in this Section.

1.02 Furnished But Installed Elsewhere

A. Anchor bolts, loose bearing plates, which will be installed under Division 3.

1.03 Requirements for Regulatory Agencies

A. AISC Specification Structural Steel for Building shall mean AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings, adopted March 9, 2005.

B. Specification for Structural joints shall mean "Specifications for Structural Joints Using ASTM A 325 or A 490 Bolts, approved by the Research Council on Riveted and Bolted Joints of the Engineered Foundation, June 30, 2004.

C. AWS Building Code shall mean AWS "Code for Welding in Building Construction", DI.1-96.

D. All steel to be fabricated and erected in accordance with all OSHA requirements.

1.04 Qualifications

A. The steel fabricator shall be AISC Category I plant certified, or employ an independent special inspection agency to verify the fabrication of all structural members. This inspection agency shall have AWS D1.1 qualifications, and be approved by the Engineer and Owner. The special inspection agency must submit reports of acceptance for all shop fabricated items as required in KBC-2002, section 1704.2. The cost of this shall be the sole responsibility of the Steel Fabricator. Welding procedures, welders, welding operations and tackers shall be qualified in accordance with AWS Building Code.

1.05 Submittals

A. Shop Drawings:

1. Submit shop drawings indicating all shop and erection details, including cuts, copes, connection, holes, threaded fasteners and welds.

2. All welds, both shop and field shall be indicated by AWS "Welding Symbols" A2.0-68.

B. Erection Procedure: Submit descriptive data to illustrate the structural steel erection procedure, including the sequence of erection and temporary staying and bracing.

C. Welding Procedure: Submit written description as required to illustrate each welding procedure to be performed in the specified work.

D. Field Welding Equipment: submit descriptive data for field welding equipment, including type, voltage and amperage.

E. Reports of mechanical tests for high strength threaded fasteners.

1.06 Product Handling

A. Delivery of materials to be installed under other sections.

1. Anchor bolts and other anchorage devices which are embedded in cast-in-place concrete or masonry construction shall be delivered to the project site in time to be installed before the start of cast-in-place concrete operations or masonry work.

2. Provide setting drawings, templates, and directions for the installation of the anchor bolts and other devices.

B. Storage of Materials:

1. Structural steel members which are stored at the project site shall be above ground on platforms, skids or other supports.

2. Steel shall be protected from corrosion.

3. Other materials shall be stored in a weathertight and dry place, until ready for use in the work.

4. Packages materials shall be stored in their original unbroken package or container.

Part 2 - Products

2.01 Materials

A. Steel Shapes, Bars, and Plates

1. ASTM A 992, Grade 50.

B. Structural steel, fabrication and erection shall comply with the American Institute of Steel Construction, Specifications for the Design, Fabrication and Erection of Structural Steel for Building.

C. Anchor Bolts: Conform to Section 1C of ASTM A 307.

D. High-Strength Threaded Fasteners: ASTM A 325, Torque Control (Tension Set) bolts.

E. Filler Metals for Welding

1. Shielded metal-arc welding: AWS A5.1, E70 Electrodes.

2. Submerged arc welding: AWS A5.17.

F. Shop Paint Primer

1. Standard Primer: SSPC Paint System Guide No. 7.00.

G. All bolted connections shall be of high strength bolts conforming to ASTM A 325 and shall be bearing type with threads excluded from shear plane.

H. All structural steel shall be accurately set and properly secured in place. Field connections of steel work shall be welded or bolted with high strength bolts, size as called for on the Drawings. Connections shall be as detailed. All welding to be done by certified welders with at least five years experience in structural welding, and in a neat workmanlike manner.

2.02 Fabrication

A. Fabricate Structural Steel in accordance with the AISC Specification with the modifications and additional requirements specified in this section:

1. Shop and field welding shall conform to AWS and AISC Standards and Specifications.

2. Flame cutting of steel will not be permitted.

B. Shop connections shall be welded.

C. Field Connections:

1. Provide bolted, except where welded connections are indicated.

2. High strength threaded fasteners shall be used for bolted connections, except where standard threaded fasteners are permitted.

D. High-Strength Bolted Construction Assembly:

1. Tightening shall be done in accordance with Section 5 of AISC-Specifications for Structural Joints. All bolts shall have 28,000 pounds of tension (330 ft*lbs torque) applied.

E. Welded Construction:

1. Welding process shall be limited to one or a combination of the following:

a. Manual shielded-arc.

b. Submerged arc.

c. Studs to be welded with automatically timed welding equipment.

F. Column Bases shall be milled and attached to columns.

G. Shop Painting:

1. Shop paint all steelwork that is not fireproofed.

2. Steelwork to be painted shall received a one-coat shop paint system in accordance with SSPC Paint System PS 7.00.

Part 3 - Execution

3.01 Erection

A. Erect structural steel in accordance with the AISC Specifications with modifications and additional requirements of this section.

B. Column Bases and Bearing Plates:

1. Attached column bases and bearing plates for beams and similar structural members shall be aligned with wedges or shims.

2. Loose column bases and bearing plates which are too heavy to be placed without a derrick or crane shall be set and wedged or shimmed.

C. Erection Tolerances:

1. Individual pieces shall be erected so that the deviation from plumb, level and alignment shall not exceed 1 to 500.

D. Field Assembly:

1. Structural steel frames shall be accurately assembled to the lines and elevations indicated, within the specified erection tolerances.

2. The various members forming parts of a complete frame or structure after being assembled shall be aligned and adjusted accurately before being fastened.

3. Fastening of splices of compression members shall be done after the abutting surfaces have been brought completely into contact.

4. Bearing surfaces and surfaces which will be in permanent contact shall be cleaned before the members are assembled.

5. Splices shall be permitted only where indicated.

6. Field connections, field welds, and shear connectors shall be as specified in "Fabrication".

7. Erection bolts used in welded construction shall be tightened and left in place.

E. Gas Cutting: Field correcting of fabrication by gas cutting shall not be permitted on any major member in the structural framing without prior approval of the Architect.

3.02 Touch-Up Painting

A. Immediately after erection, clean field welds, bolted connections, and abraded areas of the shop paint, and paint all exposed areas with the same material s used for shop painting. Apply brush or spray to provide a minimum dry film thickness of 2.0 mils.

END OF SECTION

Part 1 - General

1.01 Scope

A. The extent of metal roof decking is shown on the Drawings, including basic layout and type of deck units required.

1.02 Quality Assurance

A. Comply with the provisions of the following codes and standards, except as otherwise shown or specified.

1. AISI "Specification for the Design of Cold-Formed Steel Structural Members".

2. SDI "Steel Roof Deck Design Manual".

B. Decking secured in place is subject to inspection and testing. Expense of removing and replacing any portion of decking for testing purposes will be borne by the Owner if attachments are found to be satisfactory. Remove work found to be defective and provide new acceptable work.

1.03 Performance Requirements

A. Compute the properties of metal roof deck sections on the basis of the effective design width as limited by the provisions of the AISI "Specifications". Provide not less than the deck section properties shown, including section modulus and moment of inertia per foot of width.

B. Allowable Deflection: Design and fabricate deck for a maximum deflection of 1/240 of the clear span under the total uniform dead and live load.

C. Uplift Loading: Install and anchor roof deck units to resist gross uplift loading of 30- lbs. per sq. ft. for all roof areas.

1.04 Submittals

A. For information only, submit 2 copies of manufacturer's specifications and installation instructions for each product specified. Include manufacturer's certification as may be required to show compliance with these specifications. Indicate by transmittal form that a copy of each instruction has been distributed to the installer.

B. Submit detailed drawings showing layout of deck panels, anchorage details and every condition requiring closure panels, supplementary framing, special jointing or other accessories.

Part 2 - Products

2.01 Materials

A. Steel for Painted Finish: ASTM A 611, Grade C.

B. Miscellaneous Steel Shapes: ASTM A 36.

C. Flexible Closure Strips for Deck: Manufacturer's standard vulcanized, closed-cell, synthetic rubber.

D. Repair Paint: Deck unit manufacturer's baked-on, rust-inhibitive paint for application to metal surfaces which have been chemically cleaned and phosphate chemically treated.

2.02 Fabrication

A. Form deck units in lengths to span 3 or more supports with flush, telescoped or nested 2" end laps and nesting side laps, unless otherwise indicated. Provide deck configurations complying with SDI "Basic Design Specifications", and as specified herein.

B. Wide-Rib Deck: Depth approximately 1-1/2"; ribs spaced not more than 6" o.c.; width of rib opening at roof surface not more than 2-1/4"; width of bottom rib surface not less than 1-1/2". The deck is to be Type B and not less than 22 gauge.

C. Fabricate metal closure strips of not less than 20 gauge sheet steel of the same qualify as the deck units. Form to the configuration required to provide tight-fitting closures at open ends and sides of decking.

Part 3 - Execution

3.01 Inspection

A. Installer must examine the areas and conditions under which metal roof decking items are to be installed and notify the Architect and Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

3.02 Installation

A. Install roof deck units and accessories in accordance with manufacturer's recommendations and final shop drawings, and as specified herein.

B. Place roof deck units on supporting steel framework and adjust to final position with ends bearing on supporting members and accurately aligned end to end before being permanently fastened. Lap end not less than 2". Do not stretch or contract the side lap interlocks. Place deck units flat and square, secured to adjacent framing without warp or excessive deflection.

C. Coordinate and cooperate with structural steel erector in locating decking bundles to prevent overloading of structural members.

D. Do not use deck units for storage or working platforms until permanently secured.

E. Permanently fasten roof deck units to steel supporting members with #12 TKS screws not less than 12" o.c. at supports and at closer spacing where required. Welding of the roof deck is not permitted.

F. Comply Steel Deck Institute requirements and procedures for fastening roof decking.

G. Lock side laps between adjacent deck units at intervals not exceeding 36" o.c. and at closer spacing where required with #12 TKS screws.

H. Saw cut and fit roof deck units and accessories around other work projecting through or adjacent to the roof decking, as shown on the Drawings. Provide neat, square and trim cuts. Cutting with gas torch is not acceptable.

I. Provide additional metal reinforcement and closure pieces as required for strength, continuity of decking and support of other work, unless otherwise shown.

J. Reinforce roof decking around openings less than 15" in any dimension by means of a flat steel sheet placed over the opening and fusion welded to the top surface of the deck. Provide steel sheet of the same quality as the deck units, not less than 20 gauge and at least 12" wider and longer than the opening. Provide welds at each corner and spaced not more than 12" o.c. along each side.

K. Provide metal closure strips at all open uncovered ends and edges of roof decking, and in the voids between decking and other construction. Weld into position to provide a complete decking installation.

L. Provide metal closure strips for the support of roof installation where the rib openings in the top surface of roof decking occur adjacent to edges and openings. Weld closure strips into position.

M. After roof decking installation, wire brush, clean and paint scarred areas, welds and rust spots on the top and bottom surfaces of decking units and supporting steel members.

1. Touch-up shop painted surfaces with the same paint used in the shop as recommended by manufacturer.

N. In areas where touch-up painted surfaces are to be exposed, apply the paint to blend into the adjacent surfaces in a manner that will minimize visual discontinuity in the coatings.

O. Assure that construction loads do not exceed carrying capacity of deck.

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 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.

1.04 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.

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 wide-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.

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. Welding Washers: 16 gauge.

2. Cant Strip: 22 gauge.

3. 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

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.

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

The work covered by this Section includes furnishing all labor, materials and equipment required to fabricate and install all fiberglass rating, stairs, treads, supports, attachments and handrails as described herein, shown on the Drawings or necessary for proper completion of the Work. All fiberglass products herein specified shall be furnished with ultraviolet protective agents.

1.02 Design Requirements

A. Uniform Live Load: 100 pounds/square foot.

B. Grating deflection Limitation: 1/4-inch.

C. Flexural Member (Beam) Deflection Limitation: L/180.

D. Flexural Safety Factor: 2.5.

E. Shear Safety Factor: 3.0.

F. Bearing Safety Factor: 3.0.

G. Compression Safety Factor: 3.0.

H. Resin System: Premium grade, fire retardant vinyl ester.

I. Hardware: 316 stainless steel.

J. FRP Angles:

K. Handrail: 2-line system with toeplate, meeting OSHA strength requirement of a 200 pound concentrated load.

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 of fiberglass grating proposed for use on the Project.

C. 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 traces. 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.

D. Submit complete engineering design data and design information for all fiberglass stairs. Data and design information shall clearly illustrate the stair profile, layout and loads considered. Submit all information concurrently with the shop drawings.

Part 2 Products

2.01 Acceptable Manufacturers

A. Open and solid grating shall be equal to that as manufactured by IKG Fiberglass Systems, Chemgrate Corporation, Fibergrate or Fibergrid, Inc.

B. Structural members, handrails and toeplates shall be as manufactured by IKG Fiberglass Systems, Strongwell, or Fibergrate Composite Structures, Inc.

2.02 Open Fiberglass Grating

A. Components for the grating shall be produced by the pultrusion process in which longitudinal glass fiber rovings are sandwiched together between a dense fiberglass mat and are permanently bonded together with thermosetting resin as they pass through a heated die. The grating shall be constructed from either wide flange I-beams or tees that are intersected by and bonded to a two-piece, mechanically interlocking crossbar designed to provide uniform bearing bar indexing and to resist bearing bearing bar racking or rotation. The final composite product shall provide a glass content of 65 percent by weight.

B. The resin system shall be a premium grade, fire retardant vinylester with ultraviolet inhibitor. The pultruded bearing bars and crossbars shall be of uniform dimension and spacing with no evidence of resin rich or resin starved areas, porosity, or interlaminar voids, and no evidence of fiber orientation or mat reinforcement irregularities. The flame spread rating for the resin system shall be Class I per ASTM E 84.

C. Structural Properties: The fiberglass grating products shall have the following minimum properties:

1. Tensile Strength: 70,000 psi per ASTM D 638.

2. Tensile Modulus: 4.0×10^6 psi per ASTM D 638.

3. Flexural Strength: 70,000 psi per ASTM D 790.

4. Flexural Modulus: 4.0×10^6 psi per ASTM D 790.

5. Compressive Strength: 40,000 psi per ASTM D 695.

6. Izod Impact: 25 feet/pound per ASTM D 256.

7. Barcol Hardness: 50 per ASTM D 2583.

8. Water Absorption: 0.5% per ASTM D 570.

9. Specific Gravity: 1.85 per ASTM D 792.

10. Coefficient of Thermal Expansion: 4×10^6 in/in/F per ASTM C 177.

11. Flame Spread Index: 25 (maximum) per ASTM E 84.

12. Smoke Density: Smoke Developed Value 785.

D. Tolerances between sections shall provide for not more than 1/4-inch clearance between adjacent sections or between gratings and frames. Adjacent sections shall fit together such that bearing bars and flush top crossbars line up to form an uninterrupted straight line wherever possible. Sections shall be designed to be removable unless indicated otherwise. Each section shall be attached to the support with a minimum of four stainless steel saddle clips per section. Hardware to attach grating clips to support shall be the Contractor's responsibility.

E. Grating panels shall be fabricated in such a manner as to be square within the manufacturer's tolerances and shall be free from warping and any defect that may affect product serviceability and reliability. Openings shall be provided in the grating where indicated to permit field installation of wiring, equipment, piping, etc. Where openings are provided, gratings shall be discontinuous to allow each section of grating to be easily removed. Where required, the openings shall be supplied with edge banding, shop bonded in accordance with the manufacturer's standards.

F. All grating walking surfaces shall have anti-skid surfaces. Angular silica particles shall be integrally embedded in laminate in all walking surfaces.

G. Grating shall be easily installed and cleaned, non-sparking and self-draining. Grating shall be capable of field fabrication with a masonry saw. All cut edges shall be sealed with resin as recommended by the manufacturer.

H. Grating panels for trenches shall be simply supported by FRP angles on all sides of the opening. The gratings shall be of the type that can be made in panels of the widths and lengths appropriate to the openings shown on the Drawings. Panels shall be furnished in sizes that are easily handled.

I. The top surface of all bars shall be flush and all gratings shall lie flat with no tendency to rock when installed. Cross bars and edge bars of adjacent panels shall align for neatness. All bearing bars shall be parallel. Cross bars shall be cut off flush with outside face of side bars.

J. The maximum allowable deflection permissible at a uniform loading of 100 pounds/square foot shall be 0.25 inch.

K. Solid grating shall comply with all the requirements above and shall be covered with a corrosion-resistant, flat walking surface of 1/8-inch fiberglass sheets bonded to the top surface of the FRP grating. The top surface shall have a gritted skid-resistant surface.

2.03 Shelf Angles

A. Main bearing bars shall be supported by FRP shelf angles of the size and thickness required to obtain flush surfaces for gratings, angle frames and surfaces in which the angle frame is embedded. There shall not be more than 1/4-inch clearance between the ends of the grating panels and the inside vertical face of the shelf angle.

B. Unless otherwise shown, openings to be covered with grating shall be bound on all four sides with a continuous shelf angle frame having FRP welded corners and sufficient strap anchors for anchorage into the concrete.

C. Where changes in channel direction, openings for grates, ends of grating runs, etc., prohibit adequate support for grating, additional FRP cross angles shall be provided by the Contractor for additional seating surface.

2.04 Stair Treads

A. Stair treads shall be fiberglass roving reinforced polyester having a height of 1-1/2-inches with span bars 1-1/2-inches on center and cross bars at 6-inches on center.

B. The treads shall be made in a single piece construction such that reinforcing glass of the bearing bars are interwoven with the reinforcing glass of the cross bars.

C. The tread nose construction shall be solid and integral with the tread and shall have a minimum width of 1.5-inches.

D. Angular, white silica particles shall be bonded in the top to provide a non-skid walking surface. The nose of the tread shall be a darker color to provide a contrast with the other portions of the walking surfaces.

E. All cut and sanded surfaces shall be coated with surfacing resin. Each tread shall be supported by a FRP ledger and held in place by 316 stainless steel fasteners.

F. Tread widths shall meet the requirements of OSHA for angles and/or distances shown on the Drawings.

2.05 Stair Stringer, Ledgers, Platforms and Supports

A. All components shall be manufactured of Extren or Dynaform FRP structural shapes. Hand lay-up field fabricated structural members are not permitted.

B. Stringers shall be FRP channels or rectangular tube shapes. Stringers shall be of sufficient depth such that tread widths are maintained within the stringer depth proper without edge protrusion.

C. Ledgers for treads shall be 2 x 2 x 1/4-inch thick equal leg angles. Ledgers shall be bolted to the stringer using 3/8-inch diameter, 300 Series stainless steel hex nuts and hex bolts. FRP threaded rods and square nuts may be used. If FRP threaded rods and nuts are used, each rod end shall be sawed flush with the nut after nuts have

been torqued. After sawing the rod flush, the square nuts shall be re-torqued. End of rods, edges of FRP square nuts and ledger edges shall be sealed with comparable resin. Torque applied shall be as recommended by the manufacturer.

D. Where platforms are shown on the Drawings to be FRP, all members shall be Extren or Dynaform structural shapes fabricated from either wide flange or channel shapes. Platform members shall be bolted together using 3/8-inch minimum diameter 300 Series stainless steel hex nuts, bolts, flat washers and lock washers. Standard FRP structural angles and components shall be used to join the structural members.

E. Supports shown on the Drawings to be FRP shall be wide flange shapes. All supports shall be provided with baseplates and pre-drilled holes to accept Contractor provided 1/2-inch diameter self-drilling or cast in 316 stainless steel anchors.

F. Ends of all structural shapes shall be sealed with comparable resin.

2.06 Handrails and Toeplates

A. Handrails shall be a minimum of 1-3/4-inch square and vertical members shall be a minimum of 2-inch square FRP shapes with radiused edges. Shapes shall have a minimum thickness of 0.125-inch. Top rails and center rails shall be contained within the width of the vertical members. Side attachment of center rails and top rails to vertical members is not permitted.

B. Handrail members shall be joined using FRP plugs, dowels and pins. FRP/epoxy plugs shall be insert type, completely filling the internal area of the handrail openings. The plugs shall be bonded to the interior of the handrail by use of resin/epoxy adhesives. Dowels shall be used to attach handrail joints via holes drilled into the handrail plugs. Dowels shall have helical grooves to assure adhesive distribution and component bonding.

C. All handrail turns shall be of mitered construction and shall be smooth to the touch. No exposed glass fibers or burrs are permitted.

D. Vertical handrail members shall have FRP baseplates where handrails are top surface mounted to stringers, platform or concrete members. Side mounted handrail vertical members shall be plugged and pre-drilled to accept 1/2-inch diameter anchors or bolting.

E. Toeplates shall be 4-inches high x 1/2-inch corrugated configurations having a minimum weight of 0.65 pounds per linear foot. Toeplates shall be mounted to vertical handrail members using 316 stainless self-tapping screws. Toeplates shall be horizontal and mounted a maximum spacing of 1/4-inch to the walking surfaces. Toeplates shall be provided with all handrails.

F. All FRP handrail systems shall be 42-inches in height above the walking surfaces, shall have a top rail and one intermediate rails. Top rails and intermediate rails shall be equally spaced. Handrail system shall comply with OSHA loading requirements.

2.07 Fabrication

The manufacturer shall pre-fabricate all platforms and walkways prior to shipment to assure proper fit-up. The walkways and handrails shall be disassembled and shipped in the largest, reasonable sizes for installation and handling.

Part 3 Execution

3.01 Installation

A. The Contractor shall furnish FRP products as herein specified, installed by persons familiar with, and experienced in the installation of FRP gratings, stairs, treads, supports and handrails.

B. Gratings shall be installed in accordance with the manufacturer's recommendations and instructions.

C. Gratings shall have no tendency to shift, rock or rattle and shall not exhibit excessive deflection under normal foot traffic.

D. All field cut ends or drilled holes shall be coated with a comparable resin in accordance with the manufacturer's instructions.

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 fiberglass pipe troughs, covers and appurtenances as described herein, shown on the Drawings or necessary for proper completion of the work. All fiberglass products herein specified shall be manufactured with ultraviolet protective agents.

B. Details and information shown on the Drawings are to provide the manufacturer with general conformity and design concept.

1.02 Design Requirements

A. Troughs shall be designed for a live load per linear foot as given below:

Trough Width	Live Load/Square Foot
12	8 Pounds
18	12 Pounds
30	20 Pounds
42	28 Pounds
48	32 Pounds

B. Troughs shall carry the design loads in 10 foot simple spans with the covers removed or 20 foot simple spans with covers in place all at 360 L/D ratio minimum. All troughs shall support one-half their volume in fluid with covers in place when supported at 10 foot intervals.

C. Troughs shall be structurally designed to span distances greater than 10 feet without vertical supports where such distances are indicated on the Drawings.

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 of fiberglass components proposed for use on the Project.

C. 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.

D. Submit complete engineering design calculations for all fiberglass 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 Kentucky. Submit calculations concurrently with the shop drawings.

E. All trough assemblies shall be clearly match marked on each end of the trough.

1.04 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

Trough assemblies shall be manufactured by IKG Industries, Seasafe, or Fibergrid, Inc.

2.02 Materials and Construction

A. The pipe support system shall consist of a closed channel trough 6-inches deep inside x 10 foot maximum lengths. The trough sides and bottom shall be jointed with continuous bonding to assure a fluid tight joint or be continuously molded as a single unit. Every other section of the trough shall have the bottom or complete bottom and side trough section fabricated from clear sections to assist in visually detecting leaks.

B. The trough width shall be the inside diameter and allow a 6-inch clearance on both sides of all pipes.

C. The covers shall be five feet maximum length with a gasketed overlap to the next panel. The covers shall be bolted along the sides to gasketed "eave-type" external flanges designed to avoid blind fasteners and hold the covers in an arc or "roofed" profile to reduce fluid ponding. The covers shall be bolted on 18-inch maximum centers to maintain a composite beam profile.

D. A fiberglass "unistrut" type channel manufactured by Aickin Corporation to secure the piping shall be fastened across the trough bottom at maximum center-to-center distances of 24-inches. The pipe supports shall be installed such that the pipe supports shall not block trough drainage. Pipes shall be fixed to the FRP support channel by PVC pipe strap/clamps specifically designed to be used with the channel.

E. Trough sections shall be joined with matching angle flanges, that are formed to the

trough profile and extended up to the tray cover for maximum support and fluid seal. Flanges shall have full gaskets and shall be secured with 304 stainless steel fasteners. The joint shall be designed to support a mid-span moment.

F. All bolts and fasteners securing the covers and flanges shall be removable, replaceable and readily accessible.

G. The troughs shall be isophthalic polyester produced by pultrusion with 40-45 percent glass by weight. Materials shall be pigmented light gray and shall meet CL I flame spread rate per ASTM E-84 and provided with UV protection.

H. The troughs shall have the following physical properties:

Properties	Longitudinal	Transverse
Tensile Strength	30,000 psi	7,000 psi
Tensile Modulus	2,500,000 psi	800,000 psi
Flex Strength	30,000 psi	10,000 psi
Compression Strength	30,000 psi	15,000 psi
Full Shear Strength Section Deflection	5,500 psi	
Modulus Elasticity	2,500,000 psi	
Tensile Strength	20,000 psi	
Compressive Strength	20,000 psi	
Tray Side Rails	3,000,000 psi minimum	

I. End flanges shall be isophthalic polyester produced by either contact molding or from pultruded structural shapes having 30-40 percent glass by weight. Material shall be pigmented light gray and meet CL I flame spread rate per ASTM E 84. UV protection shall be provided.

J. End flanges shall have the following physical properties:

1. Ultimate Tensile Strength: 10,000 psi

2. Flex Strength: 16,000 psi

3. Flex Modulus: 100,000 psi

K. Fasteners shall be hex head machine bolts, flat washers and nuts, all of 304 stainless steel.

L. Gaskets shall be 40 durometer hardness, 1/16-inch thick and be made from materials that are chemically inert to the chemicals being conveyed by the piping contained in the troughs.

Part 3 Execution

3.01 Installation

A. The Contractor shall install and align all troughs and bolt flanges without springing troughs or overstressing components.

B. If adjustments or modifications must be made to prevent or correct for interference, the Contractor shall perform no cutting or modifications to the troughs without prior approval from the manufacturer.

C. The Contractor shall include in the Bid, costs for 15 days field time for a manufacturer's installation representative to be at the site to inspect and assist the Contractor during installations.

D. The Contractor shall have the manufacturer's representative provide the Owner with written documentation that the troughs have been correctly installed.

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 Perimeter Insulation

A. Perimeter insulation shall be 2-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.

2.02 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. Thickness shall be as shown on the Drawings.

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.

C. Polystyrene wall insulation shall be approved for use in FHA construction.

2.03 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 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.

3.02 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.

3.03 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 Scope

A. Environmental Requirements: Apply insulation in dry weather, when ambient temperature is above 45 degrees F.

B. Protection

1. Protect the building and the site from damage and defacing by operations, using tarps at hoisting points.

2. Restore or replace adjacent work or materials damaged during the handling of insulation materials.

1.02 Submittals

Submit product data and manufacturer's descriptive literature and installation instructions for insulation materials. Indicate specific systems and procedures for use, and date of publication.

1.03 Delivery, Storage and Handling

Store materials in a dry, covered area, off ground and out of direct sunlight.

1.04 Quality Assurance

Comply with the Standards of the American Society for Testing and Materials (ASTM) as referenced herein.

1.05 Warranty

Provide a warranty for all roof insulation work to be free of defective materials and workmanship in accordance with the requirements of Section 01740 of these Specifications.

Part 2 Products

2.01 Acceptable Manufacturers

A. Atlas Energy Products

B. Celotex Corporation

C. Homasote Company

D. International Permalite, Inc.

E. Manville Roofing Systems Division

F. R Max, Inc.

2.02 Isocyanurate Roof Insulation

A. Type: Rigid isocyanurate boards, 4 x 8 feet with facing sheets as recommended by manufacturer of roofing materials.

B. Thickness: as shown on the Drawings.

C. Aged "R" Value at 75 Degrees F: as shown on the Drawings.

D. Fire Resistance: FM Class 1

2.03 Wood Fiberboard

½-inch thick as recommended by manufacturer of roofing materials.

2.04 Accessories

A. Adhesive shall be UL listed, Class A in accordance with ASTM E84-87.

B. Provide tapered insulation boards with 1:12 taper and compatible with roof insulation.

Part 3 Execution

3.01 Preparation

A. Immediately prior to application of insulation materials, sweep roof deck, removing debris and foreign material.

B. Prior to beginning roofing work, a preroofing conference will be held to review work to be accomplished.

1. The Contractor, Engineer, roofing subcontractor and all other subcontractors who have equipment penetrating the roof or whose work involves access to the roof shall be present.

2. The Contractor shall notify the Engineer at least three days prior to the time for the conference.

3. The Contractor shall record minutes of the meeting and shall distribute those minutes to all attending parties.

3.02 Rigid Insulation Installation

A. Loose lay insulation over the deck in accordance with the roofing manufacturer's instructions.

B. Install insulation in one layer. Lay insulation in the longest possible lengths, continuous between roofing tracks. Butt edges for snug contact with gaps shall not exceed 1/16-inch.

C. Adhere insulation to concrete deck with continuous ribbons to hold insulation in place.

D. Install only as much roof insulation each work period as can be covered with roofing in that work period.

E. Place tapered roof insulation as shown on the Drawings for positive drainage around penetrations and to wall scuyspers.

F. Place one course of wood fiberboard over roof insulation. Adhere fiberboard with adhesive or a hot mopping of asphalt.

END OF SECTION

Part 1 General

1.01 Scope of Work

A. Provide all labor, equipment, and materials to install the roof system over the properly prepared substrate.

B. Prime Concrete Deck with 2 coats of Garla-Prime primer.

C. Install 2.5" Iso Board in Insu-Loc insulation adhesive.

D. Mop ½" Wood Fiberboard in Type IV Special Steep Asphalt.

E. Mop 2 plies of Type IV Fiberglass Felt in hot asphalt.

F. Mop 1 ply of Stress Ply E in hot asphalt.

G. Install Versi-Ply 40 and Stress Ply E Mineral on all flashings.

H. Flood coat and gravel with Black Knight Cold Adhesive.

I. Strip in the seams of the flashing with Flashing Bond and mesh.

J. Aluminize the entire flashing with 2 coats of Garla-Brite aluminizer.

1.02 Related Section

A. Drawings and general provisions of the Contract apply to this section.

1.03 References

ASTM D-41	Specification for Asphalt Primer Used in Roofing, Dampproofing and Waterproofing
ASTM D-312	Specification for Asphalt Used in Roofing
ASTM D-451	Test Method for Sieve Analysis of Granular Mineral Surfacing for Asphalt Roofing Products
ASTM D-1079	Terminology Relating to Roofing, Waterproofing and Bituminous Materials
ASTM D-1227	Specification for Emulsified Asphalt Used as a Protective Coating for Roofing
ASTM D-1863	Specification for Mineral Aggregate Used as a Protective Coating for Roofing
ASTM D-2178	Specification for Asphalt Glass Felt Used as a Protective Coating for Roofing
ASTM D-2822	Specification for Asphalt Roof Cement
ASTM D-2824	Specification for Aluminum-Pigmented Asphalt Roof Coating

ASTM D-4601	Specification for Asphalt Coated Glass Fiber Base Sheet Used in Roofing
ASTM D-5147	1991 Test Method for Sampling and Testing Modified Bituminous Sheet Materials
ASTM D-6162	Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements
ASTM D-6163	Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements
ASTM E-108	Test Methods for Fire Test of Roof Coverings
FM	Factory Mutual
NRCA	National Roofing Contractors Association
UL	Underwriters Laboratories
WH	Warnock Hersey

1.04 Submittals

A. Submit under provisions of Submittals Section.

B. Submit certification that the roof system furnished is approved by Factory Mutual, Underwriters Laboratories, or Warnock Hersey for external fire E-108 Class 1A and that the roof system is adhered properly to meet or exceed 1-90.

C. Submit certification that the roof system furnished meets local or nationally recognized building codes for fire Class A and/or wind resistance.

D. Product Data for each type of product specified including manufacturer's technical product data, installation instructions and recommendations for each type of roofing product required. Include data substantiating that materials comply with specified requirements.

E. For all modified bituminous sheet roofing, include independent test data according to ASTM designation D-5147-91 "Standard Test Methods for Sampling and Testing Modified Bituminous Sheet Material", substantiating that materials comply with specified requirements.

F. Any material submitted as an equal to specified material must also submit a list of three jobs where the proposed material has been used in a similar roofing system as that which is specified and within one hundred mile radius from the location of the specified job. In addition, the three jobs must be at least five years old and be available for the Owner or Owner's Representative to inspect.

G. Show evidence that the products and materials are manufactured in the United States and that materials provided conform to all requirements specified herein, and are chemically and physically compatible with each other and are suitable for inclusion within the total roof system specified herein.

H. Show evidence that the Installer specializes in modified bituminous roof application with a minimum 5 years experience and who is certified by the roofing system manufacturer as qualified to install manufacturer's roofing materials.

I. Provide a sample of each product.

J. Unexecuted Manufacturer's warranty.

K. Certified copy of ISO 9001 compliance.

L. Any deficiencies in performance, warranty terms or improper submittal procedure will constitute grounds for immediate rejection of alternate.

1.05 Quality Assurance

A. Manufacturer Qualifications: Roofing system manufacturer shall have a minimum of 12 years experience in manufacturing bitumen roofing products in the United States and be ISO 9001 certified.

B. Installer Qualifications: Installer (Roofer) shall be specializing in modified bituminous roof application with minimum 5 years experience and who is certified by the roofing system manufacturer as qualified to install manufacturer's roofing materials.

C. It is the intent of this specification to provide a roof system with an external fire rating. The descriptions given below are general descriptions. The insulation, recovery board, and other components shall be required by the membrane manufacturer to provide a Class A fire resistance rating.

D. Installer's Field Supervision: Require Installer to maintain a full-time Supervisor/Foreman on job site during all phases of bituminous sheet roofing work and at any time roofing work is in progress, proper supervision of workmen shall be maintained. A copy of the specification shall be in the possession of the Supervisor/Foremen and on the roof at all times.

E. It shall be the Contractor's responsibility to respond immediately to correction of roof leakage during construction. If the contractor does not respond within 24 hours, the Owner has the right to hire a qualified contractor and backcharge the original contractor.

F. Disqualification of Bidders: A bidder can be disqualified by the Owner for any of the following reasons, but not limited to:

1. The failure to attend the Pre-Bid conference at the time and place so described under Bidding Dates.

2. Lack of proficiency as shown by past work or incomplete work under other contracts which, in the judgment of the Owner might hinder or prevent the prompt completion of additional work if so awarded or any involvement in any

legal actions which relate to past or present performance. This includes, but is not limited to lawsuits, court appointed actions, and/or ongoing litigation.

G. Pre-application Roofing Conference: Approximately 2 weeks before scheduled commencement of modified bitumen roof system installation and associated work meet at project site with installer of each component of associated work, installers of deck or substrate construction to receive roofing work, installers of rooftop units and other work in the around roofing must precede or follow roofing work (including mechanical work if any), Architect/Owner, roofing system manufacturer's representative, and other representatives directly concerned with performance of the Work, including (where applicable) Owner's insurers, test agencies and governing authorities.

Objectives to include:

1. Review foreseeable methods and procedures related to roofing work.

2. Tour representative areas of roofing substrates (decks), inspect and discuss condition of substrate, roof drains, curbs, penetrations and other preparatory work performed by other trades.

3. Review structural loading limitations of deck and inspect deck for loss of flatness and for required attachment.

4. Review roofing system requirements (drawings, specifications and other contract documents).

5. Review required submittals both completed and yet to be completed.

6. Review and finalize construction schedule related to roofing work and verify availability of materials, Installer's personnel, equipment and facilities needed to make progress and avoid delays.

7. Review required inspection, testing, certifying and material usage accounting procedures.

8. Review weather and forecasted weather conditions and procedures for coping with unfavorable conditions, including possibility of temporary roofing (if not mandatory requirement).

9. Record (contractor) discussion of conference including decisions and agreements (or disagreements) reached and furnish copy of record to each party attending. If substantial disagreements exist at conclusion of conference, determine how disagreements will be resolved and set date for reconvening conference.

10. Review notification procedures for weather or non-working days.

1.06 Delivery, Storage and Handling

A. Deliver products to site with seals and labels intact, in manufacturer's original containers, dry and undamaged.

B. Store and handle roofing sheets in a dry, well-ventilated, weather-tight place to ensure no possibility of significant moisture exposure. Store rolls of felt and other sheet materials on pallets or other raised surface. Stand all roll materials on end. Cover roll goods with a canvas tarpaulin or other breathable material (not polyethylene).

C. Do not leave unused materials on the roof overnight or when roofing work is not in progress unless protected from weather and other moisture sources.

D. It is the responsibility of the contractor to secure all material and equipment on the job site. If any material or equipment is stored on the roof, the contractor must make sure that the integrity of the deck is not compromised at any time. Damage to the deck caused by the contractor will be the sole responsibility of the contractor and will be repaired or replaced at his expense.

1.07 Manufacturer's Inspections

A. When the project is in progress, the Roofing System Manufacturer will provide the following:

1. Keep the Owner informed as to the progress and quality of the work as observed.

2. Provide job site inspections a minimum of three days a week.

3. Report to the Owner in writing any failure or refusal of the Contractor to correct unacceptable practices called to the Contractor's attention.

4. Confirm after completion of the project and based on manufacturer's observation and tests that manufacturer has observed no applications procedures in conflict with the specifications other than those that may have been previously reported and corrected.

1.08 Project Conditions

A. Weather Condition Limitations: Do not apply roofing membrane during inclement weather or when a 40% or greater chance of precipitation is expected.

B. Do not apply roofing insulation or membrane to damp deck surface.

C. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during same day.

D. Proceed with roofing work only when existing and forecasted weather conditions will permit unit of work to be installed in accordance with manufacturer's recommendations and warranty requirements.

1.09 Sequencing and Scheduling

A. Sequence installation of modified bituminous sheet roofing with related units of work specified in other sections to ensure that roof assemblies including roof accessories, flashing, trim and joint sealers are protected against damage from effects of weather, corrosion and adjacent construction activity.

B. All work must be fully completed on each day. Phased construction will not be accepted.

C. The Contractor is to coordinate with the G.C. on the project for the installation of HVAC Units on roof areas.

1.10 Warranty

A. Upon completion of installation, and acceptance by the Owner and, the manufacturer will supply to the Owner a 30 Year Warranty.

B. Contractor will submit a minimum of a two-year warranty to the membrane manufacturer with a copy directly to Owner.

Part 2 Products

2.01 General

A. When a particular trade name or performance standard is specified it shall be indicative of a standard required.

B. Provide products as manufactured by The Garland Company. Bidders proposing substitutes shall submit all required information to Owner at least 10 days prior to bid due date.

C. Any item or materials submitted as a substitute to the manufacturer specified must comply in all respects as to the quality and performance of the brand name specified. The Owner shall be the sole judge as to whether or not an item submitted as an equal is truly equal.

2.02 Description

A. Modified bituminous roofing work including but not limited to:

1. Two plies of approved ASTM D-2178 Type IV glass fiber roofing felt bonded to the prepared substrate with hot bitumen.

2. Hot Bitumen: ASTM D312, Type IV special steep asphalt having the following characteristics:
   a. Softening Point 210°F - 225°F

   b. Flash Point 500°F

   c. Penetration @ 77°F 15-25 units

   d. Ductility @ 77°F 1.5 cm

3. All flashings will be set in bitumen and will be one ply of 40 mil SBS base flashing ply covered by an additional layer of modified bitumen membrane.

4. The modified membrane will be:

   a. **STRESSPLY E**

      135 mil SIS and SBS

      (Styrene-Isoprene-Styrene and Styrene-Butadiene-Styrene) rubber modified roofing membrane with fire retardant characteristics and reinforced with a dual fiberglass scrim and polyester mat.

2.03 Bituminous Materials

A. Asphalt Primer: V.O.C. compliant, ASTM D-41.

B. Asphalt Roofing Mastic: V.O.C. compliant, ASTM D-2822, Type II.

C. Interply Adhesive

   1. Shall meet ASTM Specifications D-312 Type IV.

2.04 Sheet Materials

A. Felt Plies

   1. Fiberglass Felts: ASTM D-2178, Type IV

B. Base Flashing Ply – Versiply 40

   1. 40 mil SBS modified membrane with woven fiberglass scrim reinforcement with the following minimum performance requirements according to ASTM D-5147.

Properties: FINISHED MEMBRANE

Tensile Strength (ASTM D-5147)
2 in/min. @73.4 ± 3.6°F MD 205 lbf/in CMD 205 lbf/in

Tear Strength (ASTM D-5147)
2 in/min. @ 73.4 ± 3.6°F MD 295 lbf CMD 280 lbf

Elongation at Maximum Tensile (ASTM D-5147)
2 in/min. @ 73.4 ± 3.6°F MD 4.5% CMD 5.0%

C. Modified Flashing Ply

STRESSPLY "E" MINERAL

D. MODIFIED MEMBRANE
PROPERTIES: Finished Membranes

1. **STRESSPLY E**
ASTM D-6162 Type III Grade G

Tensile Strength (ASTM D-5147)
2 in/min. @ 73.4 ± 3.6°F MD 500 lbf/in CMD 550 lbf/in
(50 mm/min. @ 23 ± 3°C) MD 122.5 kN/m CM131.25 kNm

Tear Strength (ASTM D-5147)
2 in/min. @ 73.4 ± 3.6°F MD 900 lbf CMD 950 lbf
50 mm/min. @ 23 ± 3°C MD 5783 N CMD 6227 N

Elongation at Maximum Tensile (ASTM D-5147)
2 in/min. @ 73.4 ± 3.6°F MD 6.0% CMD 6.0%
50 mm/min. @ 23 ± 3°C

Low Temperature Flexibility (ASTM D-5147) Passes -30°F (-34°C)

2.05 Surfacings

A. Garla-Brite

Flash Point 103°F (39°C) min.
Weight/Gallon 7.9 lbs./gal. (1.0 g/cm3)

B. Aggregate: To conform to ASTM D-1863.

1. Pea Gravel

2.06 Related Materials

A. Roof Insulation: Reference Section 07220 - Roof and Deck Insulation for requirements.

B. Roof Insulation Fasteners: Reference Section 07220 - Roof and Deck Insulation for requirements.

C. Base Sheet: shall meet the requirements of ASTM D-4601 Type II and be recommended and furnished by the membrane manufacturer.

D. Nails and Fasteners: Non-ferrous metal or galvanized steel, except that hard copper nails shall be used with copper; aluminum or stainless steel nails shall be used with aluminum; and stainless steel nails shall be used with stainless steel. Fasteners shall be self-clinching type of penetrating type as recommended by the manufacturer of the deck material. Nails and fasteners shall be flush-driven through flat metal discs of not less than 1-inch diameter. Metal discs may be omitted when one-piece composite nails or fasteners with heads not less than 1-inch diameter are used.

E. Metal Discs: Flat discs or caps of zinc-coated sheet metal not lighter than 28 gauge and not less than 1-inch in diameter. Discs shall be formed to prevent dishing. Bell or cup shaped caps are not acceptable.

F. Walkway Pads: As recommended and furnished by the membrane manufacturer.

Part 3 Execution

3.01 Examination

A. Examine substrate surfaces to receive modified bitumen sheet roofing system and associated work and conditions under which roofing will be installed. Do not proceed with roofing until unsatisfactory conditions have been corrected in a manner acceptable to Roof System Manufacturer.

3.02 General Installation Requirements

A. Cooperate with manufacturer, inspection and test agencies engaged or required to perform services in connection with installing the roof system.

B. Insurance/Code Compliance: Where required, install and test the roofing system to comply with governing regulation and specified insurance requirements.

C. Protect other work from spillage of roofing materials and prevent materials from entering or clogging drains and conductors. Replace or restore other work damaged by installation of the modified bituminous roofing system work.

D. Coordinate installing roofing system components so that insulation and roofing plies are not exposed to precipitation or left exposed overnight. Provide cut-offs at end of each day's work to cover exposed ply sheets and insulation with two (2) plies of #15 organic roofing felt set in full moppings of bitumen and with joints and edges sealed with roofing cement. Remove cut-offs immediately before resuming work.

E. Asphalt Bitumen Heating: Heat and apply bitumen according to EVT Method as recommended by NRCA. Do not raise temperature above minimum normal fluid-holding temperature necessary to attain EVT (plus 5°F at point of application) more than 1 hour prior to time of application. Determine flash point, finished blowing temperature, EVT, and fire-safe handling temperature of bitumen either by information from manufacturer or by suitable test. Do not exceed recommended temperature limits during bitumen heating. Do not heat to a temperature higher than 25° below flash point. Discard bitumen that has been held at temperature exceeding finishing blowing temperature (FBT) for more than 3 hours. Keep kettle lid closed except when adding bitumen.

F. Bitumen Mopping Weights: For interply mopping, apply bitumen at the rate of approximately 25 lb. of bitumen per roof square. For a flood coat, apply bitumen at the rate of approximately 60-70 lb. of bitumen per square (plus or minus 25 percent on a total job average basis).

G. Substrate Joint Penetrations: Prevent bitumen from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

H. Apply roofing materials as specified herein unless recommended otherwise by manufacturer's instructions. Keep roofing materials dry before and during application. Do not permit phased construction. Complete application of roofing plies, modified sheet and flashing in a continuous operation. Begin and apply only as much roofing in one day as can be completed that same day.

I. Cut-Offs: At end of each day's roofing installation, protect exposed edge of incomplete work, including ply sheets and insulation. Provide temporary covering of two (2) plies of #15 organic roofing felt set in full moppings of bitumen with joints and edges sealed.

3.03 HPR Modified Membrane Application

A. The modified membrane shall then by solidly bonded to the base layers with specified asphalt at the rate of 25 to 30 lbs. per 100 square feet.

B. The roll must push a puddle of asphalt in front of it with asphalt slightly visible at all side laps. Care should be taken to eliminate air entrapment under the membrane.

C. Apply pressure to all seams to ensure that the laps are solidly bonded to substrate.

D. Subsequent rolls of modified shall be installed across the roof as above with a minimum of 4" side laps and 8" end laps. The end laps shall be staggered. The modified membrane shall be laid in the same direction as the underlayers but the laps shall not coincide with the laps of the base layers.

E. Apply asphalt no more than five feet ahead of each roll being embedded.

F. Extend membrane 2" beyond top edge of all cants in full moppings of the specified asphalt as shown on the drawings.

3.04 Flashing Membrane Installation (General)

A. All curb, wall and parapet flashings shall be sealed with an application of mastic and mesh on a daily basis. No condition should exist that will permit moisture entering behind, around or under the roof or flashing membrane.

B. Prepare all walls, penetrations and expansion joints to be flashed and where shown on the drawings with asphalt primer at the rate of 100 square feet per gallon. Allow primer to dry tack free.

C. The modified membrane will be used as the flashing membrane and will be adhered to an underlying base flashing ply with specified asphalt unless otherwise noted in these specifications and nailed off 8" O.C. at all vertical surfaces.

D. The entire sheet of flashing membrane must be solidly adhered to the substrate.

E. Seal all vertical laps of flashing membrane with a three-course application of Flashing Bond and fiberglass mesh.

F. Counter flashing, cap flashings, expansion joints, and similar work to be coordinated with modified bitumen roofing work are specified in other sections.

G. Roof accessories, miscellaneous sheet metal accessory items, including piping vents and other devices to be coordinated with the roofing system work are in other sections.

3.05 Flashing Membrane Installation (Specific)

A. EXHAUST FAN DETAIL
DETAIL #MBH-36

1. Minimum curb height is 8". Prime vertical at a rate of 100 square feet per gallon and allow to dry.

2. Set cant in bitumen. Run all plies over cant a minimum of 2".

3. Install base flashing ply covering curb with 6" on to field of roof.

4. The second ply shall be a modified flashing ply installed over the base flashing ply 9" on to field of roof. Attach top of membrane to top of curb and nail 8" O.C. All vertical seams will receive a three-course application of mastic and mesh allowed to cure and aluminize.

5. Place metal exhaust fan over the wood nailers and flashing to act as counterflashing. Fasten per manufacturer's recommendation.

B. SCUPPER THROUGH WALL

Detail # MBH-15

1. Inspect the nailer to assure proper attachment and configuration.

2. Run one ply over nailer, into scupper hole and up flashing as in typical wall flashing detail. Assure coverage of all wood nailers.

3. Install a scupper box in a ¼ inch bed of mastic. Assure all box seams are soldered and have a minimum four (4) inch flange. Make sure all corners are closed and soldered. Prime scupper at a rate of one hundred (100) square feet per gallon and allow to dry.

4. Fasten flange of scupper box every three (3) inches o.c. staggered.

5. Strip in flange of scupper box with base flashing ply covering entire area with six (6) inch overlap on to the field of the roof and wall flashing.

6. Install a second ply of modified flashing ply in bitumen over the base flashing ply, nine (9) inches on to the field of the roof. Apply a three-course application of mastic and mesh at all seams.

C. PLUMBING STACK
DETAIL #MBH-50

1. Minimum stack height is 12".

2. Run roof system over the roof. Seal the base of the stack with elastomeric sealant.

3. Prime flange of new sleeve. Install properly sized sleeves set in ¼" bed of roof cement.

4. Install base flashing ply in bitumen.

5. Install modified membrane in bitumen.

6. Caulk the intersection of the membrane with elastomeric sealant.

7. Turn sleeve a minimum of 1" down inside of stack.

D. COPING CAP
DETAIL #MBH-20

1. Minimum flashing height is 8". Maximum flashing height is 24". Prime vertical wall at a rate of 100 square feet per gallon and allow to dry.

2. Set cant in bitumen. Run all field plies over cant a minimum of 2".

3. Attach tapered board to top of wall.

4. Install base flashing ply covering entire wall and wrapped over top of wall and down face with 6" on to field of roof set in hot asphalt. Nail membrane 8" O.C.

5. The second ply shall be a modified flashing ply installed over the base flashing ply 9" on to field of roof in bitumen. All vertical seams will receive a three-course application of mastic and mesh allowed to cure and aluminize.

6. Install continuous cleat, fasten 6" O.C. to outside wall.

7. Install new metal coping cap hooked to continuous cleat.

8. Fasten inside cap 24" O.C. with approved fasteners with neoprene washers.

E. PITCH POCKET UMBRELLA
DETAIL #MBH-53

1. Run all plies up to the penetration.

2. Pitch pans shall be 24 gauge galvanized steel and at least 4" deep. The pitch pocket should extend at least 1" beyond the penetration in all directions. All corners and seams should be welded tight and watertight.

3. Place the pitch pocket over the penetration and prime all flanges.

4. Strip in flange of pitch pocket with one ply of base flashing ply. Extend 6" onto field of roof.

5. Install second layer of modified membrane extending 9" onto field of roof.

6. Fill pitch pan half full with non-shrink grout. Let this cure and top off with pourable sealant.

7. Caulk joint between roof system and pitch pan with roof cement.

8. Place a watershedding bonnet over the top of the pitch pocket and clamp the top with a drawband collar. Caulk the upper edge of the band with an elastomeric sealant.

3.06 Application of Surfacing

A. Aggregate Surfacing

1. Apply surfacing materials in the quantities specified (500 lbs. per square for aggregate 400 lbs. per square for slag). After felt flashings, tests, repairs, and corrective actions have been completed and approved. Uniformly embed aggregate in a flood coat of bitumen at a rate of 60 - 70 lbs. per square coverage.

2. Aggregate shall be dry and placed in a manner required to form a compact, embedded overlay. To aid in proper embedment, aggregate may be lightly rolled provided that there is not damage to the built-up roofing membrane.

3.07 Cleaning

A. Remove drippage of bitumen adhesive from all walls, windows, floors, ladders and finished surfaces.

B. In areas where finished surfaces are soiled by asphalt or any other sources of soiling caused by work of this section, consult manufacturer of surfaces for cleaning advice and conform to their instructions.

3.08 Final Inspection

A. At completion of roofing installation and associated work, meet with Installer, installer of associated work, Owner, roofing system manufacturer's representative, and other representatives directly concerned with performance of roofing system.

B. Walk roof surface areas of the building, inspect perimeter building edges as well as flashing of roof penetrations, walls, curbs and other equipment. List all items requiring correction or completion and furnish copy of list to each parting attending.

C. The Roofing System Manufacturer reserves the right to request a thermographic scan of the roof during final inspection to determine if any damp or wet materials have been installed. The thermographic scan shall be provided by the Roofing Contractor at a negotiated price.

D. If core cuts verify the presence of damp or wet materials, the Roofing Contractor shall be required to replace the damaged areas at his own expense.

E. Repair or replace (as required) deteriorated or defective work found at time above inspection to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

F. The Contractor is to notify the Owner upon completion of corrections.

G. Following the final inspection, acceptance will be made in writing by the material manufacturer.

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 install all sheet metal work, including metal flashing and counterflashing, flashing transitions, wall flashing, gutters, downspouts, scuppers, and related work as described herein and/or shown on the Drawings.

1.02 Submittals

A. Submittals shall be made in accordance with the requirements of Section 01340 of these Specifications.

B. Submit written information regarding material proposed and installation instructions for the use substantiating compliance with Specification requirements. Submit two samples, 12 x 12-inches, of each type of flashing or sheet metal material and each accessory specified. Submit sample packs of each type of fastener.

C. Submit shop drawings, showing manner of forming, jointing and securing flashings, guttering and accessories. Detail waterproof connections to adjoining work and at obstructions and penetrations. Shop drawings shall indicate thickness and dimensions of all parts, fastening and anchoring methods, details and locations of all seams, joints and other provisions necessary for thermal expansion and contraction.

1.03 Storage and Protection

A. Sheet metal materials and accessories shall be stored and protected in accordance with the requirements of Section 01611 of these Specifications.

B. The Contractor shall protect all copper materials from exposure to chlorides and muriatic acids. Wash affected areas immediately with five percent soda solution and rinse with clear water. Replace discolored materials.

C. Sheet metal work shall be handled with sufficient care to prevent damage to surfaces, edges and ends. All material at site shall be stored above ground in a covered, dry location. Damaged material that cannot be restored to its original condition will be rejected and shall be replaced at no additional cost to the Owner.

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.

Part 2 Products

2.01 Materials and Construction

A. Copper: Where copper flashing and appurtenances are called for on the Drawings, provide and install cold rolled copper with ASTM B 370. Concealed thru-wall copper flashing shall weigh not less than five ounces per square foot and shall be coated on both sides with asphalt-impregnated glass fabric. Exposed copper flashing shall weigh not less than 16 ounces per square foot and shall be uncoated. Unless noted otherwise, all new exterior scuppers and downspouts shall be copper.

B. Fasteners: Nails, screws, bolts, rivets and other fastenings for sheet metal shall be of the size and type suitable for the intended use and shall be compatible with metal which it shall contact. Fasteners used with aluminum and stainless steel shall be stainless steel. Types of fasteners shall be as recommended by the manufacturer and shall conform with Federal Specifications.

C. Downspouts and Scuppers

1. Downspouts shall be 3 x 4-inches corrugated rectangular 20 ounce copper with brass support brackets spaced on 60-inch centers.

2. Scuppers shall be formed from 24 ounce copper.

3. All hangers, fasteners and accessories shall be of compatible materials.

D. Splash Blocks: Splash blocks shall be reinforced precast concrete, 3,000 psi, 30 x 16 x 4-inches thick.

E. Sealant: Where sealant is specified or shown on the Drawings, it shall be in accordance with the requirements of Section 07900 of these Specifications.

F. Bituminous Plastic Cement: Where bituminous plastic cement is specified or shown on the Drawings, use cement conforming to Federal Specification SS-C-153, Type I.

G. Solder: Solder shall be ASTM B 32, Alloy grade 58, composed of 50 percent tin and 50 percent lead.

Part 3 Execution

3.01 Inspection

A. Verify that substrates are smooth and clean to extent needed for sheet metal work.

B. Verify that reglets, nails, cants and blocking to receive sheet metal are installed and free of concrete and soil.

C. Do not start sheet metal work until conditions are satisfactory.

3.02 Preparation

Before installing sheet metal, verify shapes and dimensions of surface to be covered.

3.03 Installation

A. General

1. Install all flashing and sheet metal work in accordance with the "Architectural Sheet Metal Manual" by SMACNA.

2. Install work watertight, without waves, warps, buckles, fastening stresses or distortion, allowing for expansion and contraction.

3. Hem exposed edges except edges forming drip lips.

4. Angle bottom edges of exposed vertical surfaces away from finished surface to form drips.

5. Thru-wall flashing shall start 1/2-inch from outside of wall and shall be turned up not less than 2-inches and shall be anchored in interior block wall mortar joint. Flashing shall be laid in a thin bed of mortar and topped with a thin bed of mortar. Joints shall be lapped at least 4-inches and sealed with plastic cement.

6. Lintel and sill flashing shall extend 6-inches beyond ends of lintel or sill and shall be turned up at the ends to form a pan.

7. Set one splash block below each downspout unless shown or noted otherwise.

B. Seams

1. Common Lock Seams: 5/8-inch finished width; four-ply loose lock.

2. Soldered Lap Seams: 1-inch finished width; sweated full with solder.

C. Counter Flashing

1. Where metals abut adjacent dissimilar metals, the juncture shall be executed in a manner that will facilitate drainage and shall be coated with a bituminous coating as specified or as recommended by the manufacturer.

2. Factory form flashing components to suit all conditions and wall thicknesses, offsets, corners and others to minimize field forming. Where field forming is necessary, fabricate to shapes indicated on the Drawings and specified herein.

3. Except as otherwise indicated on the Drawings, comply with instructions and applicable details of "Architectural Sheet Metal Manual" by SMACNA.

4. Install with lines and corners of exposed units true and accurate. Exposed faces shall be flat and free of buckles, excessive waves and avoidable tool marks, considering temper and reflectively of metal. Provide uniform and neat seams.

5. All joints at flashing transitions shall be neatly joined and they shall be fastened and sealed or fastened and soldered.

D. Downspouts

1. Hangers shall conform with SMACNA, minimum 1/8-inch x 1-inch flat stock brass.

2. Downspout shall be securely fastened to the wall with brass or copper bands located not more than five feet apart. Anchorage shall be made with 1/4-inch brass machine bolts into noncorrosion anchors.

E. Scuppers: Conform design and installation with SMACNA. Scupper outlet tube to conductor head shall be rectangular shape, 4-inches long, minimum.

F. Soldering

1. Copper: Clean and flux metals prior to soldering. Sweat solder completely through seam width.

3.04 Inspection

Damaged work shall be repaired or replaced. The Contractor shall make, at Contractor's own expense, all necessary changes, modifications and/or alterations required to ensue a satisfactory installation.

3.05 Cleaning

A. As work progresses, neutralize excess flux with 5 to 10 percent washing soda solution, and thoroughly rinse.

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

END OF SECTION

Part 1 General

1.01 Scope

The work covered by this Section includes furnishing all labor, equipment and materials required to furnish and install all roof hatches, prefabricated roof curbs, metal coping systems and related work as shown on the Drawings and/or specified herein.

1.02 Submittals

Complete shop drawings and engineering data shall be submitted to the Engineer in accordance with the requirements of Section 01340 of these Specifications.

1.03 Storage and Protection

Equipment shall be stored and protected in accordance with the requirements of Section 01640 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.

Part 2 Products

2.01 Roof Hatches

A. Roof hatches shall be constructed of aluminum and shall be designed to support a minimum imposed live cover load of 40 psf.

B. Cover shall be one-piece of 11 gauge aluminum with 1-inch thick fiberglass insulation enclosed by a 18 gauge aluminum cover liner. Cover shall be supported by heavy-duty, tamperproof, interior pintle hinges equipped with compression springs in telescoping tubes for easy operation. Cover shall be provided with 3-inch beaded lip flange and a continuous sponge neoprene gasket for a weatherproof, draftproof, dusttight seal.

C. The cover shall be provided with an automatic latching, hold open arm with vinyl grip release handle for one-handed release. A spring latch capable of both inside and outside operation shall be furnished on the cover. The latch shall have provisions for padlocking.

D. The roof hatch shall be provided with a prefabricated, 11 gauge aluminum curb with a height of 12-inches. The curb shall have integral cap flashing, padlock hasp, 1-inch rigid fiberglass insulation around outside of core and 3-1/2-inch anchorage flange. Coat flange with bituminous paint to prevent contact with concrete roof surfaces.

E. All hardware shall be cadmium plated or of stainless steel for corrosion resistance.

F. Roof hatches shall be single leaf and shall be Bilco Type S, or Babcock-Davis Type B-RHA.

G. Provide a fiber reinforced polymer railing system with self-closing gate sized for the hatch – Bil-Guard Hatch Rail System.

2.02 Prefabricated Equipment Curbs

A. Prefabricated equipment curbs and equipment base support units shall be manufactured by the Pate Company, Thy-Curb Division of Thybar Corporation or I.L.G. Industries.

B. Prefabricated roof curbs shall be of box section design, 18 gauge galvanized steel shell and base plate, continuous mitered 3-inch cant, welded corner seams 1-1/2-inch step to match deck insulation thickness, T-bar reinforcing on sides 36-inches and greater and factory installed, treated wood nailer. Curb shall be insulated with 1-1/2-inch thick, three pound density, rigid fiberglass board insulation.

C. The Contractor shall coordinate the roof opening size, location, roof curb type, reinforcement and curb width as required by the type of equipment and load to be supported.

D. All curbs shall be tapered design for a level installation.

2.03 Roof Walkway Boards

Provide homogenous asphalt impregnated, minimum 1/2-inch thick, 36-inches wide, 36-inches minimum length, roof walkways with top weathercoated and surfaced with dark grey ceramic granules; bottom and sides unsurfaced; equal to Carey-top, Sealtight Whitewalk or Roofwalk manufactured by Celotex Corporation, W.R. Meadows or J & P Petroleum Company, respectively. Material shall be compatible with roofing system. Install where shown on the Drawings.

2.04 Prefinished Metal Coping

Provide MM Systems-Snap-Lok Coping, Architectural Products Co. – AP Snap-Tight Coping, or Hickman-Permasnaps. Coping shall be 0.063" aluminum coping system. Provide welded corner units, internal formed gutter system, smooth finish and Kynar 500 Finish. Provide at least 20 standard colors for selection.

Part 3 Execution

3.01 Installation

A. All doors and hatches shall be completely assembled in the containing frames and shipped as a complete unit.

B. Roof hatches and copings shall be installed as shown on the Drawings and in accordance with the manufacturer's shop drawings and instructions. Curbs shall be properly flashed and watertight.

C. Install roof walkway boards where shown and as recommended by the manufacturer.

3.02 Inspection and Testing

A. Following installation, operating tests will be performed, demonstrating to the Engineer that all doors and covers operate freely, without binding and close without forcing or springing. The Contractor shall make, at Contractor's own expense, all necessary changes, modifications and/or adjustments required to ensure satisfactory performance.

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 $\pm$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 and galvanized.

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. 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 existing wall conditions or steel framing, make provisions for securing frames with ¼" flat head self-tapping through spacers. Countersink heads and finish frame surface with auto body filler.

H. 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.

I 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.

J. 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.

K. 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.

L. Grouting: All hollow metal frames set in masonry shall have the head and jambs grouted full.

M. 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.

N. 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 galvanized 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. 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.

H. 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.

I. 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.

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.

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 extruded aluminum 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.

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 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 Summary

A. This Section includes items known commercially as finish or door hardware that are required for swing, sliding, and folding doors, except special types of unique hardware specified in the same sections as the doors and door frames on which they are installed.

B. Hardware specified herein is to cover all necessary material required to fully complete the hardware requirements of specified openings. It is the intention that the hardware specified shall be of sufficient quantities necessary to complete the Work. Notify the Architect of omissions or discrepancies prior to bid date for clarifications or instructions. Adjustments to the Contract Sum will not be allowed for omissions not clarified prior to bid opening.

C. This Section includes the following:

1. Hinges.
2. Lock cylinders and keys.
3. Lock and latch sets.
4. Electric Locksets.
5. Flush Bolts.
6. Push/pull units.
7. Closers.
8. Overhead stops.
9. Miscellaneous door control devices.
10. Power supplies
11. Door trim units.
12. Protection plates, door edging.
13. Smoke seal stripping for interior doors.

D. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 6 - Finish Carpentry: Finish Hardware Installation.

2. Division 8 Section "Steel Doors and Frames".

3. Division 8 Section "Flush Wood Doors".

E. Products furnished but not installed under this Section include:

1. None

1.02 Reference

A. ANSI A117.1 – Specifications for making buildings and facilities usable by physically handicapped people.

B. ADA – Americans with Disabilities Act of 1990

C. DHI – Door and Hardware Institute

D. BHMA – Builder's Hardware Manufacturers Association

E. NFPA – National Fire Protection Association

1. NFPA 80 – Fire Doors and Windows

2. NFPA 101 – Life Safety Code

3. NFPA 105 – Smoke and Draft Control Door Assemblies

4. NFPA 252 – Fire Tests of Door Assemblies

F. UL – Underwriters Laboratories

1. UL10C – Fire Tests of Door Assemblies (Positive Pressure)

2. UL 305 – Panic Hardware

G. WHI – Warnock Hersey Incorporated

H. SDI – Steel Door Institute

I. AWI – Architectural Woodwork Institute

1.03 Submittals

A. HARDWARE SCHEDULE: Submit six copies of schedule per Division 1. Organize vertically formatted schedule into "Hardware Sets" with index of doors and headings, indicating complete designations of every item required for each door or opening. Horizontal hardware schedules are not acceptable and shall be marked incomplete and returned. Include following information:

1. Type, style, function, size, quantity and finish of hardware items. Use BHMA Finish codes per ANSI A156.18.

2. Name, part number and manufacturer of each item.

3. Fastenings and other pertinent information

4. Location of hardware set coordinated with floor plans and door schedule

5. Explanation of abbreviations, symbols, and codes contained in schedule.

6. Mounting locations for hardware.

7. Door and frame sizes, materials and maximum degrees of swing.

8. List of manufacturers used and the nearest representative with address and phone numbers.

   a) Catalog cuts.

   b) Manufacturer's technical data and installation instructions for electronic hardware.

B. Furnish as-built/as-installed schedule with closeout documents, including keying schedule, wiring/riser diagrams, manufacturers' installation, adjustment and maintenance information and hardware consultant's final inspection report.

C. Keying Schedule: Submit separate detailed schedule indicating clearly how the Owner's final instructions on keying of locks has been fulfilled.

D. Templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware. Check shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

E. Furnish three copies of maintenance manuals for each different hardware item; including operation and maintenance instructions, parts listing with sources indicated, recommended parts inventory listing, emergency instructions, and similar information. Include all diagnostic and repair information available to manufactures and installers maintenance personnel. Submit for Owners information at Project closeout as specified in Division 1. Comply with Sections 01600 and 01700.

F. Product Data: Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

1.04 Quality Assurance

A. Supplier Qualifications: A recognized architectural door hardware supplier, with warehousing facilities in the Project's vicinity, that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and

quality to that indicated for this Project and that employs an experienced architectural hardware consultant (AHC) who is available to Owner, Architect, and Contractor, at reasonable times during the course of the Work, for consultation.

B. Provide concealed fasteners for hardware units that are exposed when door is closed except to the extent no standard units of type specified are available with concealed fasteners. Where thru-bolts are used as a means of reinforcing the work, provide sleeves for each thru-bolt or use sex screw fasteners.

C. Fire-Rated Openings: In compliance with NFPA 80. Hardware UL10C/UBC-7-2 (positive pressure) compliant for given type/size opening and degree of label. Provide proper latching hardware, non-flaming door closers, approved-bearing hinges, plus resilient and required intumescent seals. Furnish openings complete.

1. Note: specified seals may exceed selected door manufacturer's requirements. See "Thresholds, Weatherstripping and Seals" for clarification.

2. Exit Doors: Operable from inside with single motion without the use of a key or special knowledge or effort.

1.05 Product Handling

A. Tag each item or package separately with identification related to final hardware schedule, and include basic installation instructions with each item or package.

B. Packaging of door hardware is responsibility of supplier. As hardware supplier from various manufacturers receives material, sort and repackage in containers clearly marked with appropriate hardware set number to match set numbers of approved hardware schedule.

C. Inventory door hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that count is correct.

D. Deliver individually packaged door hardware items promptly to place of installation (shop or Project site).

E. Provide secure lock-up for door hardware delivered to the Project, but not yet installed. Control handling and installation of hardware items that are not immediately replaceable so that completion of the Work will not be delayed by hardware losses both before and after installation.

1.06 Sequencing and Coordination

A. Coordinate with concrete.

B. Reinforce walls.

C. Coordinate finish floor materials and floor-mounted hardware.

D. Conduit and raceways as needed for electrical, electronic and electro-pneumatic hardware items. Fire/life-safety system interfacing. Point-to-point wiring diagrams plus riser diagrams to related trades.

E. Furnish manufacturer templates to door and frame fabricators.

F. Use hardware consultant to check Shop Drawings for doors and entrances to confirm that adequate provisions will be made for proper hardware installation.

1. Confirm that door manufacturers furnish necessary UBC-7-2 compliant seal packages.

1.07 Maintenance

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware. Present special tools and maintenance instructions to Owner at time of testing and demonstration interval.

1.08 Warranties

A. General Warranty: Warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Hardware Manufacturers Warranty: All hardware shall be free of defects and imperfections in manufacture and finish. Hardware shall be guaranteed by the manufacturer to perform all the various functions required for, twelve months from date of Substantial Completion.

C. Provide the following special warranty for the following items:

1. Cylindrical Locksets: 5 years.

2. Electric Locksets:2 years.

3. Door Closers: 10 years.

4. Power Supplies 10 years.

Part 2 Products

2.01 Manufacturers

A. Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of finish hardware are indicated in the "Hardware Schedule" at the end

of this Section. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

2.02 Materials and Fabrication

A. Manufacturer's Name Plate: Do not use manufacturers' products that have manufacturer's name or trade name displayed in a visible location (omit removable nameplates) except in conjunction with required fire-rated labels and as otherwise acceptable to Architect.

B. Base Metals: Produce hardware units of basic metal and forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness, but in no case of lesser (commercially recognized) quality than specified for applicable hardware units by applicable ANSI/BHMA A156 series standards for each type of hardware item and with ANSI/BHMA A156.18 for finish designations indicated. Do not furnish "optional" materials or forming methods for those indicated, except as otherwise specified.

C. Fasteners: Provide hardware manufactured to conform to published templates generally prepared for machine screw installation. Do not provide hardware that has been prepared for self-tapping sheet metal screws, except as specifically indicated.

D. Furnish screws for installation with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of this other work as closely as possible including "prepared for paint" surfaces to receive painted finish.

2.03 Hinges

A. Hinges shall be certified to exceed two million, five hundred thousand full load-operating cycles by a recognized independent testing laboratory. Templates: Except for hinges to be installed entirely (both leaves) into wood doors and frames provide only template-produced units.

1. Hinges shall be 5-knuckle, concealed vertical and lateral thrust bearings.

B. Screws: Provide Phillips flat-head screws complying with the following requirements:

1. For metal doors and frames install machine screws into drilled and tapped holes.

2. For wood doors and frames install wood screws.

3. For fire-rated wood doors install #12 x 1-1/4-inch, threaded-to-the-head steel wood screws.

4. Finish screw heads to match surface of hinges or pivots.

C. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:

1. Out-Swing Doors with Locks: Nonremovable pins (NRP).

2. Interior Doors: Nonrising pins.

3. Tips: Hospital, finished to match leaves.

4. Number of Hinges: Provide number of hinges indicated but not less than 3 hinges for door leaf for doors 90 inches or less in height and one additional hinge for each 30 inches of additional height. Unless otherwise specified, hinge size for doors through 3'-0" shall be 4-1/2 inches x 4-1/2 inches.

5. Hinges for doors over 3'-0" wide shall be ball bearing, 5 inches x 4-1/2 inches.

6. Fire-Rated Doors: Not less than 3 hinges per door leaf for doors 86 inches or less in height with same rule for additional hinges.

7. Patient Room doors to have swing clear hinges.

D. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the Work include:

1. McKinney Hinge: TA2314

2. Bommer Hinge BB5001

3. Hager Hinge: BB1199

2.04 Keying Systems

A. Keying Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." In addition to Owner, Contractor and Architect, conference participants shall also include Owners security consultant. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:

1. Existing Grand Master key system.

2. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.

3. Preliminary key system schematic diagram.

4. Requirements for key control system.

5. Address for delivery of keys.

B. All cylinders shall comply with the requirements of ANSI/BHMA Grade 1 and shall be have a minimum of 6 pins. All cylinders shall be of the same manufacturer as the lock sets. Keying shall be performed by lock manufacturer, factory direct distributor or Owners authorized keying service, where permanent records are maintained.

C. Provide solid cylinder rings for all mortise and rim cylinders.

D. Provide temporary construction cylinders keyed alike for the 4 exterior locksets during construction period. Temporary cylinders and keys remain property of hardware supplier. Plastic construction core are not permitted.

1. General Contractor shall remove temporary construction cores and install permanent cores into locksets and cylinders. Return temporary construction cylinders to hardware supplier.

E. Keys and Key Blanks: Furnish keys of nickel silver to maintain assurance of keying system and accuracy in keys and long cylinder wear. Key blanks shall be available only from factory-direct sources, not available from after-market key blank manufacturers. All keys shall be "embossed "Do Not Duplicate".

1. For estimate, use factory GMK charges.

2. Visual stamped key control on keys, indelible marking on cylinder bodies. Architect and Owner shall approve stampings and markings prior to ordering of locksets and cylinders; furnish Owner's written approval of the system.

F. Do not package permanent keys with locks. Package key separately from locksets and cylinders. Deliver all keys, key blanks and other security keys direct to Owner from lock manufacturer by secure courier, return receipt requested.

G. Failure to properly comply with these requirements may be cause to require replacement of all or any part of the keying system, cylinders and keys involved as deemed necessary at no additional cost to the Owner.

H. Key Quantity: Furnish keys in the following quantities:

1. 8 each Temporary construction keys to General Contractor.

2. 3 each Grand Master keys for each grand master used, to Owner.

3. 5 each Master Keys for each master used, to Owner.

4. 2 each Change keys per cylinder to Owner.

5. 10 each Key blanks each type used to Owner.

I. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the Work include:

1. Yale Keyway to be determined

2. Sargent Keyway to be determined

2.05 Locksets and Latchsets

A. Locksets and latchsets case shall be constructed of 12 gauge (minimum) wrought steel, zinc dichromate plated to protect against corrosion. Lock cases shall be closed on all sides and back. Locks shall have field adjustable, beveled, with an 11 gauge armored front. Locks shall have a 3/4 " inch throw anti-friction stainless steel latch. Deadbolts, where specified, shall be full one inch throw made of one piece hardened stainless steel.

B. Locksets shall be field reversible, without opening the lock body. Locksets shall have through bolted sectional lever trims, and shall have no exposed mounting screws.

C. Locksets shall have cold forged stainless steel knobs. Knob to be 2-1/4" diameter minimum. Knobs shall operate independently. Outside knob on the keyed locksets shall be removable only when the designated key is in the cylinder.

D. Escutcheon: provide heavy stainless steel forging 8 inch high x 2-1/2 inch wide.

E. Locksets shall have the capability of accepting 6 or 7-pin standard mortise cylinder.

F. Provide standard strike for each latch or lock bolt, with curved lip extended to protect frame. Comply with UL requirements for throw of bolts and latch bolts on rated fire openings.

G. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include:

1. Yale: 8800 series LFE knob/escutcheon.

2. Sargent 7800 series N knob, KE1 excutcheon.

2.06 Closers

A. Where manual closers are indicated for doors required to be accessible to the physically challenged, provide adjustable units complying with ANSI A117.1 provisions for door opening force and delayed action closing. Except as specifically indicated, comply with manufacturer's recommendations for size of door control units, depending upon size of door, exposure to weather, and anticipated frequency of use.

B. Closers shall be cast aluminum or iron construction with forged lever arms, independent adjusting valves for closing, latching and back check. Hydraulic regulation controlled by tamper-proof, non-critical screw valves. All closer adjustments shall be shielded by full sized plastic cover plate after installation.

C. Furnish drop brackets and spacers where required for aluminum, metal and wood doors. Opening pressure: Exterior doors 8.5 lb., interior doors 5 lb., labeled fire doors 15 lb. Furnish closers with non-flaming fluid that meets UL10C.

D. Install closers to allow maximum degree of opening, position back check to activate well in advance of the stop position to cushion the opening swing and prevent door and frame damage. Do not use door closer to stop door travel. Unless specified, install closers with through bolt mounting method on metal and wood doors. Install door closers on room side, away from public view, unless otherwise noted.

E. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include:

1. Norton 7500 series
2. LCN 4040 series.
3. Yale 4000 series.
4. Sargent 351 series.

2.07 Protective Plates

A. Provide manufacturers standard exposed, counter sunk (CS) holes with fasteners for door trim units, Kick plates, edge trim, push/pull plates and similar units; either machine screws of self-tapping screws. Edges shall be beveled on 3 sides (B3E).

B. Fabricate protection plates, armor, kick or mop, not more than 2 inches less than door width on stop side and not more than 1 inch less than door width on pull side, and 1 inch less than the door width on double doors, by the height indicated. Size plates to provide clearance for bottom rail, grills, louvers and door lites.

1. Protective plates shall be nominal 10 inches in height.
2. Fire rated openings; plates not to exceed 16-inch high.
3. Metal Plates: Stainless steel plates 0.050, US 18 Ga.

C. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the Work include:

1. Trimco: KOO50, 18 gage, (0.050 inches), B4E, CS.
2. Rockwood: K1050, 18 gage, (0.050 inches), B4E, CS.
3. Hager: 193, 18 gage, (0.050 inches), B4E, CS.
4. McKinney: MCK-K1050, 18 gage, (0.050 inches), B4E, CS.

2.08 Door Stops

A. Furnish heavy duty wrought stainless steel base material, concave or convex wall stops, coincide with lock function, wherever door strikes wall unless otherwise noted in hardware sets, provide wall type with appropriate fasteners. If not listed in hardware set, but existing opening does not have a door stop, then provide the appropriate wall or floor stop.

1. Where wall stop type cannot be used, provide floor type. If neither can be used, provide overhead type.

2. Floor Stops: Place at maximum swing and out of traffic flow to avoid trip hazards.

B. Provide gray resilient rubber bumpers.

C. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the Work include:

1. Trimco: 1270W

2. Rockwood: 408/411

3. Hager: 234W

4. McKinney: MCK408/411

2.09 Flushbolts and Coordinators

A. Automatic flush bolts shall be certified to exceed one hundred thousand full load-operating cycles by a recognized independent testing laboratory. Coordinators shall be certified to exceed one hundred thousand full load-operating cycles by a recognized independent testing laboratory.

B. Provide units UL listed up to 1-1/2 hours for use on wood or metal doors and 3 hours on metal fire rated doors. Furnish in investment cast steel, brass, bronze or stainless steel base material. Wrought materials will not be permitted.

C. Units shall be non-handed, and feature adjustable rods to accommodate door and frame variations. Automatic flush bolts shall latch the inactive leaf of pair of doors, when the active door is closed. When the active door is opened, bolts will automatically retract, releasing the inactive door.

D. Provide spring loaded type dust proof strikes where manual or automatic operated flush bolts are applied. Provide units for applications in floor or threshold conditions.

E. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the Work include:

1. Trimco: 3917.

2. Ives: FB458.

3. Rockwood: 555.

4. McKinney: MCK555.

2.10 Hardware Finishes

A. Match items to the manufacturer's standard color and texture finish for the latch and locksets (or push-pull units if no latch or locksets).

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.

C. The designations used in schedules and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18, "Materials and Finishes," including coordination with the traditional U.S. finishes shown by certain manufacturers for their products.

D. The designations used in schedules and elsewhere to indicate hardware finishes are the industry-recognized standard commercial finishes, except as otherwise noted.

1. Brushed Stainless Steel, no coating: US32D/ANSI 630 at cylinders, hinges, locksets, latchsets, latches, protective plates, door pulls, overhead stops and wall stops unless otherwise noted.

2. Powder Coated Aluminum finish: ANSI 689, for door closers, unless otherwise noted.

3. Anodized aluminum finish: US28/ANSI 628, for weatherseal.

4. Mill aluminum finish: US28/ANSI 628, for thresholds.

Part 3 Execution

3.01 Examination

A. Examine substrates to which hardware assemblies attach to hollow metal frames, doors and walls, with installer present, for compliance with requirements for installation tolerances, blocking and other conditions affecting performance of assemblies specified in this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 Installation

A. Builder's Hardware Installation:

1. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation or application of surface protection with finishing work specified in the Division 9 Sections. Do not install surface-mounted items until finishes have been completed on the substrates involved.

B. Mount hardware units at heights indicated in following applicable publications, except as specifically indicated or required to comply with governing regulations and except as otherwise directed by Architect.

1. Mount exit devices at manufacturers recommended height.

2. "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute.

3. Americans with Disabilities Act, (ADA), of 1990 Guidelines.

C. Set units level, plumb, and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

D. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

1. Patch and fill wood frames and doors with solid wood stock or dowel material before cutting for new hardware. Do not reuse existing screw holes fill and re-pilot.

2. Metal doors/frames: Weld or fasten with screws: filler pieces in existing hardware cutouts and mortises not scheduled for re-use by new hardware. Leave surfaces smooth - - no applied patches.

3. Gaskets: install jamb-applied gaskets before closers, overhead stops, rim strikes, etc. Install sweeps across bottoms of doors before astragals, cope sweeps around bottom pivots, trim astragals to tops of sweeps. Install astragals for storage room doors on inside/non key side (inactive leaf) and lock protector on key side.

4. When hardware is to be attached to existing metal surface and insufficient reinforcement exists, use RivNuts, NutSerts or similar anchoring device for screws.

E. Drill pilot holes for fasteners in wood doors and/or frames.

3.03 Adjusting, Cleaning and Demonstrating

A. Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units that can not be adjusted to operate freely and smoothly or as intended for the application made.

1. Where door hardware is installed more than one month prior to acceptance or occupancy of a space or area, return to the installation during the week prior to acceptance or occupancy and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

B. Clean adjacent surfaces soiled by hardware installation.

C. Manufacturers representatives shall Instruct Owner's personnel in the proper adjustment and maintenance of door hardware and hardware finishes.

D. Six-Month Adjustment: Installer will visit Project to accomplish following:

1. Re-adjust hardware.

2. Evaluate maintenance procedures and recommend changes or additions, and instruct Owner's personnel.

3. Identify items that have deteriorated or failed.

4. Hardware installer shall submit written report to the Architect identifying problems and possible future problems.

3.04 General

Provide hardware for each door to comply with requirements of Section "Door Groups," hardware set numbers indicated in door schedule, and in the following schedule of hardware sets.

A. Manufacturer abbreviations:

1. MC – McKinney

2. NO – Norton

3. RX – Rixson

4. RO – Rockwood

5. SN - Securitron

6. YA – Yale

B. Abbreviations used in hardware schedule:

1. DH – door height
2. DW – door width
3. H+J – head and jamb
4. OW – opening width
5. NRP – Non rising pin.

C. Hardware sets:

Set #1 - Exterior pair exterior function x manual flush bolts

6	Hinges	TA2314 4 1/2 X 4 1/2 NRP	32D	MC
2	Flush Bolts	555	US26D	RO
1	Lockset (exterior)	LFE 8847	630	YA
1	Closer (PA w/stp+hld) RHR	CPS-7500-T SRI	689	NO
1	Overhead Holder LHR	9 series hold open version	630	RX
1	Dust Proof Strike	570	US26D	RO
1	Astragal Overlap	357 SS TEK (DH)	PE	
1	Astragal seal	S88 D (DH)	PE	
1	Weatherstrip	45041CNB TEK (H+J)	PE	
2	Door Bottom	345ANB TEK (DW)	PE	
1	Threshold 1/2"	171 A FHSL25 (OW)	PE	

Set #2 - Exterior single passage

3	Hinges	TA2314 4 1/2 X 4 1/2	32D	MC
1	Latchset (passage)	LFE 8801	630	YA
1	Closer (PA w/stop)	CPS-7500 SRI	689	NO
1	Weatherstrip	45041CNB TEK (H+J)	PE	
1	Door Bottom	345ANB TEK (DW)	PE	
1	Threshold	177 AT FHSL25 (OW)	PE	

Set #3 - Exterior single storage

3	Hinges	TA2314 4 1/2 X 4 1/2 NRP	32D	MC
1	Lockset (storage)	LFE 8805	630	YA
1	Closer (PA w/stop)	CPS-7500 SRI	689	NO
1	Latch Protector	321	US32D	RO
1	Weatherstrip	45041CNB TEK (H+J)	PE	
1	Door Bottom	345ANB TEK (DW)	PE	
1	Threshold	177 AT FHSL25 (OW)	PE	

Set #4 - Int UL single passage

3	Hinges	TA2314 4 1/2 X 4 1/2	32D	MC
1	Latchset (passage)	LFE 8801	630	YA
1	Closer (PA)	PR7500 SRI	689	NO
1	Wall Stop (convex)	408	US32D	RO
1	Smoke Seal	S88 D (H+J)	PE	

Set #5 - Int UL single electric storage inswing

2	Hinges	TA2314 4 1/2 X 4 1/2	32D	MC
1	Electric Hinge	TA2314 4 1/2 X 4 1/2 QC6	32D	MC
1	Lockset (stor., elec.)	LFE 8891 24VDC	630	YA
1	Closer (pull side)	7500 SRI	689	NO
1	Wall Stop (convex)	408	US32D	RO
1	Smoke Seal	S88 D (H+J)		PE
1	Power Supply	BPS-24-1		SN
1	Card Reader	by others/electrical		

Set #6 - Int UL single electric storage outswing

2	Hinges	TA2314 4 1/2 X 4 1/2	32D	MC
1	Electric Hinge	TA2314 4 1/2 X 4 1/2 QC6	32D	MC
1	Lockset (stor., elec.)	LFE 8891 24VDC	630	YA
1	Closer (PA w/stop)	CPS-7500 SRI	689	NO
1	Closer (PA w/stop)	CPS-7500 SRI	689	NO
1	Wall Stop (convex)	408	US32D	RO
1	Smoke Seal	S88 D (H+J)		PE
1	Power Supply	BPS-24-1		SN
1	Card Reader	by others/electrical		

Set #7 - Int pair passage x manual flush bolts

6	Hinges	TA2314 4 1/2 X 4 1/2	32D	MC
2	Flush Bolts	555	US26D	RO
1	Dust Proof Strike	570	US26D	RO
1	Latchset (passage)	LFE 8801	630	YA
1	Closer (PA w/stp+hld)	CPS-7500-T SRI	689	NO
1	Overhead Holder	10 series hold open version	630	RX
2	Door Silencers	608	GREY	RO

NOTE: 110A RHRA, 112A LHRA.

Set #8 - Int single passage

3	Hinges	TA2314 4 1/2 X 4 1/2	32D	MC
1	Latchset (passage)	LFE 8801	630	YA
1	Wall Stop (convex)	408	US32D	RO
3	Door Silencers	608	GREY	RO

Set #9 - Int single privacy

3	Hinges	TA2314 4 1/2 X 4 1/2	32D	MC
1	Latchset (privacy)	LFE 8802	630	YA
1	Wall Stop (concave)	411	US32D	RO
3	Door Silencers	608	GREY	RO

Set #10 - Cased opening

1 No hardware required

END SECTION

Part 1 General

1.01 Scope

A. Self supporting aluminum framed vertical glazing system.

B. Sandwich panels of translucent skins separated with an aluminum grid.

C. Integral air barrier and vapor retarder.

D. Perimeter sealant.

1.02 Performance Requirements

A. System Design: Design and size components to withstand dead loads and live loads caused by snow, hail, and positive and negative wind loads acting on plane of panel without damage or permanent set.

1. Design Loads: Calculate in accordance with applicable code.

2. Design Wind Load: 15 lb/sq ft positive and negative.

3. Measure performance in accordance with ASTM E 330, using test load of 1.5 times the design wind pressure and 10 second duration of maximum load.

B. Seismic Loads: Design and size components to withstand seismic loads and sway displacement as calculated in accordance with applicable code.

C. Deflection: Limit mullion deflection to 3/4 inch with full recovery of glazing materials.

D. Light Transmission: See drawings for percent.

E. Thermal Resistance of Panel System (Excluding Vision Areas). R of value shown on the drawings.

F. Sound Attenuation Through Wall System (Exterior to Interior): STC of 50, minimum, calculated in accordance with ASTM E 413, tested in accordance with ASTM E 90.

G. Vapor Seal: No vapor seal failure at interior static pressure of 1 inch, 72 degrees F, and 40 percent relative humidity.

H. Water Leakage: None, when measured in accordance with ASTM E 331 at a test pressure difference of 2.86 lbf/sq. ft.

I. Expansion / Contraction: System to provide for expansion and contraction within system components caused by a cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components.

J. System Internal Drainage: Drain water entering joints, condensation occurring in framing system, or migrating moisture occurring within system, to the exterior by a weep drainage network.

K. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside face of glazing panel and heel bead of glazing compound.

L. Not Permitted: Vibration harmonics, wind whistles, noises caused by thermal movement, thermal movement transmitted to other building elements, loosening, weakening, or fracturing of attachments or components of system.

1.03 Submittals

A. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, panel configuration, internal drainage details.

B. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, anticipated deflection under load, affected related Work, weep drainage network, expansion and contraction joint location and details, and field welding required.

C. Samples: Submit two samples, 24 x 24 inch in size, illustrating prefinished aluminum surface, specified panel with skins, glazing materials illustrating edge and corner.

D. Installation Data: Special installation requirements.

1.04 Quality Assurance

A. Perform work in accordance with AAMA CW-DG-1.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than seven years of documented experience.

C. Installer Qualifications: Company specializing in performing the work of this section with minimum five years of experience.

D. Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in Kentucky.

1.05 Delivery, Storage and Protection

A. Handle work of this section in accordance with AAMA CW-10.

B. Protect prefinished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather. Puncture wrappings at ends for ventilation.

1.06 Environmental Requirements

A. Do not install sealants when ambient temperature is less than 40 degrees F.

B. Maintain this minimum temperature during and after installation of sealants.

Part 2 Products

2.01 Manufacturers

A. Sandwich Panel Manufacturers:

1. Kalwall: www.kalwall.com.

2. Major Industries, Inc: www.majorskylights.com.

3. Skywall Translucent Systems, Division of Butler Manufacturing Company: www.skywall.com.

2.02 Materials

A. Extruded Aluminum: ASTM B 221 (ASTM B 221M).

B. Sheet Aluminum: ASTM B 209 (ASTM B 209M).

C. Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A 653/A 653M, with G90/Z275 coating.

D. Steel Sections: ASTM A 36/A 36M; shaped to suit mullion sections.

E. Fasteners: Stainless steel.

2.03 Components

A. Panels: Bonded to both sides of structural extruded aluminum grid of indicated pattern; exposed surfaces of exterior sheet chemically and permanently treated to protect against surface erosion and extreme weather conditions; exposed surface of interior sheets fire retardant to a flame rating of 75 and smoke rating of250:

B. Support Framing Members: 2 inch wide x 2-3/4" deep profile; of minimum 1/8 inch thick extruded aluminum.

C. Battens, Cover Strips, Cover Plates, and Integral Flashings: Extruded aluminum, to suit location and application; sized to rigidly retain panels in place.

2.04 Sealant Materials

A. Sealant and Backing Materials: As specified in Section 07900 of Types described below.

B. Perimeter Sealant: Type - polysulfide.

2.05 Fabrication

A. Fabricate system components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.

B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.

C. Prepare components to receive anchor devices. Fabricate anchors.

D. Arrange fasteners and attachments to ensure concealment from view.

E. Reinforce framing members for external imposed loads.

2.06 Finishes

A. Finish Coatings: Conform to AAMA 611 and AAMA 2604.

B. Exterior Exposed Aluminum Surfaces:

1. Fluorocarbon coating, 7 mil thick to color as selected.

C. Interior Exposed Aluminum Surfaces:

1. Fluorocarbon coating, 7 mil thick to color as selected.

D. Concealed Steel Items:

1. Galvanized in accordance with requirements of ASTM A 123/A 123M.

E. Apply one coat of bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar materials.

Part 3 Execution

3.01 Examination

A. Verify dimensions, tolerances, and method of attachment with other work.

B. Verify wall openings and adjoining air barrier and vapor retarder materials are ready to receive work of this section.

3.02 Installation

A. Install translucent panel system in accordance with manufacturer instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances and align with adjacent work.

E. Install sill flashings.

F. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

G. Install perimeter sealant, backing materials, and installation criteria in accordance with Section 07900.

3.03 Cleaning

A. Remove protective material from prefinished aluminum surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

C. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.

3.04 Protection of Finished Work

A. Protect finished Work from damage.

END OF SECTION

Part 1 General

1.01 Scope

The work under this Section consists of furnishing all labor, materials, equipment and services necessary for the complete and satisfactory installation of all suspended acoustical ceilings and ceiling suspension systems as called for on the Drawings and/or these Specifications.

1.02 Submittals

A. Submit shop drawings in accordance with the requirements of Section 01340 of these Specifications. The shop drawings shall include the ceiling grid layout for each room, insert and hanger spacing and fastening details, splicing and joint details for main and cross runners and details where electrical or mechanical fixtures penetrate the ceiling.

B. The Contractor shall submit three full-size panels of each type of ceiling required and one 12-inch length of each type of suspension system member, moulding and hanger to the Engineer for review. No materials shall be delivered to the job site prior to the Engineer's review and acceptance of the samples.

C. The Contractor shall submit the following manufacturer's literature to the Engineer prior to beginning installation activities:

1. Two copies of the manufacturer's recommendations for the proper installation of the suspension system.

2. Six copies of the ceiling manufacturer's instructions for the proper maintenance of the installed work. Include the name of the manufacturer, the material brand name, color and texture designations (if any), and precautions for the use of cleaning materials or methods.

1.03 Storage and Protection

A. Deliver materials in original, unopened, protective packaging, with legible, intact manufacturer's labels indicating brand name, pattern, size, thickness and fire rating as applicable.

B. Store materials in original protective packaging to prevent soiling, physical damage or wetting.

C. Store cartons open at each end to stabilize moisture content and temperature in accordance with manufacturer's instructions.

D. Do not begin installation until sufficient materials to complete a room are received.

1.04 Job Conditions

A. Complete installation of dampening materials before beginning work.

B. Maintain humidity of 65 to 75 percent in area where acoustical materials are to be installed, 24 hours before, during and after installation.

C. Maintain a uniform room temperature in the range of 55 degrees F (12 degrees C) to 70 degrees F (21 degrees C) prior to and during installation of materials.

1.05 Extra Stock

Upon completion of installation, the Contractor shall provide the Owner with an extra stock of each type of ceiling material utilized in the work covered by this item. Such extra stock shall be not less than one percent of the area installed or one full, unopened carton, whichever is greater.

1.06 Quality Assurance

A. The Contractor shall provide the Engineer with the following certifications prior to beginning installation work:

1. Manufacturer's certification that all materials furnished under this Section meet or exceed all requirements of these Specifications. Each certificate shall be signed by an officer of the manufacturer and shall contain the project name, description of material and quantities supplied.

2. Certification from the manufacturer or the manufacturer's authorized representative indicating that the installing contractor has adequate knowledge and experience to successfully and satisfactorily install the manufacturer's products.

Part 2 Products

2.01 Suspension System

A. The ceiling suspension system shall be an exposed grid type with an intermediate-duty structural classification when tested in accordance with ASTM Test Method C 635. All components of the suspension system shall be from a single manufacturer and shall conform with the following requirements:

1. Main and cross members shall be of bulb section, double-thickness web design, fabricated from minimum 0.015-inch cold rolled steel conforming to ASTM A 366. Main and cross beam members shall have a web height of 1-1/2-inches and a bottom flange width of 15/16-inch. Standard cross tees shall have a 1-1/4-inch web height. Exposed bottom flange shall be furnished with a continuous rolled steel cap the length of the member. Main beam shall be

routed on 6-inch centers to locate intersecting cross members. Cross beam members, 48-inches in length, shall be routed at the center and at 12-inches on each side of center. Ends of cross members shall have locking tabs for attachment to adjoining cross member through the web of the main beam.

2. Edge mouldings shall be either channel or angle-shaped, fabricated from minimum 25 gauge, cold rolled steel and finished identical to the main and cross members. The width of the exposed flange shall not be less than 15/16-inch.

3. Hold-down clips, as supplied by the suspension system manufacturer, shall be utilized throughout the suspended ceiling installation. Accessible-type clips shall be used in interior locations to allow ready access to the plenum area above the ceilings. Special heavy-duty, hold-down mechanisms or systems suitable to the Engineer shall be utilized to resist wind uplift in exterior locations.

4. Hanger wire shall be minimum 12 gauge, galvanized, soft-annealed, mild steel wire.

5. All steel roll formed parts, including cap for exposed flange, shall be chemically cleansed, electro-galvanized and phosphate treated to resist corrosion and form a chemical affinity for paint. All surfaces, except natural aluminum, shall then receive a baked-on, low-sheen, satin white enamel finish. Steel stamped parts shall be chemically cleansed, electro-galvanized and treated with a chromate conversion coating.

2.02 Standard Ceiling Units

A. Construction: Standard ceiling units shall be mineral fiber ceiling panels (nominally 24 x 48 x 5/8-inch) constructed in accordance with Federal Specification SS-S-118A, Type III, Class 25. Panels shall have a natural fissured pattern of non-directional, random-sized fissures combined with small perforations. Panels shall have square reveal-type, rabbeted edges. Surfaces shall be washable and suitable for painting.

B. Performance Standards

1. Sound Transmission Coefficient (ASTM E 90): 44 maximum.

2. Noise Reduction Coefficient (ASTM C 423): 0.55 minimum.

3. Light Reflectance (ASTM C 523): 0.75 minimum FS SS-S-118A): LR-1.

Part 3 Execution

3.01 Installation

A. All acoustical materials and suspension systems shall be installed in strict accordance with manufacturer's shop drawings and recommendations and the Ceiling and Interior Systems Contractors Association handbook for acoustical ceiling systems.

B. Installation of products in this Section shall occur after all components in the ceiling plenum are installed. The building shall be in proper condition to receive the acoustical materials and suspension system before any of the material shall be installed. The acoustical material shall be installed under conditions of normal occupancy. All wet work shall be completed, dry and the building fully enclosed.

C. Furnish and install the acoustical materials and suspension systems as specified above, per the recommendation of ASTM C 636. Deflection of any component must not exceed 1/360 of the span.

D. Grid System Installation

1. Main runners shall be installed on 24-inch center and suspended by galvanized steel wire spaced not more than 48-inches on center along the main runners.

2. Cross tees, nominally 24-inches in length, shall be spaced 48-inches on center along the main runner to form 24 x 48-inch modules.

3. Install wall mouldings at intersection of suspended ceiling and all vertical surfaces.

4. Miter corners where wall mouldings intersect or install corner caps.

3.02 Cleaning

A. Clean soiled or discolored unit surfaces after installation.

B. Touch up scratches, abrasions, voids and other defects in painted surfaces.

C. Damaged or improperly installed units shall be removed and replaced at no cost to the Owner.

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 Kentucky 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.

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	
Portable containers of flammable liquids			
Emergency stop bars			

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 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.

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.

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.

3. Submerged: All surfaces below a water surface or exposed to spray. Surfaces exposed to spray includes all areas within 6-inches of maximum water surface in quiescent tanks and within 18-inches of maximum water surface in mixed or agitated tanks. Building surfaces with this exposure shall only be painted when surfaces above water level have an interior exposure.

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	Walls and Ceilings	134	-	-	-	-
	Filter Interior	334W		344W		
	Equipment*	-	157	144	-	-
	Piping*	-	157	144	-	-
Containment	Walls and Floors* * *	235		245		

* See coating, lining, and/or painting paragraphs in individual piping or equipment Specification Sections and/or on Drawings.

** See Finish Schedule in the Architectural Drawings where each type shall be used.

*** Paint the inside floor and vertical surfaces of containment areas which would be wet if the containment area were full of liquid. At floors, the final coat shall contain a small amount of aluminum oxide to provide an anti-slip finish, all as directed by the Engineer. Provide samples of anti-slip finish as directed by the Engineer. See Finish Schedule in Architectural Drawings for variations of this requirement.

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

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: 157
Type: Polyurethane
Use: Galvanized Metals

Surface Preparation: SP-1 With Manufacturer's Recommended Pre-Treatment

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: 235
Type: Vinyl Ester
Use: Concrete

Surface Preparation: SP-10

Coat	Minimum Dry Film Thickness (Mils)	Tnemec	Sauereisen	Carboline		Sherwin Williams
1st	12.0 – 18.0	Series120-5002 VinesterPrimer 12.0 – 18.0	Sauereisen No. 550 VE Prime 4-5mils	Armorguard P-14 Primer		Corobond Vinyl Ester Primer 3.5 mils
2nd	12.0 – 18.0	Series 120-5001 Vinester Finish 12.0 18.0	Sauereisen No. 472 VE Fiberline 21 mils	Armorguard Epoxy		Magnalux304 FF Flake Filled Vinyl Ester 14-16 mils
3rd		N/A	N/A	Armorguard Epoxy		Magnalux 304 FF Flaked Filled Vinyl Ester 14-6mils
System	24.0	24.0	25.0	40.0		30mils

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: 334W
Type: Epoxy
Use: Submerged Concrete-Potable Water

Surface Preparation: CC-1
All coatings provided under this system shall be NSF 61 approved

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: 344W
Type: Epoxy
Use: Submerged Ferrous Metal-Potable Water

Surface Preparation: SP-10
All coatings provided under this system shall be NSF 61 approved

Coat	Minimum Dry Film Thickness (Mils)	Carboline	Tnemec	Induron	Ameron	Sherwin Williams
1st	3.0	Carboguard 561/561 LT Red	Series 20-1211 Pota-Pox Red	PE-54 Epoxy	Amercoat 370	Macropoxy 646 NSF Epoxy
2nd	4.0 - 6.0	Carboguard 561/561 LT Beige	Series 20-1255 Pota-Pox Beige	PE-54 Epoxy	Amercoat 370	Macropoxy 646 NSF Epoxy
3rd	4.0 – 6.0	Carboguard 561/561 LT White	Series 20–WH02 Pota-Pox Tank White	PE-54 Epoxy	Amercoat 370	Macropoxy 646 NSF Epoxy
System	12.0					

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 potable water not otherwise specified above shall be painted med. Blue and stenciled as directed by the Engineer.

7. All electrical conduits and junction boxes not otherwise specified above shall be painted orange and stenciled as directed by the Engineer.

8. All natural gas lines not otherwise specified above shall be painted red and stenciled as directed by the Engineer.

9. All sewer lines not otherwise specified above shall be painted brown and stenciled as directed by the Engineer.

10. FRP panels, stainless steel panels, valves, tanks and instruments shall not be painted.

11. All hydrofluosilic acid lines shall be painted light blue with red bands and stenciled as directed by the Engineer.

12. All ferric sulfate lines shall be painted orange with black bands and stenciled as directed by the Engineer.

13. All corrosion inhibitor (K-5) lines shall be painted light green with red bands and stenciled as directed by the Engineer.

14. All caustic lines shall be painted yellow with green bands and stenciled as directed by the Engineer.

15. All PACL lines shall be painted orange with green bands and stenciled as directed by the Engineer.

16. All sodium hypochlorite lines shall be painted yellow with red bands and stenciled as directed by the Engineer.

17. All copper and/or copper sulfate lines shall be painted black with blue bands and stenciled as directed by the Engineer.

18. All chemical piping shall be painted, chemicals missing shall be painted yellow and stenciled as directed by the Engineer.

19. All lettering shall be done in capital letters of approved size and type.

20. Legend symbols shall be applied on piping on every run and spaced not greater than 8 feet apart.

21. 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.

22. Pumps 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 all materials, labor and equipment required to furnish and install all entrance sign letters, room name plates, plaque and accessories as specified herein and/or shown on the Drawings.

1.02 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 a sample of the sign colors to the Engineer for review.

1.03 Storage and Protection

Signs shall be stored and protected in accordance with the requirements of Section 01611 of these Specifications.

Part 2 Products

2.01 Interior Signs

A. Description: Interior signs shall be plastic in plastic frames with grade 2 dome-shaped Braille of styles listed below as Manufactured by Seton Identification Products or approved equivalent.

B. Sign Styles: Provide one frame – Style M9344 and one sign on the doors to the following locations of the following styles:

1. Unisex Non-Handicap Toilet – similar to Style M1582

C. Size and Color: Sign shall be 8" x 8" and colors shall be selected by the Engineer.

2.02 Building Signs

A. Description: Building signs shall be constructed of 60-mil plastic, have rounded corners, have four corner mounting holes, be printed, and then be coated with "Tedlar". Colors shall not fade and sign shall not degrade due to exposure to sunlight and other environmental conditions. Signs shall be Style M7768 as manufactured by Seton Identification Products or approved equivalent.

B. Text: Text shall be as described on the Drawings and, unless noted otherwise, shall be a single line composed of 4-inch high letters.

C. Size & Color: Sign shall be 1 ½ " larger than the text on all four sides and colors shall be selected by the Engineer.

Part 3 Execution

3.01 Installation

A. Interior Signs - Install centerline of sign in the middle of the door at 60-inches above finish floor with stainless steel screws.

B. Building Signs – Signs shall be securely anchored to buildings with stainless steel fasteners at locations as directed by the Engineer.

3.02 Cleaning

A. Scratched, marred or abrated surfaces shall be touched up to match original.

B. Finished surfaces shall be cleaned to remove markings and fingerprints.

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. Kentucky Building Code

B. International 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.

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 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. Identifying signs shall be located at each extinguisher.

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

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

1.02 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 detailed accessory list and manufacturer's product literature to Engineer for approval.

C. Submit complete operation and maintenance data on the accessories in accordance with the requirements of Section 01730 of these Specifications.

1.03 Storage and Protection

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 the Engineer with written certification that all products furnished comply with all applicable provisions of these Specifications.

Part 2 Products

2.01 Acceptable Manufacturers

Toilet room accessories shall be manufactured by Bradley Corporation, Bobrick Washroom Equipment, Inc. or Pocono Metal Products Company, Inc. Model numbers listed in Article 2.02 of this Section are used to establish standards of quality and products of equal manufacture are acceptable.

2.02 Accessory Schedule

A. Room

1. Over Each Lavatory: One Bobrick Model No. B-292-1836 stainless steel framed mirror and shelf, with galvanized back plate secured with concealed theft-proof hangers.

2. At Each Water Closet: One Bobrick Model B-274 multi-roll tissue holder.

Part 3 Execution

3.01 Installation

Install toilet room accessories in strict accordance with manufacturer's recommendations.

3.02 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. Extent of loading dock equipment is indicated on the Drawings.

B. Types of loading dock equipment include laminated tread bumpers and hydraulic dock levelers.

C. Concrete work for dock levelers is specified in Division 3.

D. Curb angles at edge of loading dock and around edge of dock leveler pit are specified in Division 5.

E. Electrical wiring and connections for loading dock equipment are specified in Division 16.

1.02 Submittals

A. Submit shop drawings in accordance with the requirements of Section 01340 of these Specifications.

B. Operation and maintenance manuals shall be furnished in accordance with the requirements of Section 01730 of these Specifications.

1.03 Storage and Protection

All loading dock equipment shall be stored and protected in accordance with the requirements of Section 01611 of these Specifications.

1.04 Quality Assurance

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

B. Hydraulic Dock Lift Standards: Comply with applicable requirements of CS 202 for construction and operation of hydraulic dock lifts (scissor lifts) except as otherwise indicated.

Part 2 Products

2.01 Acceptable Manufacturers

A. Bumpers: Subject to compliance with requirements, bumpers shall be manufactured by Blue Giant Equipment Corporation, Chafant Sewing Fabricators, Inc., Durable Mat Company, Equipment Company of America, Kelly Company, Inc., Pawling Corporation, Pioneer Manufacturing, Inc., Serco Engineering Corporation, or Steel-Flexx Corporation.

B. Dock Levelers: Provide dock levelers as complete units produced by a single manufacturer, including necessary accessories, fittings and anchorages. Dock levelers shall be manufactured by Rite-Hite Corporation, DLM Dock Leveler Manufacturing, Flexion, Inc., Kelly Company, Inc., Pioneer Manufacturing Company, Blue Giant Equipment Corporation, or Serco Engineering Corporation.

2.02 Dock Bumpers

A. Laminated Tread Bumpers: Provide laminated tread dock bumper units of size indicated, fabricated from multiple plies cut from fabric-reinforced rubber truck tires to a uniform thickness of 6-inches. Laminate piles under pressure on 3/4-inch diameter steel supporting rods, which are welded and bolted to 1/4-inch thick structural steel angle closures with pre-drilled anchor holes. Size angles to provide not less than 1-inch of tread piles extending beyond the face of the closure angles. Face dimensions of dock bumper shall be 10 x 36-inches.

B. Anchorage Devices: Provide anchor bolts, nuts, washers, bolts, sleeves, cast-in-place and other anchorage devices as required to fasten bumpers securely in place and to suit installation type indicated. Furnish anchorage components that are galvanized or cadmium plated unless otherwise indicated.

2.03 Dock Levelers

A. General: Provide the manufacturer's standard dock leveler of the type, function, operation, capacity, size and construction indicated, complete with required controls, safety devices and accessories.

B. Type: Provide edge of dock, hinged-lip dock levelers at the location indicated. Provide leveler width of 84 inches

C. Function: Provide dock leveler units which compensate in the following manner for differences in height between the truck bed and the loading platform.

1. Vertical Travel: Provide a minimum working range of 5-inches above and below the adjoining platform level for dock leveler ramps. Provide an operating range above the platform level of sufficient height to enable the lip to extend and clear the truck bed before contact.

2. Automatic Vertical Compensation: The floating travel of the ramp, with lip extended and resting on the truck bed, shall compensate automatically for upward or downward movement of the truck bed during loading and unloading.

3. Automatic Lateral Compensation: Tilting of the ramp with lip extended and resting on the truck bed shall compensate automatically for canted truck beds of up to 4-inches over the width of the ramp.

4. Lip Operation: Provide the manufacturer's standard mechanism for automatic extension and support of the hinged lip on the ramp edge that will enable the lip

to rest on the truck bed over the dock leveler's working range, yet allow the lip to yield under impact of the incoming truck, with the lip's automatic retraction upon the truck's subsequent departure. Provide extended length of leveler not less than 29-1/2-inches from face of dock and lip extension not less than 13-inches beyond the face of the dock bumpers.

D. Rated Capacity: Provide dock levelers capable of supporting a gross moving load of 40,000 pounds without permanent deflection or distortion, as determined by actual tests in compliance with the requirements of ANSI MH14.1 for rated capacity of fixed dockboards.

E. Construction: Provide the manufacturer's standard dock leveler construction for the type and capacity of units indicated, consisting of a frame made of structural and formed steel shape and a platform, including a hinged lip, fabricated from non-steel plate. Design and fabricate the assembly to withstand deformation during both operating and stored phases of service for the use intended. Include two dock bumpers attached to the frame.

F. Provide a unit that the manufacturer recommends for an exterior installation..

2.04 Control

A. Hydraulic Operating System: Provide manufacturer's standard operating system. Provide electric hydraulic raising and hydraulic lowering of the lip, controlled from a remotely located pushbutton station. Equip the leveler with a packaged unit including a unitized, totally enclosed, non-ventilated electric motor, pump, manifold reservoir and valve assembly of proper size, type and operation for the capacity of the leveler indicated.

B. Electrical Requirements: Coordinate wiring requirements and current characteristics with the building electrical system, see Division 16.

C. Remote Control Station: Provide a single button station of the constant pressure type. Holding the button depressed causes the ramp to raise, releasing the button allows the ramp to lower at a controlled rate. Provide an exterior-rated station with a key to "lock out" the control button.

D. Hydraulic Lip Operation: Provide electric-powered hydraulic raising and hydraulic lowering of the lip.

2.05 Shop Painting

Provide the manufacturer's premium enamel finish system over steel surfaces, which have been cleaned and pretreated, to obtain optimum paint bond. Paint the surfaces in the manufacturer's standard color.

Part 3 Execution

3.01 Installation

A. Coordinate installation of loading dock equipment, indicated to be attached to concrete or masonry and furnish anchoring devices with templates, diagrams and instructions for their installation. Coordinate delivery of anchoring devices to Project site to avoid delaying progress

B. General: Comply with manufacturer's detailed instructions for the installation of loading dock equipment.

C. Dock Bumpers: Attach dock bumpers to the structure in a manner to comply with requirements indicated for spacing, arrangement and position relative to top of platform and anchorage. Attach dock bumpers to preset anchor bolts embedded in concrete or to cast-in-place inserts or treaded studs welded to embedded steel plates or angles. If preset anchor bolts, cast-in-place inserts or threaded studs welded to embedded plates or angles are not provided, attach dock bumpers by drilling and anchoring with expansion anchors and bolts.

D. Dock Levelers: Attach leveler securely to the loading platform construction in accordance with the manufacturer's directions.

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, operating tests will be performed to demonstrate to the Engineer that the loading dock equipment will perform in a satisfactory manner. The Contractor shall make, at Contractor's expense, all necessary modifications, changes and/or adjustments required to ensure satisfactory operation.

3.04 Cleaning

A. After installation, restore marred, abraded surfaces to the original condition.

B. 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 (MP-HYPO-TP-1, 2; MP-HYPO-MP-1, 2, 3, 4)

A. Work described in this Section includes furnishing all labor, equipment, materials, tools and incidentals required for a complete and operable installation for chemical pumping systems. This includes pumps, gear reducers, motors, pulsation dampeners, leak detectors, control panels/drives, and other such accessories specified under this Section. Equipment specified herein that is not supplied by the pump manufacturer as an integrated package will be rejected. All equipment shall be installed and tested in accordance with these Specifications and the manufacturer's recommendations.

B. Pumping units shall include but not be limited to electric motor, variable speed drive, coupling, and coupling guard where required.

C. AC variable frequency drives and controls as specified in Section 16489 where shown I Table 1. AC drives shall be sensorless Vector type drives and motors as specified in Section 16489.

D. Submit shop drawings on anchorage system for pumps meeting the requirements of the 2002 Kentucky Building Code for Seismic Use Group III and Seismic Design Category "C". Shop drawing shall be stamped and signed by a professional engineer registered in the State of Kentucky.

1.02 Design Requirements

A. Operating requirements for pumps shall be as shown in Table 1 of this Section.

B. Pumps shall be horizontal, frame mounted, long coupled, with gear reducer suitable for pumping of liquid shown in Table 1.

C. Pumps shall not require seal water.

D. The pump shall be positive displacement, self-priming, without glands and valves. The pump shall be capable of running dry without detrimental effects or damage. Pump shall be capable of being operated in either direction without flow variation.

E. All materials in contact with medium being pumped shall be in compliance with NSF 61. Any oils used shall be food grade, vegetable-based and be suitable for use in potable water applications.

1.03 Submittals

A. Submit shop drawings in accordance with the requirements of Section 01340 of these Specifications.

B. Shop drawings shall be prepared and assembled by the listed manufacturers. Shop drawings prepared and assembled by manufacturer's sales representatives, fabrication shops or other than the listed manufacturers will not be accepted.

C. Operation and maintenance manuals shall be furnished in accordance with the requirements of Section 01730 of these Specifications.

1.04 Storage and Protection

Pumps shall be stored and protected in accordance with the requirements of Section 01611 of these Specifications.

1.05 Quality Assurance

A. The manufacturer shall assume unit responsibility for all items specified in this Section. Unit responsibility shall require that all items be products of, or warranted by, the manufacturer. The manufacturer shall be responsible for all coordination between components and provide all submittals, installation and start-up assistance and certifications on the equipment as a unit.

B. 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

Pumps shall be manufactured by Watson Marlow Bredel.

2.02 Materials and Construction

A. The pump housing shall be manufactured using the following materials:

1. Housing: Cast iron, ASTM A 48.

2. Housing Cover: Steel.

3. Rotor and Shoe: Cast iron with Type 316 stainless steel shims or shall be a one piece cast iron casting.

4. Hose: See Table 1 for material. Hoses shall have 53-68 Shore A durometer. Hoses shall be manufactured with an inner layer as shown in Table 1. Minimum hose burst pressure shall be 800 psi.

5. Hose lubricant shall be a glycerin based lubricant.

6. Bearings: Anti-friction, grease-lubricated, minimum AFBMA B-10 life 40,000 hours. The bearing frame shall be bolted to the pump frame. The pump bearing shall be independent of the gear motor.

7. Drive Shaft: Alloy steel SAE 1045.

8. Close coupled pumps where the rotor is mounted directly on the gear motor shall not be acceptable.

B. Inlet/Outlet Connections: Suction and discharge nozzles shall be fitted with flanges conforming to ANSI B16.5, Class 150.

C. Drive Assembly: Pumps shall be driven by a motor and flange-mounted speed reducer. Gear rating shall have a minimum of an AGMA Class II rating and a minimum service factor of 1.4. Speed reducers shall be capable of operating in a variable speed application at any speed for indefinite time periods.

D. Internal Bearing Frame:

1. Pump rotor shall be independently supported on its own set of ball bearings such that the bearings are located directly under the rotor's load. Bearings shall be supported by the bearing hub located within the pump housing and shall be sealed via a dynamic seal constructed of Buna-N. Bearings shall be sealed and greased for life.

2. Rotor shall be driven by a through-center shaft which shall be bolted and sealed to the front of the rotor. Shaft shall extend through the bearing hub and shall be splined for hollow shaft connection to the direct coupled gear unit. An undercut shall be machined into the shaft to allow disengagement from the drive which shall allow predictive failure to prevent pump or gearing damage in the event of overtorque or a locked rotor.

3. The internal bearing hub shall be vented through the rear of the pump housing to allow visual detection in the event of a hose lubricant seal failure.

E. Pumps, reducer and motor shall be mounted on a common baseplate.

F. Each pumping unit shall be capable of pulling 95 percent of full vacuum and shall have a metering accuracy of $\pm$1 percent.

G. Provide a high level switch for the lubricant reservoir to indicate high lubricant level and/or broken hose. Normally closed contacts on the high level switch shall open on high level to indicate an alarm condition and the pump shall be stopped.

H. Provide a high discharge pressure switch for each pump: 120 VAC, 10 amp, Form C contacts, 1/2-inch process connection. Provide diaphragm seal with 316 SS lower hosing and diaphragm material. Process connection to diaphragm seal shall be 1/2" NPT. Pressure switch shall be connected to the diaphragm seal and pre-piped to a

4-1/2-inch minimum dial size pressure gauge. Pressure switch to be provided with normally closed contacts that shall open upon high discharge pressure. Open contacts shall create a common alarm condition and the pump will be stopped.

I. Pressure Gauges: Furnish properly ranged pressure gauges to indicate pressure. Gauges shall be furnished with isolation ring type seals. Gauges shall have 4-1/2-inch dial size. Acceptable Manufacturers: Ashcroft, Dwyer, or US Gauge.

2.03 Variable Speed Control Panel (FCP-1240, 1250, 1260, 1270)

A. When variable frequency drives (VFDs) are required for pump control per Table 1, the pump manufacturer shall provide control panel mounted AC variable frequency drives in accordance with Section 16489.

B. Pump Manufacturer shall provide a NEMA 4X 316 SS control panel. Power supplied to the panel shall be as shown in Table 1 All motor starters, variable speed drives, relays, timers, and other control devices required for control and operation of the equipment shall be mounted in the panel. Provide a flange mounted main power disconnecting circuit breaker. All controls shall operate on 120 VAC.

C. Control Panel: Manufacturer shall provide NEMA 4X, control panels, for chemical feed systems in accordance with the requirements of Section 17981, Factory Control Panel.

D. In addition to the requirements of Section 16489, provide devices and controls as required by the following Articles:

E. Panel Surface Mounted Devices: Control panels shall be furnished with the following panel mounted devices (as a minimum requirement). All devices shall be located on the front of the panel unless otherwise indicated.

1. VFD-LOCAL-OFF-REMOTE selector switch for start/stop control.
2. Forward/Off/Reverse selector switch – LOCAL Jog control.
3. Manual SPEED control potentiometer
4. RUN indicating light for each pump
5. Elapsed run time meter for each pump.
6. VFD FAULT indicating light.
7. BROKEN HOSE indicating light.
8. HIGH DISCHARGE PRESSURE indicating light.
9. SPEED indication from the tachometer.

10. VFD programming key pad.

F. Remote System Interface: The panel shall be provided with 120 VAC Form C contacts, rated 10 amps at 120 VAC for remote status. It shall accept 120 VAC dry contacts for remote control. Analog signals for remote use shall be isolated 4-20 mA. The panel shall accept remote 4-20 mA signals for control. The remote System interface shall include the following points:

1. Panel outputs – Discrete

   a. Pump Running.

   b. VFD/LOCAL/OFF/REMOTE switch in REMOTE – Dry Contact

   c. Common trouble alarm – normally closed – dry contact.

   d. Broken Hose – normally closed – dry contact.

   e. High Pressure – normally closed – dry contact.

2. Panel inputs – Discrete

   a. Remote Start/Stop – Dry Contact.

   b. High Lubricant Level switch – Dry Contact.

   c. High Discharge Pressure switch – Dry Contact.

3. Panel outputs – Analog

   a. Pump Remote Speed Indication.

4. Panel inputs - Analog

   a. Pump Remote Speed Setpoint.

G. Provide the following controls with the VFDs.

1. The VFD controls shall stop the pump upon receiving High Lubricant Level from a level switch on the pump (normally closed contacts shall open upon high lubricant level or hose breakage). Additionally, when this switch indicates high lubricant level, the controls shall energize a "Broken Hose" light and shall open dry contacts for remote indication of this alarm condition. "Broken Hose" (High Lubricant Level) indication light shall remain lit and pump shall not restart until a front of panel mounted "RESET" pushbutton is pressed.

2. The VFD controls shall stop the pump upon receiving High Discharge Pressure from a pressure switch on the discharge of the pump (normally closed contacts shall open upon high pressure). Additionally, when this switch indicates high

discharge pressure, the controls shall energize a "High Discharge Pressure" light and open dry contacts for remote indication of this alarm condition. "High Discharge Pressure" indication light shall remain lit and pump shall not restart until a front panel mounted "RESET" pushbutton is pressed. Provide an adjustable time delay relay on the high discharge pressure trip, to allow for momentary high pressure spikes on pump startup.

3. The common fault alarm output dry contacts shall be open if any of the following occur (alarm condition shall be "latched in" and the Common Alarm activated):

   a. Motor Overload / Drive Fault

   b. High Lubricant Level

   c. High Discharge Pressure

4. Inputs for remote "VFD-LOCAL-OFF-REMOTE" and "Forward/Off/Reverse" switches.

   a. When the panel mounted "VFD-LOCAL-OFF-REMOTE" switch is in "Local" position, the "Forward/Off/Reverse" switch shall operate the pump. When the "VFD-LOCAL-OFF-REMOTE" switch is in the "VFD" position, the pump shall be operated as determined by the VFD Programming Keypad (Manual Start or Manual Stop). When the "VFD-LOCAL-OFF-REMOTE" switch is in the "REMOTE" position, the pump shall be operated as determined by the Remote Start/Stop Input to the Control Panel.

   b. The "Forward/Off/Reverse" switch shall be a momentary return-to-center switch. When in "Forward" position, the variable frequency drive shall operate the pump in the forward direction. When in the "Off" position, the pump shall stop. When in the "Reverse" position, the variable frequency drive shall operate the pump in the reverse direction.

2.05 Inlet Suction Accumulators and Discharge Pulsation Dampeners

A. The inlet suction accumulators and discharge pulsation dampeners shall be constructed of the materials shown in Table 1.

B. The minimum volume of the accumulators/dampeners shall be shown in Table 1.

C. Suction accumulators and pulsation dampeners shall be provided with a pressure gauge with an operating range of 0-100 psi.

D. Accumulators/Dampeners shall be manufactured by Blacoh.

E. The dampeners shall be provided with ANSI Class 150 flanges for connection to the piping.

2.06 Calibration Chamber

Where shown on the Drawings, suction piping shall have provisions provided by the Contractor for permanent installation of a removable and transferable calibration chamber. The graduated translucent calibration chamber shall have a capacity as shown in Table 1 and have graduated marks in milliliters. The calibration chamber shall be easily removable.

2.07 Factory Testing

A. The manufacturer shall conduct an inlet vacuum test for each pump prior to shipment. The test will follow the below listed general guidelines. The assembled pump shall be tested running on air with the outlet fitting open to atmosphere.

1. Block the inlet with blind flange with vacuum gauge connected.

2. Run the pump for a minimum of 30 seconds or until the pump reaches or exceeds 28-inches of mercury vacuum.

3. If the pump fails to reach the specified vacuum, replace the hose, re-test and repeat the vacuum test. No pump shall be shipped that does not pass the vacuum test.

B. Provide written documentation prior to shipment stating that all pumps have passed the vacuum test with the vacuum achieved during testing.

2.08 Tools and Spare Parts

A. The manufacturer shall furnish two sets of any special tools required for dismantling the drive and/or required tools for replacement and repair of hoses.

B. The manufacturer shall provide the following spare parts. The parts shall be packaged and sealed for long-term storage.

1. Two, each size and type bearing and seal.

2. Four, each type and size rotor shoe.

3. Sufficient lubricant and oils for two complete pump re-builds.

4. Two hoses for each pump.

2.09 Motors

A. Provide motors shall be as specified in Section 16150 of these Specifications.

B. The motor shall be sized to be non-overloading throughout the entire pump flow/pressure range.

C. Motors shall be sized to provide starting torque at any point on the entire pump flow/pressure range.

2.10 Shop Painting

All surfaces shall be cleaned, shop primed, and painted using the manufacturer's standard coating systems in accordance with the requirements of Section 09900 of these Specifications.

Part 3 Execution

3.01 Installation

The pumps shall be installed in accordance with the manufacturer's recommendations.

3.02 Field Painting

Field painting for items not shop painted shall be in accordance with the requirements of Section 09900 of these Specifications.

3.03 Inspection and Testing

Following installation, operating tests will be performed to demonstrate to the Engineer that the pumps will function in a satisfactory manner. The Contractor shall make, at Contractor's expense, all necessary changes, modifications and/or adjustments required to ensure satisfactory operation.

3.04 Manufacturer's Services

A. Furnish the services of a factory representative for one, eight-hour day 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 for one, eight-hour day who has complete knowledge of proper operation start-up procedure and maintenance requirements to inspect the final installation and supervise a test run of the equipment.

C. Furnish the services of a factory representative for one, eight-hour day who has complete knowledge of the operational and maintenance requirements of the system. The factory representative shall instruct the Owner's personnel in the proper operation of the equipment.

D. The schedule of all services provided shall be in accordance with a schedule approved by the Owner.

TABLE 1
PERISTALTIC HOSE PUMP SCHEDULE

Equipment No.	MP-HYPO-MP-1, 2	MP-HYPO-MP-3, 4	MP-HYPO-TP-1, 2
Rated Capacity Range x	1.25 to 42 gph	0.46 to 25.3 gph	25 gpm
Body Style	Simplex	Simplex	Simplex
Rated Pressure, psig	50	50	50
Minimum Pressure, psig	5	5	5
Capacity per Revolution, gallons	0.022	0.058	.76
Maximum RPM	32	73	33
Horsepower	0.75	0.75	5.0
Voltage	120/1	120/1	120/1
Motor Rating	TENV	TENV	TENV
Service	Sodium Hypochlorite	Sodium Hypochlorite	Sodium Hypochlorite
Maximum Concentration, %	12.5	12.5	12.5
Hose Material	EPDM	EPDM	EPDM
Variable Speed Drive	Yes	Yes	No
Variable Speed Drive Type	AC-VFD (Vector)	AC-VFD (Vector)	-
Inlet Pulsation Accumulator	Yes	Yes	No
Housing Material	Polypropylene	Polypropylene	-
Bladder Material	EPDM	EDPM	-
Air Volume, cubic inches	175	175	-
Discharge Pulsation Dampener	Yes	Yes	No
Housing Material	Polypropylene	Polypropylene	-
Bladder Material	EPDM	EDPM	-
Air Volume, cubic inches	175	175	-
Calibration Column Capacity, ml	2,000	2,000	-

*Pumps shall operate at minimum or maximum flow rate continuously with flow variation no greater than ± 1%.

3.05 Cleaning

Prior to the acceptance of the work of 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 (MP-CORR-MP-1,2; MP-FL-MP-1,2; MP-FILTAID-MP-1,2; MP-ACTPOLY-MP-1,2)

A. Work described in this Section includes furnishing all labor, equipment, materials, tools and incidentals required for a complete and operable installation for chemical pumping systems. This includes pumps, variable-speed gear motor, leak detectors, controls, and other such accessories specified under this Section. Equipment specified herein that is not supplied by the pump manufacturer as an integrated package will be rejected. All equipment shall be installed and tested in accordance with these Specifications and the manufacturer's recommendations.

1.02 Design Requirements

A. Operating requirements for pumps shall be as shown in Table 1-4 of this Section.

B. Pumps shall be positive displacement peristaltic type complete with spring-loaded pumphead, self-contained variable speed drive, and flexible extruded tube as specified.

C. Peristaltic pumping action is created by the compression of the flexible tube between the pumphead rollers and track, induced forward fluid displacement within the tube by the rotation of the pump rotor, and subsequent vacuum-creating restitution of the tube.

D. Pumps shall be dry self-priming, capable of being run dry without damaging effects to pump or tube, and shall have a maximum suction lift capability of up to 30' vertical water column. Maximum pressure rating: 30 psi.

E. Pump shall not use check valves or diaphragms and shall not require dynamic seals in contact with the pumped fluid. Process fluid shall be contained within pump tubing and shall not directly contact any rotary or metallic components.

F. Flow shall be in the direction of the rotor rotation, which can be reversed and shall be proportional to rotor speed.

1.03 Submittals

A. Submit shop drawings in accordance with the requirements of Section 01340 of these Specifications.

B. Shop drawings shall be prepared and assembled by the listed manufacturers. Shop drawings prepared and assembled by manufacturer's sales representatives, fabrication shops or other than the listed manufacturers will not be accepted.

C. Submit shop drawings on anchorage system for pumps meeting the requirements of the 2002 Kentucky Building Code for Seismic Use Group III and Seismic Design Category "C". Shop drawing shall be stamped and signed by a professional engineer registered in the State of Kentucky.

D. Operation and maintenance manuals shall be furnished in accordance with the requirements of Section 01730 of these Specifications.

1.04 Storage and Protection

Pumps shall be stored and protected in accordance with the requirements of Section 01611 of these Specifications.

1.05 Quality Assurance

A. The manufacturer shall assume unit responsibility for all items specified in this Section. Unit responsibility shall require that all items be products of, or warranted by, the manufacturer. The manufacturer shall be responsible for all coordination between components and provide all submittals, installation and start-up assistance and certifications on the equipment as a unit.

B. This specification is the basis for design of peristaltic metering pumps. All pumps must, at a minimum, meet the following critical design requirements.

C. To maximize pump efficiency and minimize tube fatigue that will impact life, performance, and accuracy, pumps must be designed not to exceed the specified P/10 ratio (theoretical maximum number of occlusions per 10 gallons pumped). Pumps exceeding the specified P/10 ratio, will not be considered suitable for the duty condition. The following criteria is set to maintain the P/10 of ratio for the tube size specified for this application:

1. Maximum two compressing rollers for two compressions per revolution.

2. Tube wall thickness of 2.4 mm and material specified.

3. Large diameter spring-loaded roller set for 2.4mm wall thickness tubing.

4. Max base drive speed of 220 RPM for 2.4mm wall thickness tubing.

5. Track geometry of no less than 180 degrees and rotor geometry with roller 180 degrees apart.

D. P/10 ratio shall not exceed the following per tube size:

Tube Size	P/10 Ratio
1.6mm x 2.4mm	181,820
3.2mm x 2.4mm	45,460
4.8mm x 2.4mm	20,840

Tube Size	P/10 Ratio
6.4mm x 2.4mm	11,570
8.0mm x 2.4mm	7,170
9.6mm x 2.4mm	4,960

E. For quality assurance, all pump tubing must be manufactured by the pump manufacturer in accordance with their specifications. Tubing not manufactured by the pump manufacturer will not be acceptable.

F. Drive and pump heads shall be 24 hour continuous duty rated and have a three-year manufacturer's warranty from date of shipment.

G. Pumps to be manufacturer's standard product. Manufacturer of tubing pumps must have at least 20 operating installations in domestic water or wastewater treatment plants located in the United States over a period of at least seven years in the same service and size as specified.

H. 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

Pumps shall be manufactured by Watson-Marlow Bredel pumps Model 520 DuS/R2.

2.02 Pump Construction

A. Pumphead

1. Pumphead shall consist of a fixed track, a hinged guard door, two spring-loaded tube clamp mechanisms, and spring-loaded roller rotor assembly. Pump tubing shall be in contact with the inside diameter of the track through an angle of 180 degrees and be held in place on the suction and discharge by a spring-loaded self-adjusting clamp mechanism. At all times, one roller shall be fully engaged with the tubing providing complete compression and preventing back flow or siphoning. Tube occlusion and spring tension shall be factory set to accommodate 2.4mm wall thickness tubing and shall not require adjustment for accommodating tubing of 1.6mm to 9.6mm ID.

   a. Pumphead Assembly

      1) Pump Track Geometry must have a minimum 96.6mm swept diameter through a minimum track angle of 180 degrees.

      2) Provide high corrosion/impact materials as specified

i) Track Construction: polyphenylene sulfide (PPS)

ii) Guard Construction: hinged impact-resistant polycarbonate breakaway guard, tool un-lockable for operator safety.

iii) Rotor Construction: polyphenylene sulfide (PPS)

b. Tube Retainer Mechanism

1) Provide two spring-loaded adjustable tube retainer mechanism to secure the tubing at the entry and exit points of the pumphead.

c. Rotor Assembly

1) Provide rotor assembly that ensures gradual tube occlusion and compensates for tube tolerance:

i) twin spring-loaded roller arms located 180 degrees apart, each fitted with stainless steel helical springs and compressing roller for occlusion of the tube twice per rotor revolution

a. Compressing Rollers: 316SS with low friction stainless steel bearings and PTFE seals, minimum diameter of 18mm.

ii) provide non-compressing guide rollers constructed of corrosion resistant Nylatron.

2) Clutch: Equip rotor with a central handgrip hub and manually activated clutch to disengage the rotor from the drive for manual rotor rotation during tube loading. Clutch shall automatically reengage rotor to gearbox upon one complete revolution.

3) Mounting: To prevent slip, the rotor assembly shall be axially secured to the dogged output shaft of the gearmotor via a slotted collect and central retaining screw.

4) Pumpheads requiring disassembly or special tools for tube changing are not acceptable.

B. Tubing

1. Pump tubing shall be in contact with the inside diameter of the track (housing) through an angle of 180 degrees and be held in place on the suction and discharge by tube retainer clamps. The tubing shall be replaceable without the use of tools and with no disassembly of the pumphead.

2. Pump tubing shall be constructed of Marprene II, a thermoplastic elastomer with a 64 Shore A Durometer and 2.4mm wall thickness.

3. Pump shall readily accept tubing ID's of 1.6mm, 3.2mm, 4.8mm, 6.4mm, 8.0mm or 9.6mm without pump adjustment or replacement.

4. Supply 15-meter roll of specified tubing size.

2.03 Pump Drive and Control Panel

1. Rating: Continuous 24 hour operation, 40° C ambient.

2. Supply: 110-120V 60 Hz, 1-Phase. Supply nine-foot length mains power cord with standard 115V three-prong plug.

3. Max drive power consumption: 135VA.

4. Enclosure: NEMA 4X.

5. Housing: Pressure cast aluminum with Alocrom pre-treatment and exterior grade corrosion resistant polyester powder coat. By nature of the environmental conditions, unpainted housings, including 316SS, are not acceptable.

6. Pumps must meet the following minimum requirements for operator interface functionality. Pumps not meeting this minimum functionality will not be accepted.

    a. Backlit graphical LCD capable of up to four lines of text with up to 16 characters per line to display pump speed, running status, flow rate, and programming instructions

    b. Keypad for start, stop, speed increment, speed decrement, forward/reverse direction, rapid prime, and programming.

    c. Menu driven on screen programming of manual or auto control, flow and remote signal calibration, and general programming.

    d. Programmable "Auto Restart" feature to resume pump status in the event of power outage interruption.

    e. Programmable "Keypad Lock" to allow operator lockout of all keys except emergency start/stop.

    f. Programmable "Maximum Speed" to allow operator to set the maximum speed of the pump within 0.1-220 rpm.

7. Supply auto control features to meet the following minimum functionality requirements for use with the SCADA system. Pumps not meeting this minimum functionality will not be accepted.

a. Remote Control Inputs

1) Speed Control:

i) Primary Analog 4-20mA or 0-10VDC speed input, with input signal trimmable and speed scaleable over any part of the drive speed range.

ii) Secondary Analog 4-20mA or 0-10VDC scaling input, with input signal trimmable and programmable scaling factor.

iii) Provisions for alternative remote accessory potentiometer for primary speed control or secondary speed scaling.

2) Start/Stop Control: via 120 VAC input- configurable command sense allowing open to equal run or open to equal stopped.

3) Forward/Reverse Control: via 120 VAC input.

4) Auto/Man Mode Control: via 120 VAC input.

5) Leak Detector Run/Stop Control:

b. Status Outputs

1) Four relay contacts rated for a max. current of 2A at 120V, NO or NC software configurable to indicate the following:

i) Running/Stopped status

ii) Forward/Reverse status

iii) Auto/Manual status

iv) General Alarm status

v) Leak Detected status

2) Speed output – Analog 4-20mA or 0-10 VDC

c. Accepts RS485 data protocol

d. Termination: supply screw down terminals suitable for up to 18 AWG field wire and accessible through four glanded cable entry points on the pump.

8. Drive motor-brushless DC motor with integral gearbox and tachometer feedback.

a. Speed Control Range of 2200:1 from 0.1 to 220 rpm +/- 0.1 rpm throughout the range.

b. Closed loop microprocessor controlled drive with pulse width modulation at speeds above 35 rpm and synchronous mode with magnetic field rotation control below 35 rpm.

c. Circuitry complete with temperature and load compensation and protection.

9. Mounting: Drive shall be self-supporting and shall not require anchoring.

10. Leak Detection

a. Factory-mount a capacitance type tube monitor directly under the pumphead, which shall shut the pump down in the event of a detected leak. Capacitance sensor shall be equipped with a sensitivity adjustment, reset pushbutton, and fault indicated LED.

2.04 Calibration Chamber

Where shown on the Drawings, suction piping shall have provisions provided by the Contractor for permanent installation of a removable and transferable calibration chamber. The graduated translucent calibration chamber shall have a capacity as shown in Table 1. The calibration chamber shall be easily removable.

2.05 Tools and Spare Parts

A. The manufacturer shall furnish two sets of any special tools required for dismantling the drive and/or required tools for replacement and repair of hoses.

B. The manufacturer shall provide the following spare parts. The parts shall be packaged and sealed for long-term storage.

1. One spare pumphead.

2. One, 15-meter pack of tubing for each different chemical service.

Part 3 Execution

3.01 Installation

A. The pumps shall be installed in accordance with the manufacturer's recommendations.

B. Contractor to supply hose barb-to-process line adapters for connection of pump tubing to process lines. Hose barbs to be secured to the pump tubing via a hose clamp tightened around the OD of the tubing.

C. Contractor shall supply shielded signal wiring for wiring of the required remote input and output to the connectors.

3.02 Field Painting

Field painting for items not shop painted shall be in accordance with the requirements of Section 09900 of these Specifications.

3.03 Inspection and Testing

Following installation, operating tests will be performed to demonstrate to the Engineer that the pumps will function in a satisfactory manner. The Contractor shall make, at Contractor's expense, all necessary changes, modifications and/or adjustments required to ensure satisfactory operation.

3.04 Manufacturer's Services

A. Furnish the services of a factory representative for one, eight-hour day 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 for one, eight-hour day who has complete knowledge of proper operation start-up procedure and maintenance requirements to inspect the final installation and supervise a test run of the equipment.

C. Furnish the services of a factory representative for one, eight-hour day who has complete knowledge of the operational and maintenance requirements of the system. The factory representative shall instruct the Owner's personnel in the proper operation of the equipment.

D. The schedule of all services provided shall be in accordance with a schedule approved by the Owner.

TABLE 1
SODIUM ORTHO/POLYPHOSPHATE (AQUA MAG K-5)
CHEMICAL METERING PUMP SCHEDULE

Pump Tag No. Quantity	MP-CORR-MP-1, 2
Service Temperature	68-104° F
Service Specific Gravity	1.3-1.4
Service Viscosity	8-1 cp
Service Vapor Pressure	--
Capacity Range, GPH	.06-5.8
Max Discharge Pressure, psig	30
Max Pump Speed for Application, rpm	100
Capacity per Revolution, gallons	0.001
Suction head, feet	-5
Discharge Size, I.D., inches	3/16
Speed Control	Yes
Calibration Chamber Capacity	60 mL
Calibration Chamber Material	PVC

TABLE 2
FLUOROSILIC ACID 25%
CHEMICAL METERING PUMP SCHEDULE

Pump Tag No. Quantity	MP-FL-MP-1, 2
Service Temperature	68-104° F
Service Specific Gravity	1.23
Service Viscosity	- -
Service Vapor Pressure	218 mm Hg
Capacity, Range GPH	0.06-5.8
Max. Discharge Pressure, psig	30
Max. Pump Speed for Application, rpm	100
Capacity Per Revolution, gallons	0.001
Suction Head, feet	0 – 5
Suction/Discharge Size – I.D., inches	3/16
Speed Control	Yes
Calibration Chamber Capacity	60 mL
Calibration Chamber Material	PVC

TABLE 3
CHEMICAL METERING PUMP SCHEDULE

Pump Tag No. Quantity	MP-FILTAID-MP-1, 2
Service Temperature	68-104° F
Service Specific Gravity	1.02
Service Viscosity	8-1 CP
Service Vapor Pressure	-
Capacity GPH	.06-6.0
Max. Discharge Pressure, psig	30
Max. Pump Speed for Application, rpm	100
Capacity Per Revolution, gallons	0.001
Suction Head, feet	- 5
Suction/Discharge Size – I.D., inches	3/16
Speed Control	Yes
Calibration Chamber Tag No. Capacity	60 mL
Calibration Chamber Tag No. Material	PVC

TABLE 4
CHEMICAL METERING PUMP SCHEDULE

Pump Tag No. Quantity	MP-ACTPOLY-MP-1, 2
Service Temperature	68-104° F
Service Specific Gravity	0.8-1
Service Viscosity	-
Service Vapor Pressure	-
Capacity GPH	.12-12.3
Max. Discharge Pressure, psig	30
Max. Pump Speed for Application, rpm	120.6
Capacity Per Revolution, rpm	0.017
Suction Head, feet	0 - 4
Suction/Discharge Size – I.D.	inch
Speed Control	Yes
Calibration Chamber Tag No. Capacity	1000 mL
Calibration Chamber Tag No. Material	PVC

3.05 Cleaning

Prior to the acceptance of the work of 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 (MP-FERRIC-TP-1, 2; MP-PACL-TP-1, 2; MP-CAUSTIC-TP-1, 2; MP-FL-TP-1, 2)

A. Work described in this Section includes furnishing all labor, equipment, materials, tools and incidentals required for a complete and operable installation for seal-less self-priming chemical end suction centrifugal pumps. All equipment shall be installed and tested in accordance with these Specifications and the manufacturer's recommendations.

B. Submit shop drawings on anchorage system for pumps meeting the requirements of the 2002 Kentucky Building Code for Seismic Use Group III and Seismic Design Category "C". Shop drawing shall be stamped and signed by a professional engineer registered in the State of Kentucky.

1.02 Design Requirements

A. Operating requirements for pumps shall be as shown in Table 1 of this Section.

B. Pumps shall be for horizontal installation.

C. The pump and motor shall be mounted on a common base with a flexible coupling between the motor and the pump.

D. The motor shall be sized to be non-overloading throughout the pump range and the maximum motor speed shall be 1,800 rpm.

E. The pump shaft shall be designed to limit shaft deflection at the stuffing box to no more than 0:002-inch.

1.03 Submittals

A. Submit shop drawings in accordance with the requirements of Section 01340 of these Specifications.

B. Operation and maintenance manuals shall be furnished in accordance with the requirements of Section 01730 of these Specifications.

1.04 Storage and Protection

Pumps 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 equipment furnished complies with all applicable requirements of these Specifications.

Part 2 Products

2.01 Acceptable Manufacturers

Equipment shall be manufactured by Sundyne (ANSIMAG-KP 326).

2.02 Materials and Construction

A. General: The seal-less self-priming end suction pumps shall be electric motor driven, magnetically coupled with the pump, motor, baseplate, and accessories provided by the manufacturer per Table 1 of this Section and the applicable Drawings of this Specification.

B. Pump casing shall be of ductile iron construction with ETFE fluropolymer or Tefzel rotomolded lining. An integrally cast suction gooseneck shall be provided to retain fluid in the pump casing for quick reprime and eliminate the requirement for a suction check valve. Drain and casing fill connections shall be provided.

C. Volute insert shall be carbon fiber reinforced Tefzel (CFR-ETFE).

D. Backplate shall be Tefzel lined ductile iron.

E. Flanges shall be ANSI 150#.

F. Impeller shall be a one piece impeller magnet assembly with the magnet ring balanced to ISO 1940 G6.3 standards.

G. Wear rings shall be carbon filled Teflon.

H. Magnets shall be high strength rare earth neodymium iron.

I. Shaft shall be pure sintered alpha grade silicon carbide.

J. Bearings radial bearings shall be two piece design of alpha grade silicon carbide with Safeguide coating. Radial bearings of single piece design shall not be used. Thrust bearings shall be alpha grade silicon carbide with Safeguide coating with the exception of the reverse thrust bearing of CFR TFE material.

K. Containment shell shall be of non-metallic design to reduce hysteresis losses with a burst pressure greater than 500 psig. The o-ring shall be chemically compatible with the fluid being pumped.

L. Mounting shall be close coupled to eliminate motor/pump alignment requirements.

2.03 Motors

Motors shall be 480 volt, 3 phase, 60 Hertz, and shall conform to the requirements of Section 16150 of these Specifications and as indicated in Table 1 of this Section.

2.04 Power Monitor

The pump manufacturer shall furnish a power monitoring system equal to "SundGard Power Monitor PM-2000" for installation by Division 16. The pump monitor shall be a digital interface device powered by a 10V power supply and shall include the following:

a. 3-Digit LED Display
b. Low trip, high trip and start-up delays
c. Trip range adjustment = 5-100%
d. Remote reset
e. 4:20 mA output
f. NEMA 4X rating

2.05 Controls

The Contractor shall furnish and install all electrical work and equipment required for a complete and operable installation as shown on the Electrical Drawings and as specified in Division 16 of these Specifications.

2.06 Tools and Spare Parts

A complete set of seals, bearings, wearing rings, shaft sleeve, etc. and sufficient lubrication material for a complete pump rebuild shall be furnished for each pump.

2.07 Shop Painting

All materials specified under this Section shall be shop primed as part of the work under this Section. Surface preparation and paint shall be as specified in Section 09900 of these Specifications.

Part 3 Execution

3.01 Installation

A. Installation shall be in strict accordance with the respective manufacturer's instructions and recommendations in the locations shown on the Drawings.

B. Installation shall include furnishing any required oil and grease in accordance with the manufacturer's recommendations.

C. Anchor bolts, if required, shall be stainless steel and shall be set by the Contractor, for

installation under Division 3, in accordance with the manufacturer's recommendations and revised shop drawings.

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, operating tests will be performed, demonstrating to the Engineer that each mechanism and the system as a whole will function in a satisfactory manner. The Contractor shall make, at Contractor's own expense, all the necessary changes, modifications and/or adjustments required to ensure satisfactory performance.

3.04 Manufacturer Service

A. Furnish the services of a factory representative for one, eight-hour day 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, having complete knowledge of proper operation start up procedure and maintenance requirements, for one, eight- hour day, to inspect the final installation and supervise a test run of the equipment.

TABLE 1

SEAL-LESS SELF-PRIMING END SUCTION PUMP SCHEDULE

Equipment Tag No.	MP-FERRIC-TP-1, 2	MP-PACL-TP-1, 2	MP-CAUSTIC-TP-1, 2	MP-FL-TP-1	MP-FL-TP-2
Rated Capacity, gpm	40	15	25	10	10
Rated TDH, feet	25	25	25	15	15
Shut-Off Head, feet	-	-	-	22	22
Minimum Flow Required, gpm	-	-	-	-	-
Motor Horsepower	2.0	1.5	1.5	1.0	1.0
Motor Speed, rpm	1,800	1,800	1,800	1,800	1,800
Motor Voltage	480	480	480	480	480
Fluid Pumped	Ferric Sulfate	Hype + ion 1750	Caustic Soda	Fluoride	Fluoride
Specific gravity	1.38-1.59	1.15-1.40	1.54	1.23	1.23
Viscosity	8-1	15-5	40	6.5	6.5
Maximum Solids Size, inches	-	-	-	-	-
Fluid Temperature, F°	68-104°	68-104°	68-104°	68-104°	68-104°

END OF SECTION

Part 1 General

1.01 Scope (MP-RES-531-P-1; MP-RES-532-P-2; MP-RES-533-P-3)

A. The work required under this Section consists of, but is not necessarily limited to, furnishing all materials, equipment, accessories, tools, and labor required to install three horizontal split case pumps, motors, and VFD's as shown on the Drawings and as specified herein. All operating tests shall be performed and all adjustments made to guarantee satisfactory system operation.

B. Pumps, motors, VFD's, couplings, coupling guards and baseplates shall be furnished by the pump manufacturer and sized to accommodate the maximum torque to be transmitted.

C. The pumps shall be horizontal, single stage, double suction, axially split case centrifugal pumps. The suction and discharge nozzles shall be integrally cast in the lower half of the casing.

1.02 Design Requirements

Operating requirements for pumps shall be as shown in Table 1 of this section.

1.03 Factory Testing

A. The pump manufacturer shall conduct full scale, full range factory performance tests with respect to capacity, head, NPSH and horsepower.

B. When tested, each pump shall be driven by the specified motor or by a certified calibrated motor equivalent to the motor horsepower and speed specified.

C. Certified test reports shall be submitted for approval prior to shipment of the pumps. Tests shall be conducted in accordance with applicable Hydraulic Institute standards for Level "A" testing for each pump. The test reports shall be certified by a corporate officer of the manufacturer and shall cover the following items:

1. Capacity vs. head curve in U.S. gallons per minute and feet.

2. Efficiency vs. flow curve in percent.

3. Brake horsepower vs. flow curve.

4. Speed of rotation.

5. Impeller size and number.

6. Certified bearing life calculations in accordance with AFBMA standards.

7. A table with a listing of a minimum of 10 test points throughout the pump range including shut off, rated capacity and run out. Show capacity, total head, BHP, efficiency, NPSHR and speed.

D. Drives and controls shall be factory tested to demonstrate control logic for pump sequencing and fault conditions prior to shipment.

E. The Engineer shall have the option to witness the pump tests.

F. Four copies of all test reports shall be submitted.

G. If the results of the factory tests fail to demonstrate compliance with the requirements of this Section, the Contractor shall modify or replace the deficient pump(s) as necessary, at no additional cost to the Owner and shall resubmit certified factory test reports on each modified or replacement pump.

1.04 Submittals

A. Submit shop drawings in accordance with the requirements of Section 01340 of these Specifications.

B. Operation and maintenance manuals shall be furnished in accordance with the requirements of section 01730 of these Specifications.

Part 2 Products

2.01 Acceptable Manufacturers

Pumps shall be as manufactured by Gould Model 3409 (14 x 18-23L), Patterson Model 18 x 14 MAB-D, or FLOWSERVE Model 350 LNN-575 and 10 R-17B.

2.02 Materials and Construction

A. Materials of construction shall be as follows:

1. Casing shall be constructed of cast iron, ASTM A 48, Class 30.

2. Impeller shall be bronze, ASTM B 584, Alloy 954.

3. Casing wear rings shall be bronze, ASTM B 584, Alloy 938.

4. Impeller wear rings shall be bronze, ASTM B 584 Alloy, 905.

5. Bearing covers shall be cast iron, ASTM A 48, Class 30.

6. Shaft shall be steel, ASTM A 576, Grade 1040.

7. Shaft sleeves shall be bronze, ASTM B 584, Alloy 905.

8. Glands shall be bronze, ASTM B 584, Alloy 836.

9. Seal cages shall be Teflon.

10. Casing gasket shall be Goodyearite.

11. no material in contact with the pumped liquid shall contain lead or have any compositions containing lead.

B. Casing: The casing shall be a horizontally split design, constructed of close-grained cast iron and shall be tested at a hydrostatic pressure of 1.5 x the design head. 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.

C. 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.

D. 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.

E. Stuffing Box Shaft Seal: Provide single cartridge type mechanical seals with precision lapped fares. Mechanical seals shall be manufactured by John Crane, Chesterton or Durmetalic. Tap and connect the upper casing to supply discharge pressure water to the shaft seal housing and to provide seal water to the seals. Valve the piping from the upper casing to the seal housing to control water flow. Seal water drains shall be provided on each side of the pump housing to allow drainage to be piped away from each shaft seal. Seal water drainage shall be contained and shall not flow onto the base plate of the pump.

F. Bearings: Provide grease lubricated bearings. The outboard bearing shall be double row thrust ball bearings locked on the shaft to take radial and any unbalanced thrust loads, 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. Bearing housings shall be integrally cast with the pump's lower casing half.

G. Flexible Coupling: Directly connect the pump to its driver by means of a Falk Series T10, all metal, flexible type coupling. Provide coupling guards per OSHA standards.

H. Pump Base: The baseplate shall be one-piece, fabricated steel with a continuous drip ring to collect leakage.

2.03 Motors

A. Motors shall be designed and manufactured in accordance with NEMA standards, the requirements of Section 16150 of these Specifications, and shall have the following characteristics:

1. Horsepower per Table 1.
2. Speed per Table 1.
3. 480 volts.
4. O.D.P. – inverter duty
5. Bearing stator RTDs.
6. 120 volt space heater.

B. The motor shall be capable of delivering full rated horsepower, continuously, with a maximum of two starts per hour.

2.04 Drive

Provide VFDs for pumps as scheduled on Table 1. VFDs shall comply with the requirements of Section 16489 of these Specifications.

2.05 Shop Painting

All materials specified under this Section shall be primed as part of the work under this Section. Surface preparation and paint shall be as specified in Section 09900 of these Specifications.

2.06 Pump Monitoring Systems

A. Each pump shall have three bearings monitored for vibration, two pump bearings and one motor bearing (the bearing closest to the pump). The manufacturer shall provide a bearing monitoring system for each pump consisting of the following:

1. Two vibration sensors per monitored bearing (six total per pump), mounted in accordance with the vibration sensor system manufacturer's recommendations. Sensors shall be piezo-velocity type. Provide each sensor with a 20-foot, armored interconnecting cable. The contractor shall verify cable length prior to

ordering and adjust the length so as not to exceed two loops of spare cable.

2. Sensor cables shall connect to a local multi-channel signal conditioner at each pump. All signal conditioners shall communicate with the owner's plant control system via a single RS-485 serial link.

3. Vibration signals shall represent peak velocity output (inches per second). The pump manufacturer shall provide sensors with sensitivity and range appropriate to the application and per the vibration system manufacturer's recommendations.

4. Acceptable Manufacturer: Bently Nevada or Metrix.

B. Each pump shall have 10 points monitored for temperature, 8 points per motor (2 per phase and 1 per motor bearing), and 1 point for each pump bearing. The manufacturer shall provide RTD measuring elements mounted in the pump bearings and pump motor as follows:

1. RTD measuring elements shall be 3-wire, 100-ohm platinum type with spring-loaded sensors.

2. Provide each RTD element with a connection head and cover.

Part 3 Execution

3.01 Installation

Installation shall be in strict accordance with the manufacturer's recommendations, in the locations shown on the Drawings. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the manufacturer's recommendations. Anchor bolts shall be set in accordance with the manufacturer's recommendations.

3.02 Field Painting

All shop primed surfaces shall be cleaned and painted as specified in Section 09900 of these Specifications.

3.03 Inspection and Testing

After all pumps have been completely installed, the Contractor, under the direction of the manufacturer's representative, shall conduct in the presence of the Engineer, such tests as are necessary to ensure that pump capacity and operation conform to the Specifications. Field tests shall include all pumps included under this Section. The Contractor shall supply all electric power necessary to complete field tests. A factory representative having complete knowledge of proper operation and maintenance shall be provided to instruct Owner's personnel on proper operation and maintenance. This work may be conducted in conjunction with the inspection of the installation and test run. The initial tests, start-up and instruction of the Owner's operation and

maintenance personnel shall be scheduled for a minimum of three, eight hour days. If there are difficulties in operation of the equipment due to the manufacturer's design or fabrication, additional services shall be provided at no cost to the Owner.

3.04 Cleaning

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

TABLE 1

	MP-RES-531-P-1	MP-RES-532-P-2	MP-RES-533-P-3
Pump Media Potable Water @ °F	35-70	35-70	35-70
Primary Design Condition Flow, GPM	6,944	6,944	3,472
TDH, Feet	86	86	54
Minimum Efficiency Percent	86	86	85
Secondary Design Condition Flow, GPM	9,000 to 9,500	9,000 to 9,500	4,000 to 4,500
TDH, Feet	60	60	40
Maximum Net Positive Suction Head Required, Feet at Primary Design Condition	10	10	16
Shut-off Head-Min (Feet)	108	108	83
Maximum Rotation Speed, RPM	900	900	1,200
Motor Horsepower	200 VSD	200 VSD	75 VSD

VSD: Variable Speed Drive

END OF SECTION

Part 1 General

1.01 Scope (MP-FERRIC-MP-1, 2; MP-PACL-MP-1, 2; MP-CAUSTIC-MP-1, 2, 3; MP-COPPER, MP-1, 2, 3)

A. The work covered by this Section consists of furnishing all labor, equipment and materials required to install, test and place into satisfactory operation the chemical metering pumps as shown on the Drawings and detailed herein.

B. Each pump shall be complete with motor, base and all accessories necessary for an installation complete in every detail as shown on the Drawings and written in the Specifications.

C. Submit shop drawings on anchorage system for pumps meeting the requirements of the 2002 Kentucky Building Code for Seismic Use Group III and Seismic Design Category "C". Shop drawing shall be stamped and signed by a professional engineer registered in the State of Kentucky.

1.02 Design Requirements

A. Metering pumps and accessories shall be as outlined in Table 1-5 of this Section.

B. Unit Responsibility: The work requires that the chemical metering pumps complete with all accessories and appurtenances (including, but not necessarily limited to, pump motor and electronic variable speed drive system, control panel housing microprocessor based controller and, external pressure relief valve, calibration column, and backpressure valves) be the end product of one responsible system supplier.

1.03 Submittals

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

B. Operation and maintenance manuals shall be furnished in accordance with the requirements of Section 01730 of these Specifications.

1.04 Storage and Protection

A. Pumps and accessories shall be stored and protected in accordance with the manufacturer's recommendations. Pumps shall not be stored outside or exposed to the weather.

B. Pumps shall be completely drained prior to shipment. Suction and discharge ports shall be provided with plastic plugs. Each pump shall be secured to a wooden skid and crated to facilitate handling and storage.

1.05 Quality Assurance

The manufacturer shall provide a written certification to the Engineer, with the shop drawings, that all equipment furnished complies with all applicable requirements of these Specifications.

Part 2 Products

2.01 Acceptable Manufacturers

All chemical metering pumps shall be manufactured by Milton Roy (Centrac S).

2.02 Operating Requirements

A. Provide electric motor driven, positive displacement, hydraulically actuated diaphragm, dual head pump(s).

B. Each pump shall meet the operating requirements as outlined in the Table 1 of this Section.

C. The pump shall be capable of delivering 0 to 100 percent of rated capacity. The capacity adjustment from 0 to 100 percent allowing for positive repeatable adjustments. Each pump shall be equipped with a brushless DC motor for variable speed operation. Steady state accuracy is ± 0.5%. The change in capacity may be made while the pump is operating. Pumps shall be self-priming and capable of indefinite operation without process fluid.

2.03 Materials and Construction

A. Material of construction for the wetted parts shall be resistant to the chemical being pumped and shall be the materials shown in Table 1.

1. The pump is to be of the hydraulically balanced diaphragm type wherein a measuring piston reciprocates within a cylinder and causes hydraulic oil to deflect a diaphragm. Mechanically operated devices are not acceptable. The pump shall be of the dual head design.

2. Diaphragm shall be a convoluted PTFE diaphragm designed for low stress and long life by FEA analysis. The diaphragm shall have an integral o-ring seal around the perimeter of the diaphragm to ensure a positive seal between the hydraulic and process fluids. Flat Teflon diaphragms are not acceptable.

3. The fluid cavity of the diaphragm head shall be designed for straight-through flow.

4. Pump shall be a dual precision cam head design.

5. Pump shall have two diaphragm liquid ends which are manifolded together.

6. Hydraulic fluid volume in the liquid end shall be maintained by a mechanically actuated refill system (MARS). This refill system requires no operator adjustment.

7. The diaphragm shall be protected from over-extension by refilling hydraulic fluid only when the diaphragm is in the full rearward position.

8. Pump shall be provided with an internal pressure relief valve which is preset at the factory. Valve shall be field adjustable. Valve shall protect the pump and motor from excessive pressure and relief pressurized hydraulic fluid back to the pump reservoir.

9. Pump shall provide 100:1 turndown ratio.

10. Pump shall provide a steady state accuracy of plus or minus 0.5% and maintain such accuracy for continuous full load operation from maximum flow rate down to 1/100 of the maximum rated flow.

11. The pump shall provide a virtually pulseless flow without the use of pulsation dampeners in the discharge line.

12. Flow rate of the pump shall be adjustable by speed only.

13. Pump cast iron body shall be protected with a chemically resistant polyamide epoxy paint.

14. Gear reduction shall be high efficiency bevel type for extended life at low speed.

B. The metered liquid will enter the metering head at the bottom and exit at the top through gravity seating ball valves. These valves shall be free-seating type to meet service conditions with valve seats having knife edge contact and will be guided to accurately control vertical and sideward movement. Valves and seat will be sealed by O-ring and be individually replaceable without removing the process piping. Valve assemblies will not incorporate any threading other than the process pipe connection.

C. The suction piping shall have provisions provided by the Contractor for permanent installation of a removable and transferable calibration chamber. The graduated translucent calibration chamber shall be of the size indicated in Table 1. The calibration chamber shall be easily removable.

2.04 Motor

1. Motor shall be totally enclosed and non-ventilated.

2. Motor shall be completely enclosed within the pump housing.

3. Pump shall use a stepper motor design, which produces 51,200 steps per stroke of the pump.

4. Motor shall maintain its speed within 0.1% from 700 RPM to 7 RPM.

5. Motor shall not contain communicators or brushes.

6. Motor bearings shall be permanently lubricated and require no periodic maintenance.

7. Motor shall contain means to transmit an electrical speed indication signal to provide positive feedback of actual motor speed to the pump controller.

8. Each motor shall be mounted, coupled and aligned to the pump by the pump manufacturer.

2.05 Drive

A. The drive unit shall be a variable type. The components shall drive the piston to the head outward, in a straight line. An oil flood valve shall lubricate the piston on each stroke. The piston shall displace hydraulic fluid uniformly and at even pressure across the entire face of the disc diaphragm which transmits an exact volume of hydraulic fluid. The flexing of the diaphragms shall cause chemicals to enter and leave the pump.

B. Pump drive mechanism will have flooded lubrication using a common oil with the hydraulic system. It will not contain auxiliary lubricator mechanisms. The pump mechanism shall be sealed from direct contact with outside atmospheres and suitable for operation in ambient conditions of -30 to 113 degrees F without the use of heating or cooling devices. The self compensating hydraulic system shall protect all working parts against damage from excess process or hydraulic pressure. Additionally, the hydraulic fluid chamber shall have an automatic air bleed system, vented to the main gear box oil reservoir.

C. The pump, motor and drive shall be mounted on a common base.

2.06 Controls

A. Supplier: All controls specified shall be furnished by the pump manufacturer.

B. All pumps shall be started and stopped remotely by equipment provided by the Contractor.

C. Control Panel: Manufacturer shall provide NEMA 4X, control panels, fabricated from FRP.

1. Controller shall have three microprocessors.

2. Receiving circuitry in the control shall be electrically isolated.

3. Controller shall be capable to operate in either Manual or Automatic mode.

4. Controller shall have Start, Stop, Up Arrows, Down Arrows, Enter, and Mode keys.

5. Operator shall be capable of adjusting the action and range of the milliamp signal, motor span, maximum and minimum speed limits of the motor, lockout code, loss of signal action, power up action, and recalibration of the milliamp signal without any external tools or equipment.

6. Control panel shall be Centrac "B" controller.

7. Panel Surface Mounted Devices

   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; industrial grade transformer type pilot light with octagonal ring; 6 volt LED lamp. Acceptable manufacturers: Allen-Bradley, Cutler Hammer, General Electric, or Square D.

Lamp colors:	Green	Run, Open
	Red	Stopped, Off, Closed
	Amber	Alarm

   c. Digital Panel Indicator: 3–1/2 digit, 1/2-inch display height, NEMA 4X rated. 4-20 mA input. Acceptable Manufacturers: Newport, Action Instruments, or Red Lion.

8. Panel Internally Mounted Devices:

   a. Variable Speed Drives.

D. Control Panel Specific (FCP-1340, 1350; FCP-1440, 1450; FCP-1040, 1050, 1060; FCP-1640, 1650, 1660)

1. Surface-Mounted Devices: The panel shall be furnished with the following front-of-panel mounted devices:

   a. Control Selector Switch: ON-OFF-REMOTE.

   b. Pump Speed Adjustment Switch: LOCAL-REMOTE.

   c. Panel Meter for error code display and % speed display.

d. Control Selector: Auto-Off-Manual.

e. PUMP SPEED adjustment potentiometer.

f. Indicator Light each Pump: RUN.

g. PUMP SPEED indicator.

h. LEAK DETECTION alarm.

E. Remote System Interface: The panel shall be provided with 120 VAC Form C contacts for remote status. It shall accept 120 VAC dry contacts for remote control. Analog signals for remote use shall be isolated 4-20 mA. The panel shall accept remote 4-20 mA signals for control. The remote system interface shall include the following points.

1. Remote System Interface:

a. Outputs – Discrete:

i. PUMP IN REMOTE (each pump) to Plant Control System.

ii. RUN (each pump) to Plant Control System.

iii. FAULT (each pump) to Plant Control System and to stop the drive when system fault occurs.

iv. PUMP-READY.

v. PUMP-AUTO/MANUAL.

b. Input – Discrete:

i. CALL TO RUN (each pump) from Plant Control System.

c. Input – Continuous:

i. PUMP SPEED SETPOINT (each Pump VSD) from Plant Control System.

F. Diaphragm Rupture Stop Switch: A rupture sensor shall immediately sense a rupture of the diaphragm(s) and activate a switch attached to the pump. The switch, when activated, will stop the pump.

G. VSD Controller to be installed in control panel.

2.07 Leak Detection

Sensor shall be provided on the liquid end of the pump head to monitor outflow of process fluid trough working diaphragm.

2.08 Control Logic

A. When the pump LOCAL-REMOTE selector switch is in LOCAL position, control shall be from the control panel and the Pump in remote OUTPUT SHALL BE DE-ENERGIZED:

1. When the pump ON-OFF-REMOTE selector switch is in the ON position, the pump shall run and pump speed shall be set manually at the pump control panel.

2. When the pump ON-OFF-REMOTE selector switch is in the OFF position, the pump shall not run.

3. When the pump ON-OFF-REMOTE selector switch is in the REMOTE position, the pump shall run and pump speed shall be set remotely.

B. When the pump LOCAL-REMOTE selector switch is in the REMOTE position, control shall be from the Plant Control System and the PUMP IN REMOTE signal shall be energized.

1. When the ON-OFF-REMOTE selector switch is in the ON position, the pump runs and pump speed shall be set manually at the control panel.

2. When the pump ON-OFF-REMOTE selector switch is in the OFF position, the pump shall not run.

3. When the pump ON-OFF-REMOTE selector switch is in the REMOTE position, the pump shall run based on input signals.

2.09 Accessories

A. Equipment Supports: Equipment supports, anchors, and restraints shall be designed for static and dynamic loads.

B. Service Factors: Service factors shall be applied in the selection and design of components where so indicated in individual sections. When not indicated there, minimum service factors shall be 1.25, except for gears and gear drives as specified herein.

C. Safety Devices: The completed work shall include all necessary permanent safety devices, such as machinery guards, emergency stops, and similar items required by OSHA, and other federal, state, and local health and safety regulations. Provide screens or guards at exposed rotating shafts, rotors, couplings, pulley, wheel, bolts,

chains, or similar components. Where guards/screens are over grease fittings, couplings, or other items requiring maintenance, provide a means for ready access. Mesh size of less than 1/2-inches.

D. Nameplates: Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in accessible locations with stainless steel screws or drive pins. Nameplates shall contain the equipment tag number, manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the machine performance ratings.

E. Anchor Bolts: Provide Type 316 stainless steel anchor bolts as specified in Section 05501, Metal Fabrications and Castings. Number and size as recommended by manufacturer.

F. Calibration Columns:

1. Calibration columns shall be provided for each chemical service application per the attached Chemical Metering Pump data Sheets.

2. Calibration columns on all chemical services shall be PVC flanges with PVC butyrate tube. Column shall be mounted and supported as indicated on the Drawings.

3. Calibration columns shall be equipped with a 1-inch NPT top connection suitable for a vent pipe.

4. Calibration columns shall be marked with volume gradations. Main divisions shall be in milliliters, unless otherwise specified.

5. Calibration columns shall be manufactured by Mills Engineering, Needham, Massachusetts; Pulsafeeder, or equal.

G. Back Pressure Valves: Provide an adjustable diaphragm back pressure valve with true union connections for field installation in the pump discharge piping as shown on the Drawings. Materials of construction shall be compatible with service conditions defined in the Pump Data Sheets. Setting as recommended by pump manufacturer and noted on Table 1, attached. Valve size shall match diameter of connected pipe.

H. External Pressure Relief Valves: Provide each pump with an adjustable external pressure relief valve. Materials of construction shall be compatible with Chemical being handled.

I. Gauge Connections: Provide tapped and plugged suction and discharge gauge connections on the piping headers immediately adjacent to the pumps.

J. Lifting Lugs: Lifting Lugs shall be provided on all equipment weighing over 100 pounds.

K. Chemical Injector/Diffuser

1. Chemical Injector/Diffuser: Injector configuration shall provide for a single feed point into center of water main. Materials of construction shall be compatible with chemical solution and be capable of withstanding 150 psig, water main pressure.

2. Water Main Connection: Shall be Heavy Duty Brass Corp. Stop, Hastelloy C (Fluoride) or Stainless Steel Ball Valve. Thread connection shall be NPT or AWWA inlet and capable of withstanding maximum water main pressure. Corp stop must include an acceptable safety device to prevent accidental withdrawal of Injection/Diffuser solution tube while under maximum pressure and/or surge conditions.

3. Injector/Diffuser Solution Tube: Injector/Diffuser solution tube shall be sized and tagged as shown in Table 6 of these Specifications. A ball check valve shall be included to prevent backpressure from the main from entering chemical feed system. A stainless steel safety chain shall be included to prevent withdrawal of solution tube past corporation stop. Safety chain length shall be preset by manufacturer for closure of the corp stop before withdrawal of solution tube. Operator shall be able to safely withdraw or insert Injector/Diffuser solution tube into center of water main while under pressure and without having to shut down the main. Injector/Diffuser tube shall extend ¼ diameter of water main into center of main.

4. Pump Discharge Line Connection to Injector/Diffuser: Shall be flexible tubing. Piping, Flex Tubing, or Hose must be capable of withstanding maximum pump discharge line pressure.

5. Injector/Diffuser Assembly shall be equal to Saf-T-Flo.

2.10 Tools and Spare Parts

The pump supplier shall provide a spare parts kit in prepackaged blister pack for each pump type and size. Package shall be arranged for ease of identification and long shelf life. As a minimum, it shall include a diaphragm, ball check valves, valve seats and valve gaskets.

Part 3 Execution

3.01 Installation

A. Blow clear all suction and discharge piping prior to connection of piping to any pump. Dismantling and removal of foreign materials lodged in the pumps will be performed by the Contractor at no additional cost to the Owner.

B. Installation shall be in strict accordance with the respective manufacturer's instructions and recommendations in the locations shown on the Drawings.

Installation shall include furnishing any required oil and grease in accordance with the manufacturer's recommendations. Anchor bolts shall be stainless steel and shall be set by the Contractor, for installation under Division 3, in accordance with the manufacturer's recommendations and approved shop drawings.

3.02 Inspection and Testing

A. Following installation, operating tests will be performed to demonstrate to the Engineer that the chemical metering pumps will function in a satisfactory manner.

B. Functional Test: Prior to plant startup, all equipment described herein shall be inspected for proper alignment, quiet operation, proper connection, and satisfactory performance by means of a function test. Pumps shall be tested on clean water prior to testing on chemicals.

C. Performance Test:

1. The Contractor shall perform field tests on completed pump assemblies to demonstrate their conformance to the Specifications to the satisfaction of the Engineer. A test log shall be presented to the Engineer upon completion of each test that records flow, as measured by graduated containers or storage volumes.

2. Flow measurements shall be made at 50 and 100% capacity:

3. Units apparently failing to meet the Specifications to the satisfaction of the Engineer shall be more accurately tested in accordance with Hydraulic Institute Standards. If the pump fails the second test, the unit will be rejected, and the Contractor shall furnish a unit that will perform as specified at the Contractor's sole expense.

3.03 Manufacturer Service

A. Furnish the services of a factory representative for one, eight hour day 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, having complete knowledge of proper operation start-up procedure and maintenance requirements, for one, eight hour day, to inspect the final installation and supervise a test run of the equipment.

C. Furnish the services of a factory representative, having complete knowledge of proper operational and maintenance requirements of the system, for one, eight hour day. The factory representative shall instruct the Owner's personnel in the proper operation of the equipment.

3.04 Cleaning

Prior to acceptance of the work of this Section, thoroughly clean all installed materials,

equipment and related areas in accordance with the requirements of Section 01710 of these Specifications.

TABLE 1
FERRIC SULFATE (31-46%)
CHEMICAL METERING PUMP SCHEDULE

Pump Tag No. Quantity	MP-FERRIC-MP-1, 2
Service Temperature	68° F to 104° F
Service Specific Gravity	1.38-1.59
Service Viscosity	8-1 cps
Service Vapor Pressure	--
Capacity, Range GPH	0.4-40
Operating Pressure, psig	100
Pump Type	Centrac S
Pump Head Material	316 Stainless Steel
Number of Heads	Duplex
Diaphragm Material	PTFE (Teflon)
Internal Ball Check Valve Material	Ceramic
Suction/Discharge Size	1/2-inch
Speed Control	Yes
Motor Horsepower	1
Motor Power Requirement	120/1
Motor RPM	700
Motor Enclosure	TENV
Calibration Chamber Capacity	4,000 mL
Calibration Chamber. Material	PVC
Back Pressure and Safety Valve Quantity	2
Back Pressure and Safety Valve Material	PVC
Back Pressure and Safety Valve Size	1-inch
Back Pressure Valve Pressure Setting	50 psig

TABLE 2
ALUMINUM CHLORIDE AND POLYALUMINUM HYDROXYCHLORIDE (HYPER+ION 1750) CHEMICAL METERING PUMP SCHEDULE

Pump Tag No. Quantity	MP-PACL-MP-1, 2
Service Temperature	68-104° F
Service Specific Gravity	1.28-1.38
Service Viscosity	15-5 cps
Service Vapor Pressure	- -
Capacity, Range GPH	0.12-12.3
Operating Pressure, psig	100
Pump Type	Centrac S
Pump Head Material	316 Stainless Steel
Number of Heads	Duplex
Diaphragm Material	PTFE (Teflon)
Internal Ball Check Valve Material	Ceramic
Suction/Discharge Size	1/2-inch
Speed Control	Yes
Motor Horsepower	1
Motor Power Requirement	120/1
Motor RPM	700
Motor Enclosure	CISP-TEFC
Calibration Chamber Capacity	1,000 mL
Calibration Chamber Material	PVC
Back Pressure and Safety Valve Quantity	2
Back Pressure and Safety Valve Material	PVC
Back Pressure Valve Size	1-inch
Back Pressure Valve Pressure Setting	50 psig

TABLE 3
CAUSTIC SODA 50%
CHEMICAL METERING PUMP SCHEDULE

Pump Tag No. Quantity	MP-CAUSTIC-MP-1, 2
Service Temperature	68-104° F
Service Specific Gravity	1.54
Service Viscosity	40-1 cp
Service Vapor Pressure	13 mm Hg
Capacity, Range GPH	0.24-24.1
Operating Pressure, psig	100
Pump Type	Centrac S
Pump Head Material	316 Stainless Steel
Number of Heads	Duplex
Diaphragm Material	PTFE (Teflon)
Internal Ball Check Valve Material	Ceramic
Suction/Discharge Size	1/2-inch
Speed Control	Yes
Motor Horsepower	1
Motor Power Requirement	120/1
Motor RPM	700
Motor Enclosure	CISP-TEFC
Calibration Chamber Capacity	1,000 mL
Calibration Chamber Material	PVC
Back Pressure and Safety Valve Quantity	2 Each
Back Pressure and Safety Valve Material	PVC
Back Pressure and Safety Valve Size	1-inch
Back Pressure Valve Pressure Setting	50 psig

TABLE 4
CAUSTIC SODA 50%
CHEMICAL METERING PUMP SCHEDULE

Pump Tag No. Quantity	MP-CAUSTIC-MP-3
Service Temperature	68-104° F
Service Specific Gravity	1.54
Service Viscosity	40-1 cp
Service Vapor Pressure	13 mm Hg
Capacity, Range, GPH	0.06-6.0
Operating Pressure, psig	100
Pump Type	Centrac S
Pump Head Material	316 Stainless Steel
Number of Heads	Duplex
Diaphragm Material	PTFE (Teflon)
Internal Ball Check Valve Material	Ceramic
Suction/Discharge Size	1/2-Inch
Speed Control	Yes
Motor Horsepower	1
Motor Power Requirement	120/1
Motor RPM	700
Motor Enclosure	CISP-TEFC
Calibration Chamber Capacity	240 mL
Calibration Chamber Material	PVC
Back Pressure and Safety Valve Quantity	1 Each
Back Pressure and Safety Valve Material	PVC
Back Pressure and Safety Valve Size	½-inch
Back Pressure Valve Pressure Setting	50 psig

TABLE 5
COPPER SULFATE
CHEMICAL METERING PUMP SCHEDULE

Pump Tag No. Quantity	MP-COPPER-MP-1, 2, 3
Service Temperature	68-104° F
Service Specific Gravity	2.2-3.0
Service Viscosity	--
Service Vapor Pressure	--
Capacity, Range, GPH	0.12-12.3
Operating Pressure, psig	100
Pump Type	Centrac S
Pump Head Material	316 Stainless Steel
Number of Heads	Simplex
Diaphragm Material	PTFE (Teflon)
Internal Ball Check Valve Material	Ceramic
Suction/Discharge Size	1/2-inch
Speed Control	Yes
Motor Horsepower	1
Motor Power Requirement	120/1
Motor RPM	1,800
Motor Enclosure	CISP-TEFC
Calibration Chamber Capacity	4,000 mL
Calibration Chamber Material	PVC
Back Pressure and Safety Valve Quantity	1 Each
Back Pressure and Safety Valve Material	PVC
Back Pressure Valve Size	1-inch
Back Pressure Valve Pressure Setting	50 psig

TABLE 6
CHEMICAL INJECTION DIFFUSERS

Feed Point No.	Chemical	Line size, inches/ tube length	Line Number	Location
1	Copper Sulfate	1" / 5.0" & 6.0"	P59, 60	20" & 24" South Lagoon Inlet
2	Powdered Acitvated Carbon	2" / 5.0" & 6.0"	2	20" & 24" Raw Water FM
3	Ferric Sulfate	Existing 1"	P39	24" Actiflo inlet
4	Polyalumin (PACL)	Existing 1"	P45	24" Actiflo inlet
5	Actiflo Poly	Existing 2"	P56, 57	Raw Water Main
6	Actiflo sand	1 1/2" pipe	P49, 50	Actiflo unit 1 & 2
7	Sodium Hypochlorite	Existing 1"	P25, 26	24" Actiflo & Filter Inlet header
8	Filter Aid Poly	1" / 6.0	P64	24" Filter Inlet header
9	Caustic Soda	Existing 1 1/2"	P7	20" & 24" Raw Water FM
10	Sodium Hypochlorite	Existing 1"	P27	30" Filter Effluent Header
11	Caustic Soda	Existing 1"	P8	30" Filter Effluent Header
12	Corrosion Inhibitor	Existing 1"	P62	30" Filter Effluent Header
13	Fluorosilicic Acid*	1" / 7.5"	P16	30" Filter Effluent Header

*Solution tube and all wetted components shall be made from Hastelloy C.

END OF SECTION

Part 1 General

1.01 Scope (MP-ACTFL-BL-1)

A. The work covered in this Section consists of furnishing all labor, equipment and material required to furnish one rotary displacement air blowers, accessories, controls and all spare parts as specified herein. The blowers will be installed for sand eductor system.

B. Accessories that the blowers shall be provided with, include but are not necessary limited to, are inlet filters, inlet silencers, discharge silencers, pressure gauges, temperature gauges, expansion couplings, check valves, butterfly valves and relief valves.

1.02 Design Requirements

A. Operating requirements for blowers shall be as shown in Table 1 of this Section.

B. Blowers shall be frame mounted, V-belt driven with side inlet and discharge connections as shown on the Drawings.

C. Each blower shall function at the rated capacity throughout the specified temperature and barometric pressure ranges without exceeding the motor nameplate rating.

D. Each complete unit shall be designed to produce an installation of minimum noise and vibration and of maximum possible efficiency. All parts of the motor and blower shall be designed to withstand, without failure, distortion or damage, the maximum stresses to which they may be subjected in the course of operation.

1.03 Factory Testing

A. One of each type of blower included in this Section shall be subjected to a certified performance test at the manufacturer's test facility using the job motor per a one psi ASME PTC-9 slip test. Certified performance curves shall be presented consisting of the blower characteristics at 100 percent rotational speed.

B. Curves shall be plotted and shall consist of: Capacity in cfm at inlet versus discharge pressure, in psig, from 50 to 100 percent of discharge pressure to the extreme design conditions over inlet temperature of 100 degrees F.

C. The test curves shall be submitted to the Engineer with operating and maintenance data.

1.04 Submittals

A. Submit shop drawings in accordance with the requirements of Section 01340 of these Specifications.

B. Operation and maintenance manuals shall be furnished in accordance with the requirements of Section 01730 of these Specifications.

1.05 Storage and Protection

A. Blowers and accessories shall be stored and protected in accordance with Section 01611 of these Specifications and the manufacturer's recommendations.

B. Blowers shall be completely drained prior to shipment. Suction and discharge ports shall be provided with plastic plugs. Each blower shall be secured to a wooden skid to facilitate handling and storage.

1.06 Quality Assurance

The packager/supplier shall furnish a 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. The blowers shall be manufactured by Roots model 33 URAI, Spencer or Sutorbilt.

B. The packager/supplier shall be an authorized agent of the blower manufacturer for assembly of package blower systems as specified herein for the type of blower used.

2.02 Blowers

A. Blowers

1. Each blower shall be rotary lobe, positive displacement type, of the two-lobe involute design. The impeller casings and end plates shall be of a close-grained, high strength cast iron.

2. The casing and end plates are to be suitably ribbed for strength and to prevent distortion under operating conditions.

3. The impellers shall be cast or ductile iron and shall be accurately balanced, statically and dynamically. The shaft shall be integral with the impeller or made separately of steel. The impellers shall be balanced, after profiling, by metal removal and not by adding counter weights. The impellers shall operate without rubbing or liquid seals or lubrication and shall be positively timed by a pair of matched gears.

4. Gears and Bearings: The shafts shall run in heavy duty bearings having a minimum B-10 life of 60,000 hours; timing gears shall be AGMA quality 12 or better.

5. Lubrication

   a. The timing gears and gear-ending bearings shall be splash oil lubricated by oil slingers mounted on the shaft.

   b. Drive end bearings shall be oil or grease lubricated with provisions for replenishing lubricant.

6. Seals

   a. A positive seal shall be provided at each bearing and at each point where a shaft passes through a headplate. The impeller side of shaft seals shall be vented to atmosphere to protect the seals and prevent carry over of lubricant into the air stream. No lubricant shall enter the impeller chamber.

   b. The seals on the drive end and driven end bearing housings shall be of the labyrinth type and shall have air vents incorporated in the end plates to prevent oil penetration into the air chamber, and relieve excessive pressure on the seals. The seals shall have internal viton O-rings to prevent air penetration down shafts into oil chambers.

7. The end covers shall be complete with amply sized oil sight glasses for observation of the oil levels.

B. Base Plates: The blower, complete with driving motor and drive guard, filters, silencers, couplings and all valves and related piping specified herein shall be factory mounted on a rigid, fabricated steel base for shipment and installation as a single unit. The inlet silencer shall be horizontally mounted between the blower and the motor; and the outlet silencer shall be horizontally mounted above the blower. Support of the blower and silencers shall provide for expansion and contraction without stress being applied to the equipment piping or base frame. The base shall be properly reinforced for stiffness and of sufficient area to carry the total load to the foundation. Piping and silencers shall be lagged and frames shall be grouted for additional vibration dampening. Lagging shall include all hot piping within reach of operator to insulate and protect operator from heat.

C. High Discharge Temperature Switch: Each blower shall be furnished with an adjustable high-temperature switch, designed to open at 225 degrees F which shall stop the blower. The switch shall be general purpose type, 120 volt, NEMA 4X as required and shall include a remote 3/4-inch IPS stainless steel bulb with thermo-well, and sufficient length of copper capillary tubing.

2.03 Motor

A. Motors shall be designed and manufactured in accordance with the NEMA standards and shall have the following characteristics:

Design B
1,800 RPM
460 volt, 60 Hz, 3 phase
Class B Insulation
Service Factor: 1.15
Continuous Duty
Open Drip-Proof

B. The motors shall be capable of delivering full rated horsepower, continuously, throughout their range and the motors shall not operate within the service factor.

C. Motors shall be as specified in Section 16150 of these Specifications.

D. Motors shall be connected to the blowers through a V-belt drive arrangement with provisions for convenient adjustment of belt tension. The V-belt drive shall be sized with a minimum safety factor of 1.5.

2.04 Accessories

A. The packager/supplier shall provide all required accessories and appurtenances for a complete installation including, but not limited to:

1. Intake Air Filters

   a. Intake air filter shall be of the dry media type, with heavy, cellulose resin-impregnated media armored with galvanized wire cloth. All materials shall be corrosion resistant. Media shall be capable of 98 percent efficiency on particles with a mean diameter of 3 microns and 99 percent efficiency on particles with a mean diameter of 10 microns or more. Headloss through the filter/silencer shall not exceed 3-inches of water for a clean filter.

   b. Media shall be capable of particle removal as required by the blower manufacturer. The filter shall be designed to pass at least 150 percent of blower design capacity and its efficiency shall not be affected by varying air velocities. The filter shall have a flange type connection compatible to ANSI B16.1, Class 125.

2. Silencers

   a. Each blower shall be provided with inlet silencer directly connected to the blower inlet and a discharge silencer coupled to the discharge port with a flex connection. Silencers shall be of the combination chamber absorption type, constructed of heavy gauge steel conforming to ASTM A 283, Grade B. Filter shall have flange connections in accordance with ANSI/ASME B16.1, Class 124. Provisions shall be made for draining accumulated moisture from the silencers. Acoustical material shall be hairfelt, fiberglass or stainless wool.

b. Silencers shall be capable of an average attenuation of 25-30 dBA, and shall have a pressure drop through each unit of not more than 8-inches of water column at blower design discharge conditions.

c. The blower, silencers, valves and accessories shall be mounted on a common skid for shipment and installation as a single unit. Silencers shall be provided with support mounting brackets, as required.

3. Relief Valves: Each blower shall be furnished with one relief valve for installation on the blower discharge piping. Valves shall be sized to provide adequate protection for the blower and motor in case of operation against a closed discharge valve. Valves shall conform to ASME Unfired Pressure Code Requirements. Valves shall be either all bronze or cast iron and minimum sizes shall be as indicated on the Drawings. Valves shall have flanged connections conforming to ANSI/ASME B16.1, Class 125. The relief valve shall be set at not less than 1 psi per manufacturer recommendations. The relief valve shall be the weighted type, capable of relieving the total air flow without overloading the motor, blower or drive assembly. Relief valves shall be equal to those manufactured by Roots Division, Dresser Industries, Inc.

4. Discharge Check Valves: Each blower shall be furnished with a split disc type, wafer body check valve for mounting on the discharge piping of the blower. Valves shall have cast iron bodies and aluminum-bronze plates with 316 stainless steel pins and springs with viton seals. Valves shall be suitable for use on compressed air at pressures varying up to 10 psig and temperatures up to 250 degrees F. Valves shall be of the size as indicated on the Drawings and shall have flanged connections conforming to ANSI/ASME B16.1, Class 125. Valves shall be equal to Mission Valve and Pump Co., DUO-CHEK II.

5. Thermometer: Each blower shall have a suction and discharge thermometer installed on the discharge pipe. The range shall be inlet thermometer: minus 20 to 120 degrees F, discharge thermometer: 30 to 300 degrees F. The thermometers shall have a 3-1/2-inch face and shall be equal to American or Ashcroft. The thermometer shall be a bi-metallic type dial thermometer with hermetically sealed stainless steel case. Mount inlet thermometer between the inlet butterfly valve and the blower intake silencer flange. Mount the discharge thermometer between the discharge check valve and the discharge butterfly valve.

6. Pressure Gauges: Each blower shall have a vacuum gauge on inlet side and pressure gauge on discharge side before and after the silencer. Vacuum gauges shall be magnehelic type with 4-inch face, zero and adjustment screw aluminum case and diaphragm actuated equal to Dwyer Instruments, Inc., Series 2000. Pressure gauges shall be bourdon tube type, stainless steel case and tube with a 3-1/2-inch face equal to American or Ashcroft. The range shall be:

a. Vacuum Gauge on Inlet side: 0 to 30-inches.

b. Pressure Gauge on Discharge Side: 0 to 15 psig.

7. Expansion Couplings

a. Each blower shall be furnished with reinforced, flexible, single filled, arch spool type, rubber expansion joints as manufactured by FedValve or Metraflex. Couplings shall be installed at locations as shown on the Drawings. Couplings shall have full faced flanges and galvanized steel split rings drilled to match the adjacent flanges. Steel washers shall be used at the joint where the rings are split. Flanges shall conform to ANSI/ASME B16.1, Class 125.

b. Discharge couplings shall have a minimum pressure rating of 65 psig and temperatures of up to 300 degrees F and shall be provided with retaining bolts. Inlet couplings shall be suitable for a maximum vacuum of 24-inches at temperatures up to 300 degrees F.

8. Butterfly Valve: Furnish flanged butterfly valves for isolation of each blower from the aeration headers and as shown on the Drawings. Butterfly valves shall be of the size indicated on the Drawings. Valves shall be suitable for use on compressed air at pressures varying up to 10 psig and temperatures up to 250 degrees F. Valves shall have ductile iron bodies and disc, 18-8 stainless steel stem and viton resilient seat and flange seal equal to Keystone Figure 122. Valves shall have manual actuators installed by the valve manufacturer. Actuator shall be designed with field adjustable stops and be capable of holding the disc stationary in any position under full rated pressure. Actuator shall be fully enclosed and designed to withstand 300 foot-pounds of input torque without failure. Valves six feet or more above the floor shall be furnished with a geared operator, chainwheel and chain for operation from floor level. Valves less than 12-inches shall have a handwheel operator.

2.05 Controls

A. Control panel shall be furnished by the blower manufacturer. Designation is FCP-ACTFL-1.

B. Power Supply: 480 volts, three phase. All controls shall operate on 120 volts maximum. Provide a suitably sized control power transformer with primary and secondary overcurrent protection. Provide a control panel main disconnect switch.

C. Enclosure: NEMA 4X.

D. Components

1. Starters: NEMA rated, circuit breaker combination type, with overcurrent protection in each phase. Interrupting capacity is a minimum of 42,000 amperes symmetrical.

2. Relays: Heavy duty industrial control type, 10 amp 600 volt reversible contacts, equal to Square D Class 8501 Type X.

3. Programmable Logic Controller (PLC): At the manufacturer's option a PLC may be used to accomplish control logic. Provide a minimum of 10 percent spare I/O points, interposing relays as specified above for external status/control signals, and hand held programmer. Acceptable manufacturers are Allen-Bradley, General Electric, Square D, Texas Instruments and Westinghouse.

4. Selectors and Pushbuttons: Heavy duty, oil-tight with octagonal ring.

5. Indicating Lights: Heavy duty, oil-tight, transformer type with lens colors as follows:

Color	Function
Green	Motor Run
Red	Motor Stop
Blue	Call to Run
Amber	High Temperature Alarm Vibration Alarm
White	Power On

E. Panel Construction: Route all wiring in Panduit or similar wireways. Protect all wiring across panel hinges. Provide numbered terminal strips for all field wiring terminations. Use barriers to separate 480 volt from 120 and lower voltage sections.

F Remote Signals

1. Panel shall receive the following:

   a. 1, dry contact.

2. Panel shall provide the following:

   a. 1, 10 amp form "C" dry contact.

H. Panel Functions

1. Control Functions

   a. On/Off pushbutton for starting and stopping of each blower. Status lights shall indicate high discharge temperature and vibration alarm conditions. Control shall not allow automatic restarting of blowers upon clearing alarm conditions.

b. Automatic stop upon detection of high discharge temperature or vibration alarm conditions.

2. Status Functions

a. Elapsed run time meters for each blower.

b. Common horn with silence pushbutton. Horn shall annunciate high discharge temperature and vibration alarms.

c. Status lights shall indicate blower run/stop status.

d. Status lights shall indicate high discharge temperature and vibration alarm conditions.

e. Status light shall indicate power on status.

2.06 Tools and Spare Parts

A. The following spare parts shall be furnished for each blower, suitably boxed and plainly labeled:

1. Two complete sets of bearings for total bearing replacement.

2. One set, complete of all shaft seals.

3. One set of gaskets.

4. Eight spare filter elements.

5. Two complete sets of spare V-belts.

2.07 Shop Painting

All materials specified under this Section shall be shop primed as part of the work under this Section. Surface preparation and paint shall be as specified in Section 09900 of these Specifications.

Part 3 Execution

3.01 Installation

A. The blowers as described in Part 2 of this Section, including all appurtenances, shall be installed in strict accordance with manufacturer instructions, tested and adjusted for satisfactory operation.

B. Items such as field wiring, piping and ductwork, not furnished by equipment manufacturer, but required for installation and operation, shall be furnished and installed by the Contractor.

3.02 Inspection and Field Testing

A. Following installation, operating tests will be performed to demonstrate to the Engineer that the rotary positive displacement blowers will function in a satisfactory manner.

B. The blowers shall operate without overheating, oil leakage, vibration, excessive wear or noise. The Contractor shall make, at Contractor's expense, all necessary changes, modifications, and/or adjustments required to assure satisfactory and efficient operation.

3.03 Manufacturer's Services

A. Furnish the services of a factory representative for one, eight hour day(s) 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, having complete knowledge of proper operation start-up procedure and maintenance requirements, for one, eight hour day(s), to inspect the final installation and supervise a test run of the equipment.

C. Furnish the services of a factory representative, having complete knowledge of proper operational and maintenance requirements of the system, for one, eight hour day(s). The factory representative shall instruct the Owner's personnel in the proper operation of the equipment.

3.04 Field Painting

All shop primed surfaces shall be cleaned and painted as specified in Section 09900 of these Specifications.

3.05 Cleaning

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

TABLE 1

ROTARY POSITIVE DISPLACEMENT BLOWERS

Description	Location
Equipment No.	MP-ACTFL-BL-1
System Requirements, Required SCFM	70
System Requirements, @ psig	10.4
Site Conditions, MSL, Elevation	760
Site Conditions, Barometric Pressure, psia	14.28
Site Conditions, Maximum Ambient Temperature, °F	100
Site Conditions, Relative Humidity, %	36
Blower Capacity, Inlet ACFM	80
Blower Inlet Pressure, psia	14.08
Blower Discharge Pressure, psia	10
Maximum Blower Speed, rpm	2210
Maximum Blower Gear Tip Speed, fpm	2025
Minimum Blower Motor HP	7.5

END OF SECTION

Part 1 General

1.01 Scope

A. The work covered by this Section includes furnishing all labor, materials, equipment and services required to furnish and place in satisfactory operation.

B. The strainers shall be furnished complete, including body, cover, baskets and connections simplex basket type strainers. The manufacturer shall be responsible for the proper coordination and integration of the strainers and the compatibility of all components.

1.02 Design Requirements

A. The Contractor shall furnish and install strainers for chemicals shown in Table 1 of this Specification.

B. Component Requirements: Where manufacturer's recommendation is stated in Table 1, the manufacturer shall provide chemical resistance data for the material being furnished.

1.03 Submittals

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

B. Shop drawings shall be prepared and assembled by the listed manufacturers. Shop drawings prepared and assembled by manufacturer's sales representatives, fabrication shops or other than the listed manufacturers will not be accepted.

C. Operation and maintenance manuals shall be furnished in accordance with the requirements of Section 01730 of these Specifications.

1.04 Storage and Protection

The equipment shall be stored and protected in accordance with the manufacturer's recommendations and Section 01640 of these Specifications.

1.05 Quality Assurance

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

Part 2 Products

2.01 Acceptable Manufacturers

The strainers shall be equal to those manufactured by Hayward Industrial Products, Inc.

2.02 Construction and Materials

A. Strainer connections shall be as shown in Table 1 of this Specification.

B. Bodies and screens shall be manufactured of material as shown in Table 1.

C. Screen mesh shall be as shown in Table 1. All screen mesh sizes shall have a minimum of 6:1 ratio of open area through the strainer basket to the cross-sectional pipe areas.

D. The strainer basket shall be removable by hand and require no tools for removal, replacement, maintenance and re-installation. The top shall have a screwed connection with O-ring seals. O-ring material is shown in Table 1.

E. All strainers shall be rated for an operating pressure of 150 psig at 75°F.

F. All strainer bodies shall have a 3/8-inch NPT valved drain. The drain shall also serve to relieve pressure when the basket must be removed.

Part 3 Execution

3.01 Installation

The strainers as described in Part 2 including all appurtenances shall be installed in accordance with the manufacturer's recommendations.

3.02 Inspection and Testing

Following installation, the strainers shall be pressure tested as part of the piping. After testing, and before the piping in which the strainer is installed, the piping shall be flushed, the strainer basket checked and emptied and the strainer placed into service. The Contractor shall make, at Contractor's own expense, all necessary changes, modifications and/or adjustments required to ensure satisfactory operation.

3.03 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.

TABLE 1

PLASTIC CHEMICAL STRAINERS

Description						
Chemical Service	Ferric Sulfates & Hyper+Ion 1750	Fluoride	Caustic Soda 50%	ACTIFL Polymer	Sodium Hypochlorite	Copper Sulfate
pH	3.5	1.2	14	3.5-5.5	12-13	4.0
Specific Gravity	1.28-1.6	1.24	1.52	.8-1	1.07-1.26	2.28
Viscosity, cps	No Data	3	3			-
Temperature	60	60	60	60	60	60
Strainer						
Size, inches	1	1	1	1		1
Simplex (S) Duplex (D)	S	S	S	S	S	S
Connections	Screwed	Screwed	Screwed	Screwed	Screwed	Screwed
Body Material	PVC	PVC	PVC	PVC	PVC	PVC
O-Ring Material	*mfr. rec.	*mfr. rec.	*mfr. rec.	*mfr. rec.	*mfr. Rec.	*mfr. Rec.
Screen						
Material	PVC	PVC	PVC	PVC	PVC	PVC
Diameter Openings	1/16	1/16	1/16	1/16	1/16	1/16
% Open Area	22	22	22	22	22	22
Cv Factor	125	125	125	125	125	125

* Mfr. rec. implies manufacturer to recommend standard material for service.

END OF SECTION

Part 1 General

1.01 Scope (MP-COPPER-FDR-1)

A. The work covered by this Section includes furnishing all labor, materials, equipment and services required to furnish, install and place in satisfactory operation, dry chemical feed equipment herein specified and shown on the Drawings.

B. Dry chemical feeder and accessories shall be provided as outlined in Table 1 of this Section.

1.02 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.

1.03 Storage and Protection

The system shall be crated and shipped as a unit, without weldment to the tank proper. Equipment and accessories shall be stored and protected in accordance with the manufacturer's recommendations.

1.04 Quality Assurance

The manufacturer shall furnish a written certification to the Engineer that all equipment furnished complies with requirements of these Specifications.

Part 2 Products

2.01 Acceptable Manufacturers

The chemical feeder hereinafter specified shall be supplied complete by a single manufacturer, together with all accessories and appurtenances necessary for a complete operating installation as shown on the Drawings. Chemical feeder shall be manufactured by Acrison, Series W-105, with Acrison Model 060 SCR/DC controllers.

2.02 Feeder and Miscellaneous Feeder Accessories

A. Volumetric Feeder

1. The feeder shall employ a dissimilar speed, Double Concentric Auger Metering Mechanism to ensure accurate, continuous, constant density material flow without flooding or bridging. The feeder housing shall be dust-tight with a minimum of 11 gauge stainless steel construction. The feeder shall be heavy-

duty and designed to provide easy cleaning without the need for removing the feeder from its mounting, or disassembling flexible connectors, hoppers, or removing the dissolving tank. The feeder shall be constructed to provide complete access to its internal components by simply removing its discharge spout. The feeder's double augers, drive shafts, and seal housing shall be constructed of 304 stainless steel; the seals shall be synthetic.

2. The Double Concentric Auger Metering Mechanism shall consist of a solid shaft metering auger and a concentric, 6-inch diameter conditioning auger (Intromitter). The larger conditioning auger (Intromitter) shall span the full length of the feeder chamber and shall be driven at a slower speed than the smaller metering auger, thereby increasing the torque capability for low speed starting and eliminating the possibility of the metering auger tunneling in the material.

3. All chemical contact areas of the feeder including the double augers, seal assembly, and discharge cylinder shall be constructed of 316 stainless steel. Minimum sheet metal thickness shall be 11 gauge and all welds shall be continuous. Feeder chambers constructed of FRP or fiberglass will not be considered.

4. Feeder Drive: The feeder shall be complete with a full wave variable speed SCR/DC drive with armature feedback having a 30:1 output speed range. All speed adjustments shall be stepless and can be made with the feeder operating. The SCR/DC controller shall include a three digit thumbwheel speed selector, and on-off switch, and line and armature fuses. Speed adjustment repeatability shall be ±0.5% of setting. The feeder shall operate on a 115 volt, 50/60 Hertz, single phase power supply. The motor shall be designed and manufactured in accordance with the standards of NEMA and shall have the following characteristics:

   a. Standard DC, SCR controlled variable speed drive.

   b. Maximum HP: 1.

   c. 180 volt armature, permanent magnet field.

   d. Totally enclosed, non-ventilated.

      i. Feeders shall be provided with tachometer (SC-XXX) to monitor and transmit 0-100 percent actual speed of the helical screw.

      ii. Motor shall be Baldor, General Electric, Westinghouse, Reliance, or U.S. Electric.

5. Metering Accuracy: The feeder shall have a volumetric metering accuracy of ±1% (error) for free flowing chemicals and a maximum of ±2% (error) for non-free flowing chemicals based on a given number of consecutive one minute samples.

B. Accessories

1. Feeder Storage Hopper: The feeder shall be supplied with an integral storage hopper to provide 3 cubic feet of storage capacity. The hopper shall be constructed of 11 gauge 316 stainless steel. Hoppers constructed of FRP or fiberglass will not be considered.

2. Storage Hopper Level Probe: The storage hopper level probe shall be provided with paddle type, motor driven level probes to sense and indicate low level.

3. Storage Hopper Vibrator: The manufacturer of the storage hopper shall furnish, mounted on the hopper, a suitable electrical vibrator to prevent arching or bridging of the chemical. A vibrator controller and percentage timer shall be provided in the main control panel.

4. Dust Collector: The storage hopper of the feeder shall be equipped with a self-contained, high efficiency cloth filter dust collector complete with a 3/4 HP, 115 volt, 60 Hertz, single phase totally enclosed motor. The filter cloth area shall be at least 60 square feet. The dust collector shall have a manual shaker, loading chute with a hinged cover and bar screen. The dust collector shall be constructed of mild steel and painted by the dust collector manufacturer with their standard paint. The dust collector shall include a local on/off switch equipped with a starter mounted on the unit.

5. Solution Tank: The solution tank shall be fabricated of 11 gauge, 316 stainless steel, have a minimum working capacity of 50 gallons, and shall be complete with a full cover. The solution tank shall have a water supply inlet, drain, discharge outlet, and a bottom flange for fastening it to the base or floor. Solution tanks constructed of FRP or fiberglass will not be considered.

6. Vapor Remover: The solution tank shall have a vapor removal unit to prevent vapors from rising into the feed mechanism. The Contractor shall pipe the discharge of the dust and vapor remover to a nearby drain.

7. Feeder Base: The feeder shall be placed on a 304 stainless steel frame base capable of supporting the feeder and its accessories.

8. Solution Tank Mixer: The solution tank shall have a slow speed mechanical mixer having a 316 stainless steel shaft and impeller, driven by a suitably sized 900 RPM minimum 1/2 HP, totally enclosed motor. Impeller speed shall not exceed 900 RPM.

9. Level Probes: The solution tank shall include high and mid level 316 stainless steel conductance type level probes. The mid level probes shall start the feeder and open the inlet water solenoid. The high level probe shall stop the feeder and close the solenoid. Also, high-high level and a low level probe shall stop the feeder and close the solenoid. Also, high-high level and a low level probe shall be provided for alarm. The level probes shall be mounted on the solution tank cover in a water-tight 316 stainless steel housing.

10. Rotameter and Valves: The feeder manufacturer shall supply a suitably sized rotameter (manufactured of PVC/Acrylic), solenoid valve (constructed of brass) and a throttling valve (constructed of bronze) to control water inflow to the dissolving tank for preparation of a constant strength solution in conjunction with other controls.

11. Access Platform: A platform with stairs shall be provided. The entire assembly shall be constructed of 304 stainless steel and comply with all OSHA standards.

C. Feeder Control Panels

1. The feeder control panels shall be factory built, shall be NEMA 4X stainless steel enclosure for strut-mounted installation, assembled and delivered to the jobsite ready for installation by the Contractor. The control panel shall function by feeding chemicals at a set federate into the solution tank based on a linear 4-20 Ma signal proportional to 0-100 percent feed rate (automatic control mode).

2. When the system is energized and/or operating under normal conditions, contacts shall close that turn on a remote "run" indication light, control in auto light and a feeder fault contact when the feeder is ready. Should a malfunction occur, the contact shall open causing the remote light to deenergize, a control panel alarm to sound, and a control panel-mounted indication light to activate.

3. The control panels shall have timers and accessory devices to activate vibrators and switching intelligence for alarms and status. Power to the control panels shall be 480 volt, three-phase, 60 Hz. Provide CPT so all controls operate on 120 volt, single-phase.

4. The control panel shall include as a minimum the following:

   a. Manual speed control potentiometer for feeder motor.

   b. Speed readout meter.

   c. Dosage control potentiometer.

   d. Mechanical mixer On-Off switch, Run light and Alarm light.

   e. Feeder Hand/Auto speed control switch.

   f. Feeder On/Off control and run light.

   g. Hopper vibrator On-Off switch, amplitude controller and intermittent timer.

   h. High/High, mid and Low/Low hopper level lights and dry contact outputs for mid level to the plant control system.

   i. Time delay shutdown relay on low hopper alarm.

j. Dry contacts for control in Auto to the plant control system.

k. Dry contacts for run indication to the plant control system.

l. Dry contacts for system fault (master alarm) to the plant control system.

m. Alarm acknowledge pushbutton.

n. All required starters and relays.

D. Bag Loading Hopper: The storage hopper will be furnished with a single door bag loading hopper constructed of 11 gauge minimum 316 stainless steel. The bag loading hopper will be complete with bag spear and cam type clamps to hold the door in the closed position.

E. Rotameters: The manufacturer shall size and furnish a rotameter to permit accurate monitoring of water-to-chemical ratio. Rotameters for water service shall have EPR O-rings, acrylic tube, polysulfonate float stops, 316 stainless steel float and guide rod, PVC end connections, and shall be furnished with a 127 mm scale rated in gpm. Rotameter accuracy shall be ±2.5 percent of full scale. Rotameters shall be rated as shown on Table 3. Rotameters shall have 1-inch NPT connections. Rotameters shall be equal to Omega Model FL-75.

Part 3 Execution

3.01 Installation

A. Installation shall be in strict accordance with the respective manufacturer's instructions and recommendations in the locations shown on the Drawings. Installation shall include furnishing any required oil and grease in accordance with the manufacturer's recommendations. Anchor bolts shall be stainless steel and shall be set by the Contractor, for installation under Division 3, in accordance with the manufacturer's recommendations and approved shop drawings.

B. The Contractor shall reconnect existing control and power wiring to the new equipment.

3.02 Surface Preparation and Shop Painting

All surfaces shall be prepared and shop primed as part of the Work under this Section. Surface preparation and shop priming shall be as specified in Section 09900 of these Specifications.

3.03 Field Painting

Field painting for items not shop painted shall be in accordance with the requirements of Section 09900 of these Specifications.

3.04 Manufacturer Service

A. Furnish the services of a factory representative for one, eight hour days 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 for two, eight hour days, who has complete knowledge of proper operation start-up procedure and maintenance requirements, to inspect the final installation and supervise a test run of the equipment.

C. Furnish the services of a factory representative for two, eight hour days who has complete knowledge of the operational and maintenance requirements of the system. The factory representative shall instruct the Owner's personnel in the proper operation of the equipment.

3.05 Cleaning

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

TABLE 1

DRY CHEMICAL FEEDER SCHEDULE

Equipment No.	MP-COPPER-FDR-1
Type	Volumetric
Service	Copper Sulfate
Product Density (lbs/CF)	75
Capacity Design pounds per 24 hour day	17.2-517
Helix Minimum Diameter	6.0/1.5
Sprout Material	316 Stainless Steel
Drive Type/Size	SCR/1/2 HP-DC
Feeder Control	Local/Stop
Feed Rate Control	Hand/Auto
Dosage Control (Auxiliary Mode)	Manual Ratio
Hopper Agitation	Electric Vibration with Timer
Solution Tank Capacity/Material	50 gallons/316 SS
Solution Tank Mixer	1/2 HP - AC
Water Control	Rotameter Panel

END OF SECTION

Part 1 General

1.01 Scope (MP-FL-DT-1; MP-FL-T-1)

A. The work covered by this Section includes furnishing all labor, materials, equipment and services required to furnish, install and place in satisfactory operation, liquid chemical storage tanks.

B. The chemical storage tanks shall be furnished complete, including all connections, supports, and accessories required for proper operation, access, and maintenance of the tank. The supplier shall be responsible for the proper coordination of piping locations as shown on the Drawings and compatibility of all components.

C. Submit shop drawings on support system for storage tanks and piping meeting the seismic requirements of the 2002 Kentucky Building Code for Seismic Use Group III and Seismic Design Category "C". Shop drawings shall be stamped and signed by a professional engineer registered in the State of Kentucky.

1.02 Design Requirements

A. The tank shall be designed to meet the service conditions shown in Table 1.

B. The minimum wall thickness of the tank shall be based on a maximum allowable hoop stress of 600 psi.

1.03 Factory Testing

A. Each tank shall be hydrostatically tested by the manufacturer prior to shipment. The test medium used for testing shall have the same specific gravity of the chemical for which the tank was designed.

B. Samples from each tank shall pass low temperature impact test (-20 degrees F) following the Association of Rotational Molders Low Temperature Impact Test Procedure. The minimum low temperature impact based on part wall thickness shall be as follows:

Wall Thickness, Inches	Foot/Pounds to Fail (Minimum)
1/4 - 1/2	100
1/2 - 3/4	150
3/4 - 1-1/2	200

1.04 Submittals

A. Shop drawings and product data shall be submitted in accordance with the requirements of Section 01340 of these Specifications. Product data shall show that all materials are compatible with intended chemical service.

B. Operation and maintenance manuals shall be submitted in accordance with the requirements of Section 01730 of these Specifications.

1.05 Storage and Protection

Equipment and accessories shall be stored and protected in accordance with the manufacturer's recommendations.

1.06 Quality Assurance

The manufacturer shall furnish a written certification to the Engineer that all equipment furnished complies with all applicable requirements of these Specifications.

Part 2 Products

2.01 Acceptable Manufacturers

Tanks shall be manufactured by the Norton Company or Poly Processing, Inc.

2.02 Materials and Construction

A. Each tank shall be manufactured using the Rotomolding process to produce a one piece tank that is stress free. Each mold shall be loaded with a resin and then rotated simultaneously around two axes while being processed. The powdered resin shall be fused into a seamless, homogeneous monolithic structure of uniform wall thickness as measured at the same elevation of the tank shell.

B. Each molded tank shall be internally and externally inspected for pinholes, foreign particles, blemishes or other defects which could reduce the structural integrity of the tank.

C. The tank shall be constructed of resin material. Nominal physical properties of the material to be used shall meet the following:

Property*	ASTM	Units	Value
Density**	D 1505	g/cc	0.937-0.940
ESCR (Specimen thickness 125 mils/3.2 mm), F50-10% Igepal	D 1693	hrs	>1000
Ultimate Tensile Strength	D 638/2" Type IV	(50 0.8 mm)/min. psi	2600

Property*	ASTM	Units	Value
Elongation at Break	D 638		
2" (50 0.8mm)/min.	Type IV	%	450
Heat Distortion/Temperature	D 648	°F	150
Brittleness Temperature	D 746	°F	< - 180
Flexural Modulus	D 790	PSI	100,000

* Physical properties are based on parts molded at optimum conditions.
** Density of the crosslinked product.

D. All resin used shall be virgin, crosslinkable, resin and no reground material may be added. The resin shall have a minimum of 0.3 percent UV 531 light absorber, or an equivalent UV system.

E. The inside 1/8-inch of the tank wall shall have a minimum of 70 percent gel as determined by ASTM D 2765 Procedure B, or by the Phillips 66 Company Procedure found in Phillips 66 Company Publication TSM-291, Quality Control Test for Crosslinking of Marlex CL series.

F. The exterior surface shall have the chemical name and Equipment Tag No. stenciled in block style letters in each quadrant. All letters shall be 2-inches high.

G. Each tank shall be furnished with a vent filter designed to prevent chemical vapor from escaping when filled and moisture from entering the tank on emptying of the chemical. The Contractor shall provide and install the filter and provide piping from tank to filter as shown on the Drawings.

H. Each tank shall be furnished with graduated level indicator attached to the side of each tank, indicating volume in gallons.

2.03 Accessories

A. Fittings

1. Side Wall Fittings

a. If plastic fittings are required below the liquid level, they shall be two-flange style. The flange shall be constructed of PVC or other specified material. There shall be a minimum of four thread bolts with bolt heads encapsulated in polyethylene. The polyethylene encapsulation shall fully cover this bolt head a minimum of ¼-inch of the threads closest to the bolt head shall be color-coded to distinguish bolt material (Green – 316 stainless steel; Red – Alloy C276; Blue – Monel, Black – Titanium). Each bolt shall have a gasket which is on the inside of the tank.

b. Stainless steel fittings shall be compressing-type with a minimum of four studs welded to the back plate for tightening. Each fitting shall have a

gasket which shall be compressed between the inside of the tank wall and the back plate of the fitting. Stainless steel fittings shall be offered with full male, full female or half-female NPT.

2. Dome Fittings

   a. All plastic fittings 4-inches and below on the dome of the tank shall be two-flange, universal ball type. The flange components shall be constructed of PVC or other specified material. There shall be a minimum of four bolts with polyethylene encapsulated heads. Each bolt shall have a gasket which is on the inside of the tank.

   b. Plastic fittings 6-inches and larger shall be welded through the dome type. The fittings shall be fabricated from PVC or other specified material. There shall be a minimum of eight bolts with polyethylene encapsulated heads. Each bolt shall have a gasket which is on the inside of the tanks. All nozzles shall be flanged.

B. All pipe connections shall be supplied with flanged, single arch, expansion couplings made in accordance with Section 15095 of these Specifications. The couplings shall be designed for the intended chemical service as shown in Table 1.

C. Sight Tube Assembly for Storage Tanks.

1. Tubular type PVC with 2-inch flanged connections.

2. Furnish with diaphragm valves, drain cock, and stainless steel guard rods.

3. All parts coming in contact with liquid shall be PVC.

4. Calibrate the tank in 100-gallon increments and paint the calibrations adjacent to the level tube with graduations and boldface figures.

5. Manufacturers:

   a. Ernst.

   b. Clark-Reliance (Jacoby-Tarbox).

D. Sight Tube Assembly for Day Tanks:

1. Tubular type PVC with 1/2-inch flanged connections.

2. Furnish with diaphragm valves, drain cock, and stainless steel guard rods.

3. All parts coming in contact with liquid shall be PVC.

4. Calibrate the tank in 10-gallon increments and paint the calibrations adjacent to the level tube with graduations and boldface figures.

5. Manufacturers:

   a. Ernst.

   b. Clark-Reliance (Jacoby-Tarbox).

E. Flanged top nozzle for level sensor shall be centered one-sixth of the tank diameter from the inside tank wall. No horizontal penetrations shall occur vertically below the flanged top nozzle on the same radial line.

F. Tanks shall be provided with the connections shown below. Unless otherwise shown, all connections shall be the bulkhead compression type of PVC with gaskets suitable for chemicals being used.

1. MP-FL-T-1

   a. 24-inch hinged, weighted manway cover with EPDM gasket allowing pneumatic fill of the tank.

   b. 3-inch combination fill line assembly with PVC piping and ball valves, external and internal pipe supports, EPDM gaskets, quick disconnect fittings, and cap.

   c. 4-inch overflow.

   d. 4-inch vent hard piped to the outside.

   e. 4-inch IMFO outlet/drain with 4 x 2-inch reducer, PVC ball valve.

   f. FRP OSHA approved ladder.

   g. FRP OSHA approved handrail – Top.

   h. PVC sight tube assembly

   i. XLPE tank pad.

2. MP-FL-DT-1

   a. 7-inch threaded cap with EPDM gasket.

   b. 2-inch combinations fill line assembly with PVC piping and ball valve, external and internal pipe supports, EPDM gaskets, quick disconnect fitting, and cap.

   c. 2-inch overflow.

   d. 3-inch vent piped to vent filter.

   e. 2-inch outlet/drain with 2 x 1-inch reducer, PVC ball valve EPDM gaskets.

f. PVC sight tube assembly

g. XLPE tank pad.

Part 3 Execution

3.01 Installation

The tank shall be installed in accordance with the tank manufacturer's recommendations.

3.02 Inspection and Testing

A. After tank has been installed and before piping connections are made and equipment attached, block all tank nozzles and fill the tank to the top of the straight wall with water. Presence of any leakage after a minimum saturation period of 24 hours will be cause for rejection of the tank and fittings.

B. After successful completion of hydrostatic tests, open all ports and nozzles and allow all tanks to completely dry out. Absolutely no chemicals are to be placed into any tankage containing residual of water and moisture.

3.03 Manufacturer's Service

The Contractor shall furnish one day start-up services by the respective equipment manufacturer's representative(s) to insure that the equipment has been properly installed and tested to provide continuous and satisfactory operation.

TABLE 1

POLYETHYLENE STORAGE TANKS

Equipment Tag No.	MP-FL-T-1	MP-FL-DT-1
Capacity, gallons	6800	55
Diameter, feet	10.0	1.92
Chemical Service	Fluorsilicic Acid	Fluorsilicic Acid
Specific Gravity	1.9	1.9
Liquid Temperature Range, °F	120	120
Freezing Temperature, °F	-4	-4
Bottom Type	Flat	Flat
Maximum Design Wind, mph	9	9
Maximum Concentrated Roof Live Load, pounds	1,000	1,000

END OF SECTION

Part 1 General

1.01 Scope (MP-CARBON-FDR-1)

A. The work covered under this Section includes furnishing all labor, materials, equipment and services required to furnish, install and place into satisfactory operation a complete system for storing and feeding powdered activated carbon (PAC) in bulk bags.

B. The PAC feed system shall include a volumetric feeder, eductor package, bulk bag lifting equipment, support tower, controls and instrumentation.

C. All motors and controls inside the carbon room shall be rated NEMA Class II, Group F, Division I in carbon area.

D. Material and labor required for MP-CARBON-FDR-1 shall be included as part of "Alternate Bid No. 1."

1.02 Design Requirements

A. The system shall be designed to store and feed design capacity of 70 pounds per hour of powdered activated carbon.

B. The system capacity shall be capable of being turned down to a minimum feed rate of 16.7 pounds per hour.

C. The system shall include a storage hopper that has a minimum volume of 1.5 cubic feet.

D. The hoist/trolley support tower and all accessories shall be designed for a maximum load of 2,000 pounds.

E. The system shall include all accessories required to provide a complete operating system.

F. The system shall be designed to handle bulk bags with a net weight up to 900 pounds.

G. (Norit only) provide a 5 scfm compressed air supply at 100 psig shall be provided by the manufacturer of the PAC System. The manufacturer shall provide piping and pressure reducing values as necessary to accommodate the system flow and pressure requirements of the system. Compressor shall Speedaire 4B22BD, rated at 135 psig.

H. A 25 gpm clean motive water supply at 80 psig shall be provided by the Contractor to the PAC system. The manufacturer shall provide piping and pressure reducing valves and booster pump (if required) as necessary to accommodate the system flow and pressure requirements of the system.

I. Furnish one 3/4-inch 304 stainless steel motor operated ball valve for installation at the MP-CARBON-FDR. Valve shall be rated for operation with 120 volt, phase power supply (CARBON-MOV-1). Valve shall open when reservoir raw water pump is in service. Valve shall be equal to Lunkenheimer Flg 304-ST top entry ball valves.

1.03 Submittals

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

B. Operation and maintenance manuals shall be furnished in accordance with the requirements of Section 01730 of these Specifications.

1.04 Storage and Protection

Equipment shall be stored and protected in accordance with the manufacturer's recommendations and Section 01611 of these Specifications.

1.05 Quality Assurance

The manufacturer shall provide a 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. The powdered activated carbon feed system shall be Acrison or Norit Americas, Inc.

B. Volumetric feeders shall be equal to Acrison.

C. Hoisting equipment shall be manufactured by Acco-Wright, Lift-Tech, Yale, or Shaw Box.

2.02 Support Tower and Bag Lifting Equipment

A. The support tower shall be designed to handle bulk bags weighing up to 2,000 pounds. The tower dimensions shall be a minimum of 5' x 5' 10-inch x 18 foot 2-inch tall. The tower shall be built from heavy-duty square tube steel conforming to ASTM A 36. The support tower shall include four baseplates to properly secure the unit to the foundation.

B. Trolley and Hoist

1. Trolley frame shall be constructed of steel plates, angles, and channels adequately braced to resist vertical, lateral and torsional forces and welded to form a rigid one-piece unit. Trolley frame will be machined to receive the hoist

and traverse mechanisms. The hoist shall be a parallel mounted, underhung type with two part, double reaving for use on a single girder.

2. Hoisting Machinery

   a. Hoisting machinery shall be rated for one-ton capacity, and shall consist of a two speed electric motor driving through necessary gear reductions to a winding drum. All shafts and couplings shall be splined. All gearing shall be enclosed in oil tight housings. Open gearing or deck-mounted hoists are not acceptable.

   b. Rope drum shall be fabricated steel and shall be grooved right and left hand for true vertical lift and receive full length of hoisting cable without overlapping. Two laps of wire rope shall remain on drum when hook is in low position.

   c. The diameter of the rope drum and running sheaves shall not be less than 16 times diameter of hoisting cable. Hoisting cable shall be stainless steel. Idler sheave shall not be less than 1/2 the diameter of running sheaves. All sheaves shall be steel or cast iron.

3. All hoist gearing shall be helical or spur, made from forged rolled, or cast steel and shall have machine cut teeth. All pinions shall be made from alloy steel and shall be heat treated.

4. All bearings shall be heavy duty, anti-friction, with proper means of lubrication. All gears shall operate in an oil bath in sealed housings providing positive splash lubrication for gears and bearings. Axle bearings, sheave bearings, and drum shaft bracket bearings shall be packed with grease and shall be lubricated through pressure type fittings or be permanently sealed with lifetime lubrication.

5. A Weston type mechanical load brake shall be provided in addition to the hoist motor brake. The mechanical load brake or electric braking system shall automatically regulate the speed during lowering and prevent undue acceleration. The mechanical load brake shall be capable of holding a full load, independent of hoist motor brake.

6. The hoist motor brake shall be magnetically operated, disc type operating in oil bath or shoe type, mounted on the extended pinion shaft. The brake shall be spring set, equally effective in both directions of motor rotation and of sufficient size to stop the motor and hold the rated capacity load. The brake shall set automatically when current is not flowing to the motor. There shall be no couplings between the brake and the load. Brake to be self-adjusting type during the life of the brake lining.

7. Trolley shall be driven by means of a two speed electric motor coupled to a spur, helical, or worm reducer located on the trolley side. All gears shall operate in an oil bath in sealed enclosures providing positive splash lubrication for gears and bearings or open grease lube on spur gearing. Trolley wheel axles shall be fixed type with permanently sealed bearings. Trolley wheels shall have single

flanges, machined to equal diameters in pairs and shall be steel with hardened tread.

8. Lifting tackle shall consist of a lower block, hook, sheaves, and extra flexible steel wire rope. Lower block shall have a heavy steel housing to support sheaves and hook. A forged steel hook shall be supported on a thrust bearing. Sheaves shall have deep flanges and be properly grooved to fit wire rope. Wire rope shall be extra flexible stainless steel recommended for overhead hoist service.

C. Track

1. Monorail Track: Beam and other overhead components shall be sized and supplied by hoist manufacturer to match hoist supplied. Sizing shall be based on a safety factor of 5 to 1. The monorail shall be of special structural sections manufactured in accordance with the Monorail Manufacturers Association. Lower flanges shall have hardened running surfaces for trolley wheels to ride on.

2. Erect track level throughout, with section ends machined, fitted and spliced with web-type or other suitable couplings to provide flush level connections. Maximum gap between adjacent ends shall not exceed 1/16-inch. Do not use cast fittings.

3. Safety Stops: Provide safety stops on all open ends of track (or where indicated) to prevent trolley from running off ends. Design stops with capability of withstanding impact imposed by motion of fully loaded hoist and trolley.

D. The support tower shall include a bulk bag lifting adapter for the lifting and positioning of the bulk bag. The bulk bag lifting adapter shall keep the bag safely suspended above the dosing module and allow complete unloading of each bag.

E. The hoisting equipment shall be furnished with a bulk bag lifting adapter and "spider" frame to lift and position the bulk bags. The unit shall be heavy duty designed to suspend the bag indefinitely above the dosing module. The design shall accommodate changes in sidewall angle and assure complete unloading of each bag.

F. Controls shall be as specified in Article 2.06 of this Section.

2.03 Hopper and Auxiliary Bulk Bag Support

A. The hopper and bag support shall be located between the bulk bag and the feeder. The hopper shall be fabricated from minimum thickness of 11 gauge carbon steel and have side slope minimum of 60 degrees. Each unit shall be furnished with a dust-tight inlet connection for attaching the bulk bags.

B. The bulk bag unloader shall include a 1-1/2 horsepower vibrator with eccentric weights for easy force adjustment. Four elastomeric pads shall be included to isolate transmission of vibrations. Power requirements shall be 460/3/60. Product contact

areas of the bulk bag unloader shall be mild steel. The support frame is to be constructed of mild steel. A trolley with hoist shall be provided and mounted to an I-beam on top of the bulk bag unloader support structure. The trolley and hoist shall have a maximum capacity of 2000 pounds.

C. The feed hopper shall be equipped with low carbon level indicated that shall provide warning of an empty bag before the dosing stops.

2.04 Volumetric Feeder (MP-CARBON-FDR-1)

A. The feeder shall be the variable speed control volumetric type utilizing a helical screw.

B. The feeder shall employ a dissimilar speed, Double Concentric Auger Metering Mechanism to ensure accurate, continuous, constant density material flow without flooding or bridging. The feeder housing shall be dust-tight with a minimum of 11 gauge steel construction. The feeder shall be heavy-duty and designed to provide easy cleaning without the need for removing the feeder from its mounting, or disassembling flexible connectors, hoppers, or removing the dissolving tank. The feeder shall be constructed to provide complete access to its internal components by simply removing its discharge spout. The feeder's double augers, drive shafts, and seal housing shall be constructed of 304 stainless steel; the seals shall be synthetic.

C. The Double Concentric Auger Metering Mechanism shall consist of a solid shaft metering auger and a concentric, 6-inch diameter conditioning auger (Intromitter). The larger conditioning auger (Intromitter) shall span the full length of the feeder chamber and shall be driven at a slower speed than the smaller metering auger, thereby increasing the torque capability for low speed starting and eliminating the possibility of the metering auger tunneling in the material.

D. All chemical contact areas of the feeder including the double augers, seal assembly, and discharge cylinder shall be constructed of 316 stainless steel. Minimum sheet metal thickness shall be 11 gauge and all welds shall be continuous.

E. Feeder shall be furnished with a fully enclosed, dust-tight, variable speed device. Feeder shall be furnished capable of a minimum of 50:1 speed variation (turndown ratio), by use of SCR drive and either stepped pulleys or sprockets and chain variation. The motor shall be designed and manufactured in accordance with the standards of NEMA and shall have the following characteristics:

1. Standard DC, SCR controlled variable speed drive.

2. Maximum HP: 1.

3. 115 volt, 60 Hz, single phase

4. Totally enclosed, non-ventilated (permanent magnet motor).

F. Motor shall be Baldor, General Electric, Westinghouse, Reliance or U.S. Electric.

G. The SCR variable speed drive shall be automatically paced by a 4-20 mA signal which is proportional to flow. To accept the pacing signal, the feeder shall be complete with a full wave variable speed SCR/DC controller capable of accepting such an input signal. Provide with the SCR/DC controller, a manual ratio station to ratio the input signal when controlled from an external signal. The SCR/DC controller shall be furnished inside the main control panel and shall include a three digit digital thumbwheel speed selector, an on-off switch, line and armature fuses, and a manual-automatic selector switch. The feeder shall operate on a 115 volt, 60 Hertz, single phase power supply.

H. Feeders shall be furnished by the powdered activated carbon feed system supplier and shall be equal to Acrison W1057.

2.05 Vortex Vessel and Eductor Package

A. The discharge of the volumetric feeder shall be to a vortex vessel to mix the activated carbon with water. The vortex vessel is fabricated from 316 stainless steel. An eductor shall be fitted to the bottom of the vortex vessel in order to convey the PAC slurry to the process injection point.

B. The maximum required water supply shall be 25 gpm at 80 psig.

2.06 Controls

A. PAC Feed Controls

1. The feeder control panel MP-FCP-CARBON-FDR-1 shall have a NEMA 4X Type 304 stainless steel enclosure assembled for remote mounting ready for external power and control wiring connection by the Contractor. The unit shall be completely pre-wired requiring only external power wiring and control input-output/wiring connections.

2. When the system is energized and/or operating under normal conditions, contacts shall close that turn on a "run" indication light. Should a malfunction occur, the contact shall open, causing a control panel alarm to sound, and a control panel mounted indication light to activate.

3. The control panels shall have timers and accessory devices which shall have switching intelligence for alarms and status. The entire system shall be powered and controlled from the manufacturer furnished control panel. The system shall require a maximum of 40 amp service. Power to the control panels shall be 480 volt, three phase. Should all external control inputs/outputs fail, the unit shall be capable of operating as a stand-alone system when in the "LOCAL" setting. Provide a flange-mounted main disconnect circuit breaker.

4. Control panel shall include the following:

   a. Manual speed control potentiometer for feeder motor.

b. Feeder speed "HAND/AUTO" selector switch.

c. Feeder "HAND/OFF/AUTO" switch control and run light.

d. Solenoid 'HAND/OFF/AUTO" switch and light.

e. All required starters and relays.

f. Vibrator "HAND/OFF/AUTO" switch.

g. Form C dry contacts for remote indication of:

i. PAC Level Low

ii. Common Fault

iii. Run

h. The control panel shall receive Enable/Off discrete signal.

i. The control panel shall receive PAC remote proportioning 4-20 mADC analog signals.

j. The control panel shall transmit PAC supply, 0-100 percent 4-20 mADC analog signal.

5. Starters: NEMA rated, circuit breaker combination type, with overcurrent protection in each phase for all system motors. Starters shall be Allen-Bradley Bulletin 500.

6. Relays (Where Required): Heavy duty industrial control type, 10 amp 600 volt reversible contacts, equal to Square D Class 8501 Type X.

7. Programmable Logic Controller (PLC): At the manufacturer's option, a PLC may be used to accomplish control logic. Provide two spare I/O points, of each type of I/O used. Provide interposing relays for all external interface discrete signals. Provide isolated analog input/outputs for all external interface analog signals. Provide a copy of the PLC programming software and an electronic copy of the PLC application program that includes annotations. A printout of the application program shall also be provided. PLC logic is to be fully annotated, including point tag descriptors. Manufactured by Allen Bradley without exception.

8. Selectors and Pushbuttons: Heavy duty, oil-tight, transformer type with lens colors as follows. Pilot devices shall be Allen-Bradley Bulletin 800H.

Color	Function

Color	Function
Red	Motor Stop
Green	Motor Equipment Run
Blue	Call to Run
Amber	Alarm Fault
White	Control Power On

9. Panel Construction: Route all wiring in Panduit or similar wireways. Protect all wiring across panel hinges. Provide numbered terminal strips for all field wiring terminations. Use barriers to separate 480 volt from 120 and lower voltage sections.

10. A high water level switch shall be provided near the top of the vortex vessel to detect rising water level and decreases in water supply pressure. A high water level alarm light on the control panel shall indicate this condition. An interlock shall prevent feeder operation when this alarm occurs.

11. In the event of a high water level alarm in the vortex vessel, the water supply and slurry discharge valves close while the system drain valve opens. This allows the vortex vessel to drain. Concurrently, the feeder is stopped due to the alarm condition. Once the vortex vessel has been drained, the water supply and slurry discharge valves open while the drain valve closes. Water flow will then be present through the system. Flow is confirmed with no alarms for a pre-determined period of time prior to restarting the feeder.

12. A flow switch shall be provided by the manufacturer in the water supply piping to ensure that flow is present. An interlock shall be provided in the control logic to prevent operation of the feeder when water supply is not present. There shall be a low flow alarm light on the control panel to indicate this condition.

B. Control Logic

1. When the feeder "HAND/AUTO" switch is in AUTO, feeder shall be paced by a 4:20 mADC signal and generate a 4:20 mADC output signal.

2. When the feeder "HAND/OFF/AUTO" switch is in "AUTO", the feeder shall activate/deactivate in response to a remote signal.

3. When the solenoid "HAND/OFF/AUTO" switch is in "AUTO", the solenoid shall open/close in response to a remote signal.

4. When the vibrator "HAND/OFF/AUTO" is in "AUTO", the vibrator shall cycle on and off for preset times. The timer shall be sized to ensure effective agitation without compaction of the material.

C. Hoist Controls

1. Supply complete integral electrical control system with the electrical hoisting equipment (by hoist manufacturer) consisting of starters, circuit breakers, overload relays, limit switches, control transformer for a 120 volt control circuit, control relays and controlling devices housed in a NEMA 4X enclosure.

2. Provide a mainline manually operated fused disconnect switch in the control panel, wall mounted by the Contractor, and a magnetic mainline contactor mounted on equipment for emergency shut off and undervoltage protection. Control panel shall include fusing for ground fault protection and thermal overload relays for running over current protection. Provide ballast resistors for trolley acceleration control. A control transformer with fused secondary shall be provided to supply 115 volts control circuit to all panels and pushbutton stations. Control panel shall be provided with overload protection in all phases. All wire sizes shall be suitable for hoist rated motors in accordance with the National Electric Code. All conduit and fittings shall conform to the requirements of the latest edition of the National Electric Code. All enclosures shall be NEMA 4X.

3. A screw type control circuit limit switch shall be mounted to the end of the rope drum shaft. When the hook reaches its upward limit of travel, an electric circuit shall be opened to stop the flow of current to the hoist motor and automatically set the magnetic motor brake. The hoist shall be manufactured to enable installation complying with current OSHA requirements.

4. Design controls to permit "jogging" in both forward and reverse directions under full load, automatically regulated acceleration, and rapid brake response.

5. All electrical equipment including motors, controls, resistors, brakes, plus all conduit, wiring, panels, and enclosures shall comply with applicable requirements for materials, workmanship, construction, and installation of latest NEMA and National Electrical Code Standards.

6. A weight type upper travel limit switch shall be provided with an automatic, momentary lowering circuit.

7. An overload cutoff shall interrupt the raising circuit when the hoist is overloaded. The cutoff shall automatically reset when the overload condition is corrected. Cutoff shall be factory set at 125 percent of load capacity.

8. The hoist shall have upper and lower travel limit switches. Provide automatic reversing circuits in each direction of hook travel which will stop the motor if run-out of the hook exceeds an adjustable preset value.

9. Provide a load limit switch, adjustable transducer type, adjustable from 100 to 125 percent of the hoist's rated capacity.

10. Pushbutton Control: Provide pendent pushbutton control station with sufficient pushbuttons to control all operations of hoist and trolley. Clearly mark each pushbutton to indicate its function. Make cable long enough to reach within four

feet of the operating floor surface. If necessary, attach an arm to hoist so that pendent cable and pushbutton controls will hang vertically and be readily accessible from operating positions. Provide a four foot swivel extension arm to maintain control pendent around pumps. Pendent and pushbuttons shall be rated NEMA 4X.

Part 3 Execution

3.01 Installation

Install all equipment in strict accordance with the manufacturer's instructions and recommendations and in locations as shown on the Drawings.

3.02 Surface Preparation and Shop Painting

All surfaces shall be prepared and shop painted in accordance with the requirements of Section 09900 of these Specifications.

3.03 Field Painting

Field painting shall be performed in accordance with the requirements of Section 09900 of these Specifications.

3.04 Manufacturer's Service

A. Furnish the services of a factory representative for one, eight hour day 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, having complete knowledge of proper operation start-up procedure and maintenance requirements, for one, eight hour day, to inspect the final installation and supervise a test run of the equipment.

C. Furnish the services of a factory representative, having complete knowledge of proper operational and maintenance requirements of the system, for one, eight hour day. The factory representative shall instruct the Owner's personnel in the proper operation of the equipment.

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 (MP-ACTPOLY-FDR-1, 2)

A. The work covered by this Section includes furnishing all labor, materials, equipment and services required to furnish, install and place in satisfactory operation, dry polymer preparation system as specified herein.

B. The system shall be designed with the capability for dispensing and wetting two pounds per minute of dry polymer and shall be sized for usage of up to 66.7 pounds per 24 hour day at a 0.5 percent solution aged for at least one hour.

C. The polymer preparation system shall be furnished complete, including all equipment, controls, supports, platforms and accessories required for proper operation, access and maintenance of the system.

D. The supplier shall have unit responsibility for the proper coordination and integration of the systems and compatibility of all components.

E. The Contractor shall furnish and install all piping and wiring necessary to connect separate units of the equipment as necessary to provide a complete and operable system.

1.02 Design Requirements

A. The Contractor shall furnish and install a complete polymer system for storing, feeding, mixing and metering dry or liquid emulsion type or neat polymers. The system shall be capable of preparing a solution upon demand from dry or liquid polymers.

B. The system shall be designed to activate all polymer in the mix/age tank and shall not product "fish-eyes", with a maximum age time of 60 minutes.

C. The system shall be designed to operate on a minimum water supply capacity of 20-25 gpm with a minimum pressure of 15 psig.

D. System Requirements

1. Dry Polymer Input: 67 pounds/day.

2. Dry Polymer Specific Weight: 45 pounds/cubic foot.

3. Minimum Hopper Capacity: 2.0 cubic feet.

4. Dry Polymer Feed Rate: 0.062 cubic feet/hr

5. Applied Solution Concentration: 0.5 percent.

6. Minimum batch, gallons: 50

E. The polymer system manufacturer is to provide a complete internally pre-piped and pre-wired system requiring only a power supply, water source, dry chemical to function.

F. The feeder-mixer equipment shall be designed to fit within the area shown on the Drawings.

1.03 Submittals

A. Complete shop drawings shall be submitted in accordance with the provision of Section 01340 of these Specifications.

B. Operation and maintenance manuals shall be submitted on the specified equipment in accordance with the provision of section 01730 of these Specifications.

1.04 Storage and Protection

All equipment shall be stored and protected in accordance with the requirements of Section 01611 of these Specifications and the manufacturer's written recommendations.

1.05 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. Equipment specified herein shall be equal to Acrison Polymair Model 515.

B. Motors shall be equal to Baldor, General Electric, Westinghouse, Reliance, Honeywell or U.S. Electric.

2.02 Polymer Mixing Equipment

A. The polymer mixing and aging tanks shall be constructed of Type 316 stainless steel. The mix tank shall be mounted over the age tank. Each tank shall be equipped with 2-inch drain, overflow, and 2-inch outlet for connection to polymer solution feed pumps. All inlets and outlets shall be provided with a PVC ball valve.

B. The mix tank shall be equipped with a turbine type chemical mixer suitable for polymer service. The impeller and shaft shall be Type 316 stainless steel. The mixer shall be provided with supports for attachment to mixing tank. The mixer shall be pre-wired to the control panel.

C. Water Supply System

1. Inlet Filter: An inlet water filtration system shall be provided for removal of suspended material prior to entry into the feeder-mixer equipment. The filter shall be suitably sized for the feeder unit specified. Filter shall be constructed to allow easy installation in the water supply piping provided by the Contractor and located for easy maintenance in the same room as the feeder-mixer equipment.

2. Pressure Switch: There shall be a factory installed pressure switch to stop cycling of the feeder-mixer if inlet water pressure falls below 10 psig. The pressure switch shall actuate an alarm light and audible alarm mounted on the equipment control panel if water pressure drops below 10 psig during cycling.

3. Inlet Solenoid Valve: The factory installed inlet water solenoid valve shall have a positive, drip-tight seal when in the closed, or de-energized position. It shall have a water service disc and seat of the renewable type. The solenoid should be located at the dispenser and shall be pre-wired to the control panel.

4. Inlet Flow Controller: The dispenser's internal flow controller shall be of the type that employs a flexible orifice that varies inversely with the pressure so that a constant flow rate is maintained. The flow control valve shall be accurate to ± five percent of the mean flow rate.

D. Dispenser Unit: Water and polymer are brought together in the dispenser unit. Dispenser unit shall completely pre-wet all polymer particles.

E. Dry Polymer Feeder

1. The feeder shall employ a dissimilar speed, concentric, Double Auger design to ensure accurate, continuous, constant density material flow without flooding or bridging. The outer Auger shall be 6-inch OD minimum and the inner auger shall be 1-3/8-inch OD minimum. The Feeder shall be dust-tight and shall be designed to provide easy cleaning without the need for removing the feeder or disassembling flexible connectors, hoppers, etc. Construction shall provide complete access to the feeder internals by simply removing the discharge spout and front plate of the feeder. The feeder and all parts in contact with the material shall be constructed of 1/8-inch thick 304 stainless steel. The seals shall be Teflon. Feeder shall be driven by a 1/3 HP, A.C. Gearmotor controlled by an adjustable timer on the control panel. Feeder shall have a metering accuracy of ± 2% maximum deviation based on one minute test samples.

2. All rotating drive components shall be 5/8-inch or larger to ensure heavy-duty performance.

3. Feeder shall be equal to series W-105 as manufactured by Acrison, Inc., Moonachie, New Jersey.

4. The hopper shall have a capacity of two cubic feet including the feeder chamber. Hopper shall be constructed of 11 gauge 304 stainless steel and be provided with a hinged/gasketed cover bolted in place.

5. The feeder discharge will be provided with a hydraulically activated gate to prevent moisture from entering the feeder while the unit is not making a batch.

2.03 Hopper Level Switch

Hopper level switch shall be included and installed in the hopper to energize a lamp and audible alarm in the control panel when material reaches a predetermined low level.

2.04 Wetting Chamber

Wetting chamber shall consist of a swirling water vortex transitioning into a 1-1/2-inch diameter (minimum) straight section in which downward flowing water is penetrated by a multitude of pinpoint spray jets and provide thorough polymer wetting. Construction shall be 316 stainless steel. The minimum throat area polymer may pass through during the wetting process is 1-1/2-inch to avoid any possibility of plugging from agglomerates of dry polymer. The wetting chamber shall be factory assembled to the same skid as the feeder.

2.05 Containment Vessel

The containment vessel shall provide a reservoir to trap any overflow from the wetting chamber and shall be constructed of 304 stainless steel. The containment vessel shall include a liquid level probe to detect any overflow and immediately stop system operation.

2.06 Water Control Components

A. The water supply line of the wetting system shall be sweated copper with a corrosion resistant coating and shall include the following items:

1. Pressure reducing valve, 3/4-inch Watts U5B or equal.

2. Pressure switch with High and Low pressure contacts.

3. Solenoid valve 3/4-inch, brass.

4. Flowmeter.

5. Pressure gauge.

B. All wetting system components shall be preassembled, piped, and wired.

2.07 Mixing Tank

A. Mixing tank shall be 50 gallons, constructed of 11 gauge 316 stainless steel complete with a full cover on which shall be installed the High and Low Level Conductance Probes, and a slow speed mixer. Mixer shall be designed to provide proper mixing at speeds not exceeding 350 RPM. Mixing tanks constructed of plastic or FRP will not be considered.

B. The level probes shall be manufactured of 38-inch 316 stainless steel rod secured by a stainless steel housing. Any level probe longer than 60-inches shall be supported by a stainless steel support leg fixed to the stainless steel housing.

C. The mixing tank shall be rectangular.

2.08 Mixer

The mixing tank shall be complete with a 1/2 HP mixer. Mixer impeller speed shall not exceed 350 RPM and the impeller shall be positioned no less than one and one half impeller diameter from the bottom of the tank. The mixer assembly shall include an angle riser support, right angle helical gear reducer and TEFC motor. The impeller and shaft shall be 316 stainless steel. The unit shall be designed for heavy-duty operation at varying tank levels. The shaft diameter shall be 7/8-inch diameter minimum throughout its entire length.

2.09 Transfer Valve

The transfer valve shall be sized for quick gravity feed transfer (2-3 minute maximum) of the mixed polymer to the aging tank on a demand signal from the level prove in the aging tank. Valve shall be motor operated with manual override and constructed of 316 stainless steel. The valve shall be mounted on the side of the tank to minimize the possibility of clogging from tramp material.

2.10 Mixing Tank Support

A heavy-duty structure shall be provided to support the mix tank assembly directly above the aging tank. The structure shall be constructed of 304 stainless steel.

2.11 Aging Tank (MP-ACTPOLY-T-1, 2)

The aging tank shall be a minimum of 100 gallons to provide at least one hour aging time when feeding 0.5% solution at maximum rate. Tank shall be 1/8-inch thick, 316 stainless steel, and shall be complete with a full stainless steel cover on which is mounted the transfer demand level probe. Labyrinth baffles shall be provided to promote a plug flow pattern with the tank to optimize polymer detention. Aging tanks constructed of plastic or FRP will not be considered.

2.12 Platform with Staircase

A platform equipped with staircase shall be provided so the operator can load the feeder hopper. The entire assembly shall be constructed of 304 stainless steel.

2.13 Transfer Polymer Pump

The manufacturer of the Polymer Preparation System shall provide a discharge pump for transferring the wetted polymer from the wetting chamber into the mixing tank and to provide a high shear environment to promote the activation of the freshly wetted polymer. Transfer pump shall be rotary impeller type in a stainless steel housing with a 316 stainless steel shaft. Pump shall have a mechanical shaft seal and be directly coupled to a 1-1/2 HP, totally enclosed, constant speed AC motor.

2.14 Controls

A. Each polymer system shall include a control panel to automatically operate the dry polymer feeder, discharge pump, and all tank mounted equipment including the mixer. A defeatable manual over-ride shall be provided for major motor driven items. Operational lights shall be furnished for all major items. An interlock shall be provided to prevent feeding of dry polymer unless water is being supplied to the wetting chamber and all motors are operational. Interlock shall be wired to a visual and audible alarm. The dry polymer feeder shall be controlled independently from timers in the panel.

B. Control panel shall be furnished by the polymer feed system manufacturer. Designation is FCP-ACTPOLY-1, and shall be mounted on the aging tank.

C. Power Supply: 480 volts, three phase. All controls shall operate on 120 volts maximum. Provide a suitably sized power transformer with primary and secondary overcurrent protection to provide power to controls, mixer, discharge pump, and dry feeder. Provide a control panel main disconnect switch.

D. Enclosure: NEMA 4X.

E. Components

1. Starters: NEMA rated, circuit breaker combination type, with overcurrent protection in each phase for all system motors. Starters shall be Allen-Bradley Bulletin 500.

2. Relays: Heavy duty industrial control type, 10 amp 600 volt reversible contacts, equal to Square D Class 8501 Type X.

3. Programmable Logic Controller (PLC): At the manufacturer's option a PLC may be used to accomplish control logic. Provide a minimum of 20 percent spare I/O points, interposing relays as specified above for external status/control signals, and hand held programmer. Acceptable manufacturers are Allen-Bradley,

General Electric, Square D, Texas Instruments and Westinghouse.

4. Selectors and Pushbuttons: Heavy duty, oil-tight, transformer type with lens colors as follows:

Color	Function
Green	Dry Feeder Mixer Run Polymer Feed Pump Run
Red	Dry Feeder Mixer Stop Polymer Feed Pump Stop
Blue	Call to Run Polymer Ready
Amber	Alarm Fault Incomplete Sequence Polymer Not Ready
White	Control Power On

F. Panel Construction: Route all wiring in Panduit or similar wireways. Protect all wiring across panel hinges. Provide numbered terminal strips for all field wiring terminations. Use barriers to separate 480 volt from 120 and lower voltage sections.

G. Remote Signals

1. Panel shall receive the following: one, dry contact.

2. Panel shall provide the following: one, 10 amp form "C" dry contact, normally open with polymer solution low level to interlock with polymer solution feed pumps.

H. System Controls

1. The system controls shall include disconnect switches, indicators, running lights and alarm lights all conveniently displayed and easily accessible on a centralized control panel.

   a. The panel shall include feed rate meter and control knob, aging timer, and auto-off manual switches for feeder, mixers and mixing-water flow.

   b. Running lights shall indicate the operation taking place in each tank.

   c. Alarm lights shall be provided for low water pressure, cone overflow, solution overflow and low hopper level.

   d. Alarms for low-polymer-powder level and low-polymer- solution level shall be provided.

e. A 10 amp, 120 V, dry contact normally open with polymer solution low level for interlock with polymer feed pumps.

f. Alarm silence and reset buttons shall be conveniently mounted.

2. When the liquid in the mixing chamber reaches low level, the dry chemical volumetric feeder shall introduce polymer at the desired rate for the solution concentration required. Water shall be introduced through the pre-wetter, properly wetting each dry particle. The mixer shall begin operation at the start of the feed cycle and continue for a pre-set mixing time, as set on the programmable controller.

3. Upon completion of the mixing cycle, the controls shall automatically activate the system's internal dump valve interconnecting the mixing and storage tank transferring the mixed solution to the storage tank. The above operating sequence shall then restart and continue production of the mixed polymer. A high level switch in the holding tank prevents overflow, in the case of a failure of the dump valve, by causing the mixing cycle to abort. Polymer feed pumps shall not be interrupted by the automatic mixing cycle. Polymer solution can be pumped from the storage tank during the mixing cycle.

2.15 Accessories

A. The following accessories shall be supplied by the polymer system manufacturer:

1. Support structures, as required.

2. Access platforms as required to fill units with bagged dry polymer and for normal operation and maintenance.

2.16 Shop Painting

Shop prime and paint all ferrous metal surfaces with the manufacturer's recommended coating system for the intended chemical service.

Part 3 Execution

3.01 Installation

The polymer system as described in Part 2 including all appurtenances shall be installed in accordance with the manufacturer's recommendations.

3.02 Field Painting

All equipment shall be field painted in accordance with the requirements of Section 09900 of these Specifications.

3.03 Inspection and Testing

Following installation, operating tests will be performed to demonstrate to the Engineer that the polymer feed system 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.

3.04 Manufacturer Service

The Contractor shall furnish start-up services by the respective equipment manufacturer's representative(s) to insure that the equipment has been properly installed and tested to provide continuous and satisfactory operation. The equipment manufacturer's representative shall also instruct the Owner's representative in the maintenance and operation of the equipment.

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

Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for a complete and operable installation of three single bay existing single bay filters having anthracite/sand media. Each unit shall be installed, tested and placed into operation in accordance with these Specifications and the manufacturer's recommendations.

1.02 Design Requirements

A. Each filter shall have a total of 612 square feet, consisting of 24'-0" filter cells, W x 25'-6" x L. Filters shall be dual media type and designed to operate at constant water level, constant rate mode with rate-of-flow controllers under the following conditions:

1. Downflow of Filtered Water: 6.0 GPM/square feet of filter area.

2. Upflow of Air Only (Air Wash): 4.0 SCFM/square foot.

3. Simultaneous Upflow of Air and Water: 4.0 SCFM/square foot (air) and 5 GPM/square foot (water).

4. Upflow of Water Only (Backwash): 20 GPM/square foot.

B. All materials shall be non-corrosive, exposed metals shall be 304 stainless steel.

C. Equipment furnished for each existing filter shall include an air/water underdrain, media support porous cap, dual media, air distribution header, and any necessary equipment required for a complete installation.

D. Underdrain system shall be designed to accommodate the following:

1. 40 percent expansion of a 30-inch deep media bed without contacting the existing washwater troughs.

2. Retention of a filter media with an effective size of 0.17 mm.

3. Air header piping shall not penetrate the filter media from the top.

1.03 Submittals

A. Submit shop drawings in accordance with Section 01340 of these Specifications.

B. Furnish to the Engineer for approval and delivery to the Owner, six copies of operation and maintenance manual. Include the following in each manual:

1. Complete installation, operation and maintenance instructions.

2. Trouble shooting guides.

3. Copies of all shop Drawings and erection Drawings.

Part 2 Products

2.01 Acceptable Manufacturers

Equipment furnished shall be Type "S" or Type SL manufactured by F.B. Leopold Company, Inc., or Infilco Degremont (Tetra LP or Tetra U blockfilter underdrain system).

2.02 Filter Underdrain

A. Experience: The underdrain system shall be a standard product of a filter manufacturer who has been actively engaged in the design and manufacture of filtration systems. Upon request, the filter manufacturer shall provide the Engineer with a list of installations of underdrain which totals not less than 10.

B. NSF Certification: All materials used in contact with the water and backwash air shall meet National Sanitation Foundation (NSF) Standard 61 Drinking Water System Components - Health Effects.

C. Operating Requirements

1. The filter underdrain system shall be designed and installed to insure long term stability in its operating characteristics. It shall be resistant to changes in headloss, flow uniformity and any other effects which would in time cause loss of efficiency or effectiveness in its operation.

2. The underdrain system for the filters shall be of the "Dual-Parallel Lateral" type whereby feeder and compensating laterals are provided in a single block system. The cross section of the underdrain shall be so arranged that the feeder (or primary) lateral is adjacent and connected to the compensating (or secondary) laterals through a series of orifices. The orifices shall be located at four different elevations and sized to provide uniform distribution of air at a rate in the range of 4 to 5 scfm/square foot and water up to 30 gpm/square foot. The feeder lateral shall provide at least 50 square inches of cross sectional area per block to reduce flow velocity during backwash.

3. The compensating laterals shall provide the essential uniform pressure and flow distribution from the top of the blocks. The discharge flow from the top of the blocks into the filter bed shall be provided by uniformly distributed dispersion

orifices throughout the filter cell. The orifices shall be sized as required to introduce necessary metering headlosses, but shall be sufficiently large to prevent clogging. Orifice design shall be such to prevent support gravel from blocking orifices if support gravel is required by this specification.

4. A water recovery channel with return holes or other design measures shall be incorporated into the underdrain block to ensure uniform and continuous air flow from the top deck orifices and greater stability. The secondary chambers of the underdrain shall have baffles sized and located to provide effective air control and to reduce level sensitivity.

D. The individual blocks used in the system shall be of a suitable impervious, high strength, completely corrosion resistant plastic material having uniform smooth surfaces and all orifices properly deburred. The blocks shall have ridges and pockets for structural rigidity and to key into surrounding grout. The blocks shall be mechanically joined to form a continuous lateral equivalent to the length of the filter cell. The joints shall be gasketed, bell-and-spigot type with internal tabs, air and watertight. Joints shall be snap-lock type so that the blocks are joined with internal interlocking snap lugs and lug receptors.

E. Grout retaining strips shall be of high-impact polystyrene properly keyed to the underdrain blocks to allow adjustment of lateral center-to-center distance without difficulty. Retaining strips shall be supplied by the underdrain manufacturer.

F. Anchor hardware shall be sized, dimensioned and supplied by the underdrain manufacturer.

G. Air distribution piping within the filter cell shall be Schedule 5, 304 stainless steel. Diameter of pipe and riser pipe (orifices) size and spacing shall be determined by the filter underdrain system supplier. To guarantee unit responsibility, the air distribution piping shall be supplied by the same manufacturer of the underdrain.

H. The plastic underdrain shall be high-strength, completely inert, resistant to erosion and corrosion, and be suitable for use with backwash air temperatures up to 200 degrees F.

I. The filter underdrain system, when installed, shall be designed to withstand a burst pressure equal to twice the maximum headloss experienced at maximum backwash rates. No credit shall be taken for the weight of gravels or filter medias.

J. The filter underdrain system shall also be designed to withstand a net downward loading of not less than 1,400 psf, plus its own dead weight.

K. Hydraulic Criteria

1. The filter underdrain shall be capable of evenly distributing air, water and a combined flow of air and water in the intended application. When subjected to a combined air/water flow of 4 scfm/square feet and 5 gpm/square feet, the headloss through primary distribution orifices shall not exceed 8-inches w.c. When subjected to a flow rate of 20 gpm per square foot of filter area (water

only), the headloss through an underdrain lateral 28 feet long shall not exceed 40-inches w.c. when the water temperature is approximately 60 degrees F. The filter manufacturer shall provide hydraulic test data to verify that the above headloss conditions can be met.

2. In addition to the above, the filter manufacturer shall, at their own facilities, if requested by the Engineer, set up a test lateral run of equal length to that required by the Project and provide an opportunity for the Engineer and/or Owner to visit the facility to witness a full scale demonstration of the headloss and flow distribution during backwash.

3. The test facility shall be capable of demonstrating concurrent air and water distribution in a submerged trough and water only distribution on a non-submerged test bench.

2.03 Porous Media Support Cap

A. Filter underdrains shall utilize a porous cap to support the media. Gravel shall not be used.

B. The porous media support cap shall be made of plastic beads sintered together. The support cap shall be mechanically attached and sealed to the underdrains. The pores shall be of size that the media being supported does not "sift" through the cap and into the underdrain area during static (weight of media and water) or backwashing conditions. The cap shall be designed to withstand a differential flow pressure of 5 psig from either direction.

2.04 Filter Media

A. A filter media system shall be provided by the filter underdrain manufacturer. The media system shall be capable of sustained operation at rates of 6 GPM per square foot, filtering treated settled water without excessive use of backwash water or undue rate of head loss build-up.

B. The Contractor shall arrange and pay for an independent testing laboratory to sample each media to confirm compliance with these Specifications. Tests shall be made prior to shipment, and immediately following delivery to the job site. Tests to be performed and test standards to be followed by the testing laboratory shall include the following:

1. Specific Gravity (Apparent): ASTM C 128 for high density sand and silica sand.

2. Sieve Analysis: ASTM C 136 and Section 5 of AWWA B100. All sieves shall be calibrated according to the procedures in ASTM E 11, and shall be of the U.S. Series.

C. IMS (Integral Media Support) Cap: The IMS cap shall be constructed of HDPE plastic beads sintered together and sealed to the top of the underdrain. The pore size and pore volume shall be sufficient to prevent the media from obstructing or passing

through the underdrain. The IMS cap shall replace the need for support gravel and shall not increase the underdrain height by more than 1-inch. The cap shall be attached to the underdrain at the factory by 316 stainless steel self-tapping screws and sealed with Leoflex™ caulking.

D. Filter sand shall be composed of hard, durable, clean silicious particles, free of all mica with an average specific gravity of 2.60 (± 0.05) and shall be in accordance with AWWA B100. Sand media shall have an effective size of 0.45 to 0.55 mm, and a uniformity coefficient of not more than 1.40. The total finished depth of sand shall be 12-inches after backwash and skimming.

E. Filter media shall be shipped and delivered in superbags. Filter media shall be palletized. The supplier shall provide recommended procedure for the protection of the materials prior to installation. Media contamination of any sort before or after placement shall be replaced with clean media.

F. Filter anthracite shall be composed of specially selected and graded, hard, durable anthracite coal particles. The specific gravity shall be 1.55 or more with hardness (MOH scale) of 2.7 or more, and shall be essentially free of iron, sulfides, clay, shale, extraneous dirt, and excessive dust, and shall be in accordance with AWWA B100. Anthracite media shall have an effective size of 0.95 to 1.05 mm with a uniformity coefficient of 1.40 or less. The total finished depth of anthracite shall be 18-inches.

Part 3 Execution

3.01 Filter Underdrains

A. The Contractor shall install the filter underdrain systems in strict accordance with the supplier's installation drawings and recommendations and as herein specified.

B. The Contractor shall take all necessary precautions recommended by the underdrain supplier and as specified herein to ensure that the underdrain system and piping connected thereto is completely clean and free of any debris, dirt, or other foreign materials which would clog the underdrain system or interfere with flow. Backwash air piping and water channels shall be thoroughly flushed clean. Air piping and water channels shall be flushed with air only. All loose debris and dirt within the filter cell and flume shall be removed by brooming down and vacuuming. Care shall be taken as necessary to prevent grout from extruding into any flow passages or ports, and any such grout shall be removed. As installation progresses, underdrain sections partially completed shall be protected with heavy building paper, vinyl sheeting, or other acceptable means to maintain cleanliness. Cleanliness shall be maintained until final placement of filter media.

C. The filter underdrain sections shall be set in place and grouted such that the air metering orifices are in a true and level plane within plus or minus 1/8-inch. The filter base slab shall be prepared as necessary to enable installation within the required level tolerance.

D. After the underdrain sections are set in place, all grouting spaces shall be completely filled to within 1/2-inch of the top surface of the underdrain, and finished off smooth.

E. Each filter cell shall be both hydraulically and air washed to check uniform water and air distribution prior to the placement of the support sand and media.

3.02 Filter Media Placement

A. Preparation: Each filter cell shall be cleaned thoroughly before any filter materials are placed. Each cell shall be kept clean throughout placement operations. Before any material is placed, the top elevation of each layer shall be marked by a level line on the inside of the filter. Filter media shall be installed in accordance with AWWA Standards. During each backwash, the water shall be applied at an initial rate of no more than 2 gpm per square foot of filter area. The backwash rate shall then be increased gradually over a period of three minutes to the rate set by the media supplier.

B. Sand

1. A minimum of 12-1/2-inches of sand shall be deposited in the filters in a uniform thickness and carefully leveled to the required grade.

2. After all filter sand is placed and before any coal is deposited, the sand shall be backwashed three times, for at least three minutes each time, at the rate of 15 gpm/square feet of filter area. After each backwashing the sand shall be allowed to compact by slowly closing the backwash valve.

3. After washing, the sand shall be scraped to remove a minimum of 1/2-inch to remove excess fine materials before the coal is installed.

4. The final depth of sand shall be 12-inches.

C. Anthracite

1. Anthracite shall be deposited in the filters in a uniform thickness and carefully leveled to the required grade.

2. After all anthracite is placed, each bed shall be flooded with water for at least 24 hours. Under the supervision of the Engineer, the anthracite shall be backwashed for a minimum of ten minutes, or until the fine materials are removed, at the rate of 20 gpm/square feet of filter area.

3. After washing, the anthracite shall be scraped as deemed necessary to remove excess fine materials.

4. The final depth of the anthracite, after washing shall be 18 inches.

3.03 Preparation of Filters for Service

A. After all filter materials have been placed and initially backwashed, each filter shall be backwashed three times, for at least ten minutes each time, at the rate of 20 gpm/square feet of filter area. After each backwashing the filter media shall be allowed to compact by slowly closing the backwash valve.

B. Upon completion of backwashing, a sieve analysis shall be made of the anthracite to determine the gradation. Sufficient material shall be removed from the top of the bed so that the uniformity coefficient will be less than specified after the anthracite layer is scraped. After scraping, the effective size shall be within the specified range.

C. Additional anthracite shall be placed as required and the filters backwashed for at least three minutes at the rate of 20 gpm/square feet of filter area. The media shall be allowed to compact by slowly closing the backwash valve. The anthracite thickness shall then be measured. If additional anthracite is required, the anthracite shall be placed evenly in the filters and the procedures described above repeated until the required depth and gradation of the anthracite filter material is achieved.

3.04 Disinfection

After all other work is completed, and before the filters are placed in service, the filters shall be disinfected by chlorination in accordance with AWWA C653.

3.05 Manufacturer's Services

A. A manufacturer's representative for the equipment specified shall be present at the jobsite for installation assistance, inspection, and certification of installation and testing, and training of Owner's personnel. The Contractor shall include a minimum of 10 days at the jobsite and a minimum of four trips.

B. The Contractor shall not begin any underdrain installation without the manufacturer's representative being on-site to instruct and observe initial installation.

C. The Contractor shall not install any media without the manufacturer's representative being on-site to instruct and observe the initial installation of media for the first filter. The Contractor shall have the manufacturer's representative provide the Owner with a letter certifying that the representative was present on-site, did instruct, did observe and approved the Contractor's installation techniques and authorized continuances of placement of the media. Any media installed prior to the manufacturer's representative being on-site and authorizing the Contractor to continue, shall be removed and replaced by the Contractor with no additional cost to the Owner.

3.06 Clean-Up

Contractor shall remove from the job site and dispose of all excess or rejected filter media and the area around the filters shall be cleaned at the end of each working day.

END OF SECTION

Part 1 General

1.01 Scope

Work described in this Section includes furnishing all labor, materials, equipment, tools and incidentals required for a complete and operable installation of three single bay existing single bay filters having anthracite and sand media. Each unit shall be installed, tested and placed into operation in accordance with these Specifications and the manufacturer's recommendations.

1.02 Design Requirements

A. Each existing filter has a total of 612 square feet, consisting of one filter cell, 24'-0" x 25'–6". Filters shall be designed to operate at constant water level, constant rate mode with rate-of-flow controllers under the following conditions:

1. Downflow of Filtered Water: 6.0 GPM/square feet of filter area.

2. Upflow of Air Only (Air Wash): 4.0 SCFM/square foot.

3. Simultaneous Upflow of Air and Water: 4.0 SCFM/square foot (air) and 5 GPM/square foot (water).

4. Upflow of Water Only (Backwash): 20 GPM/square foot.

B. All materials shall be non-corrosive, exposed metals shall be 304 stainless steel.

C. Equipment furnished for each existing filter shall include an air/water underdrain, dual media, air distribution header and any necessary equipment required for a complete installation.

D. Underdrain system shall be designed to accommodate the following:

1. 40 percent expansion of a 30-inch deep media bed without contacting the existing washwater troughs.

2. Retention of a filter media with an effective size of 0.17 mm.

3. Air header piping shall not penetrate the filter media from the top.

1.03 Submittals

A. Submit drawings of the proposed layout for new and existing filters in accordance with Section 01340 of these Specifications.

B. Furnish to the Engineer for approval and delivery to the Owner, six copies of operation and maintenance manual. Include the following in each manual:

1. Complete installation, operation, and maintenance instructions.

2. Trouble shooting guides.

3. Copies of all Shop Drawings and erection Drawings.

Part 2 Products

2.01 Acceptable Manufacturers

Equipment furnished shall be manufactured by AWI (Anthratech U.S. of Sandy, Utah).

2.02 Filter Underdrain

A. Experience: The underdrain system shall be a standard product of a filter manufacturer who has been actively engaged in the design and manufacture of filtration systems. The filter manufacturer shall provide the Engineer with a list of installations of underdrains which totals not less than 10.

B. NSF Certification: All materials used in contact with the water and backwash air shall meet National Sanitation Foundation (NSF) Standard 61 Drinking Water System Components - Health Effects.

C. Operating Requirements

1. The filter underdrain system shall be designed and installed to ensure long term stability in its operating characteristics. It shall be resistant to changes in headloss, flow uniformity and any other effects which would in time cause loss of efficiency or effectiveness in its operation.

2. The filter underdrain system shall include a series of laterals. The laterals shall feed into the concrete floor gullet. The existing filters have an existing 2-foot wide gullet down the center of the length of the filter box. The new filters have a 2-foot wide end gullet across the width of the filter. Backwash velocity in the gullet of either filter will not exceed 10 ft/sec.

3. Laterals shall be designed to prevent wave action during air scour, and shall compensate for water velocity and momentum changes during backwashing operations by varying the size of the orifices along the lateral length. The height of the laterals shall not exceed 5 1/2".

4. The filter underdrain system shall be capable of supporting a vertical downward load of 2,400 pounds per square foot and a vertical upward load of 1,600 pounds per square foot.

5. A gullet cover plate shall be integrally fabricated with each lateral. The cover plate shall include a series of variably sized orifices to collect filtered water and evenly distribute backwash water to the laterals.

D. Laterals shall be two-compartment air/water flute laterals of 304L stainless steel construction, with variably sized water orifices, air scour slots, air release vents, and integral orifice shields. The flutes shall be designed to prevent two-phase wave action generation during air scour, and shall compensate for velocity and momentum changes during backwash. Laterals shall have two separate compartments designed to independently distribute air and water during backwashing.

E. The air scour header shall be fabricated from 304L stainless steel schedule 10 pipe with individual connections to the air section of each lateral. The air scour header shall include a flanged connection. The manifold shall flange connect to the new manifold connections inside each filter. Floor support brackets shall be supplied by the manufacturer.

F. The underdrain system shall be shop assembled for rapid bolted installation to the concrete floor in the field. Hold down clamps, gaskets, adhesive set bolts, leveling shims, and sealant shall be furnished by the manufacturer.

G. Anchor hardware shall be sized, dimensioned and supplied by the underdrain manufacturer.

H. Air distribution piping within the filter cell shall be Schedule $^{1}10$, 304 stainless steel. Diameter of pipe and riser pipe (orifices) size and spacing shall be determined by the filter underdrain system supplier. To guarantee unit responsibility, the air distribution piping shall be supplied by the same manufacturer of the underdrain.

I. The underdrain shall be high-strength, completely inert, resistant to erosion and corrosion, and be suitable for use with backwash air temperatures up to 200 degrees F.

J. The filter underdrain system, when installed, shall be designed to withstand a burst pressure equal to twice the maximum headloss experienced at maximum backwash rates. No credit shall be taken for the weight of support sand or filter medias.

K. Filter grade silica support sand shall be used in each filter to support the filter media. The sand shall have an effective size of 0.35 mm and a uniformity coefficient of 1.5 or less. Support sand shall be supplied by the underdrain manufacturer in quantities sufficient to prevent the loss of filter media through the underdrain system.

L. Hydraulic Criteria

1. The filter underdrain shall be capable of evenly distributing air, water and/or a combined flow of air and water in the intended application. When subjected to a combined air/water flow (if applicable) of 4 scfm/square feet and 5 gpm/square feet, the headloss through primary distribution orifices shall not exceed 8-inches w.c. When subjected to a flow rate of 20 gpm per square foot of filter area (water only), the headloss through an underdrain lateral 40 feet long shall not exceed 36-inches w.c. when the water temperature is approximately 60 degrees F. The filter manufacturer shall provide hydraulic test data to verify that the above headloss conditions can be met.

2. In addition to the above, the filter manufacturer shall, at their own facilities, if requested by the Engineer, set up a test lateral run of equal length to that

required by the Project and provide an opportunity for the Engineer and/or Owner to visit the facility to witness a full scale demonstration of the headloss and flow distribution during backwash.

3. The test facility shall be capable of demonstrating concurrent air and water distribution in a submerged trough and water only distribution on a non-submerged test bench.

2.03 Filter Media

A. A filter media system shall be provided by the filter underdrain manufacturer. The media system shall be capable of sustained operation at rates of 6 GPM per square foot, filtering treated settled water without excessive use of backwash water or undue rate of head loss build-up.

B. The Contractor shall arrange and pay for an independent testing laboratory to sample each media to confirm compliance with these Specifications. Tests shall be made prior to shipment, and immediately following delivery to the job site. Tests to be performed and test standards to be followed by the testing laboratory shall include the following:

1. Specific Gravity (Apparent): ASTM C 128 for high density sand and silica sand.

2. Sieve Analysis: ASTM C 136 and Section 5 of AWWA B100. All sieves shall be calibrated according to the procedures in ASTM E 11, and shall be of the U.S. Series.

C. Filter sand shall be composed of hard, durable, clean silicious particles, free of all mica with an average specific gravity of 2.60 (± 0.05) and shall be in accordance with AWWA B100. Sand media shall have an effective size of 0.45 to 0.55 mm, and a uniformity coefficient of not more than 1.40. The total finished depth of sand shall be 12-inches after backwash and skimming.

D. Filter media shall be shipped and delivered in superbags. Filter media shall be palletized. The supplier shall provide recommended procedure for the protection of the materials prior to installation. Media contamination of any sort before or after placement shall be replaced with clean media.

E. Filter anthracite shall be composed of specially selected and graded, hard, durable anthracite coal particles. The specific gravity shall be 1.55 or more with hardness (MOH scale) of 2.7 or more, and shall be essentially free of iron, sulfides, clay, shale, extraneous dirt, and excessive dust, and shall be in accordance with AWWA B100. Anthracite media shall have an effective size of 0.95 to 1.05 mm with a uniformity coefficient of 1.40 or less. The total finished depth of anthracite shall be 18-inches.

Part 3 Execution

3.01 Filter Underdrains

A. The Contractor shall install the filter underdrain systems in strict accordance with the

supplier's installation drawings and recommendations and as herein specified.

B. The Contractor shall take all necessary precautions recommended by the underdrain supplier and as specified herein to ensure that the underdrain system and piping connected thereto is completely clean and free of any debris, dirt, or other foreign materials which would clog the underdrain system or interfere with flow. Backwash air piping and water channels shall be thoroughly flushed clean. Air piping and water channels shall be flushed with air only. All loose debris and dirt within the filter cell and flume shall be removed by brooming down and vacuuming. Care shall be taken as necessary to prevent grout from extruding into any flow passages or ports, and any such grout shall be removed. As installation progresses, underdrain sections partially completed shall be protected with heavy building paper, vinyl sheeting, or other acceptable means to maintain cleanliness. Cleanliness shall be maintained until final placement of filter media.

C. The filter underdrain sections shall be set in place such that the air metering orifices are in a true and level plane within plus or minus 1/8-inch. The filter base slab shall be prepared as necessary to enable installation within the required level tolerance.

D. Each filter cell shall be both hydraulically and air washed to check uniform water and air distribution prior to the placement of the supporting sand and media.

3.02 Filter Media Placement

A. Preparation: Each filter cell shall be cleaned thoroughly before any filter materials are placed. Each cell shall be kept clean throughout placement operations. Before any material is placed, the top elevation of each layer shall be marked by a level line on the inside of the filter. Filter media shall be installed in accordance with AWWA Standards. During each backwash, the water shall be applied at an initial rate of no more than 2 gpm per square foot of filter area. The backwash rate shall then be increased gradually over a period of three minutes to the rate set by the media supplier.

B. Sand

1. A minimum of 12-1/2-inches of sand shall be deposited in the filters in a uniform thickness and carefully leveled to the required grade.

2. After all filter sand is placed and before any coal is deposited, the sand shall be backwashed three times, for at least three minutes each time, at the rate of 15 gpm/square feet of filter area. After each backwashing the sand shall be allowed to compact by slowly closing the backwash valve.

3. After washing, the sand shall be scraped to remove a minimum of 1/2-inch to remove excess fine materials before the coal is installed.

4. The final depth of sand shall be 12-inches.

C. Anthracite

1. Anthracite shall be deposited in the filters in a uniform thickness and carefully leveled to the required grade.

2. After all anthracite is placed, each bed shall be flooded with water for at least 24 hours. Under the supervision of the Engineer, the anthracite shall be backwashed for a minimum of ten minutes, or until the fine materials are removed, at the rate of 20 gpm/square feet of filter area.

3. After washing, the anthracite shall be scraped as deemed necessary to remove excess fine materials.

4. The final depth of the anthracite, after washing shall be 18 inches.

3.03 Preparation of Filters for Service

A. After all filter materials have been placed and initially backwashed, each filter shall be backwashed three times, for at least ten minutes each time, at the rate of 20 gpm/square feet of filter area. After each backwashing the filter media shall be allowed to compact by slowly closing the backwash valve.

B. Upon completion of backwashing, a sieve analysis shall be made of the anthracite to determine the gradation. Sufficient material shall be removed from the top of the bed so that the uniformity coefficient will be less than specified after the anthracite layer is scraped. After scraping, the effective size shall be within the specified range.

C. Additional anthracite shall be placed as required and the filters backwashed for at least three minutes at the rate of 20 gpm/square feet of filter area. The media shall be allowed to compact by slowly closing the backwash valve. The anthracite thickness shall then be measured. If additional anthracite is required, the anthracite shall be placed evenly in the filters and the procedures described above repeated until the required depth and gradation of the anthracite filter material is achieved.

3.04 Disinfection

After all other work is completed, and before the filters are placed in service, the filters shall be disinfected by chlorination in accordance with AWWA C653.

3.05 Manufacturer's Services

A. A manufacturer's representative for the equipment specified shall be present at the jobsite for installation assistance, inspection, and certification of installation and testing, and training of Owner's personnel. The Contractor shall include a minimum of 10 days at the jobsite and a minimum of four trips.

B. The Contractor shall not begin any underdrain installation without the manufacturer's representative being on-site to instruct and observe initial installation.

C. The Contractor shall not install any media without the manufacturer's representative being on-site to instruct and observe the initial installation of media for the first filter. The Contractor shall have the manufacturer's representative provide the Owner with a letter certifying that the representative was present on-site, did instruct, did observe and approved the Contractor's installation techniques and authorized continuances of placement of the media. Any media installed prior to the manufacturer's representative being on-site and authorizing the Contractor to continue, shall be removed and replaced by the Contractor with no additional cost to the Owner.

3.06 Clean-Up

Contractor shall remove from the job site and dispose of all excess or rejected filter media and the area around the filters shall be cleaned at the end of each working day.

END OF SECTION

Part 1 General

1.01 Scope

The work described in this Section shall include furnishing all materials, equipment and labor necessary to install reinforced, geomembrane baffles in the basins as shown on the Drawings.

1.02 Design Requirements

A. The baffles shall be suitable for installation in clearwells as shown on the Drawings, and shall conform to the dimensions and clearances shown on the Drawings. All material must be NSF and FDA approved.

B. The baffles shall include custom fabricated reinforced geomembrane curtain material, anchor bolts and all necessary appurtenances. Each baffle shall be tested to withstand chlorine extreme temperatures, abrasion and hydraulic shock, and shall have a prudent safety factor all stresses that may occur during fabrication, erection, intermittent, or continuous 24 hour per day operation. [Baffles shall be provided and installed by the clearwell contractor.]

C. All submerged materials, except anchors, shall be non-corroding plastics. Anchor bolts shall be manufactured from 316 stainless steel.

1.03 Submittals

A. The Contractor shall submit complete shop drawings and product data of all equipment furnished in accordance with the requirements of Section 01340 of these Specifications.

B. Submit a one square foot sample of curtain material which is to be used for the baffle curtains.

1.04 Storage and Protection

Materials 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 equipment furnished complies with all applicable requirements of these Specifications, and has been in use in similar applications for a minimum of five years.

Part 2 Products

2.01 Acceptable Manufacturers

Baffles shall be equal to Bio-Separator/Therna-Fab, Inc.

2.02 Materials

A. Baffle/curtain material shall be a 45 mil polypropylene liner compounded from first quality domestic material specifically designed for potable water applications. The liner shall be constructed from two plies of polypropylene sheeting laminated together over one ply of 10 x 10 - 1000 denier polyester fabric. Polypropylene resin shall comprise greater than 45 percent by weight of the total sheeting formulation. Fabric shall be fully encapsulated by polypropylene at roll edges.

B. Baffle/curtain shall have a 3/8-inch, poly-pro rope in the top, bottom and sides for supporting ballast. The top edge shall have double 2 x 2 x 1/4 inch stainless steel angles bolted on each side of the reinforced hem with lift points adequate to permanently suspend the curtain, spaced six feet on center.

C. The baffle/curtain shall be supported using 5/8-inch, 316 stainless steel weg-it eyebolts or 316 embedded anchor cast into the roof, side and bottom slab at six feet on center, supplied and installed by the Contractor.

D. The baffle/curtain shall be attached to the sides and bottom anchorage with a 2 x 2 x 1/4 inch angle bolted to the side and bottom at 6'-0" centers. Curtain hem shall be doubled at both sides and bottom connection, bottom hem shall have an additional layer of material.

Part 3 Execution

3.01 Installation

Baffles shall be installed in accordance with the manufacturer's recommendations as approved by the Engineer.

3.02 Surface Preparation and Painting

No surface preparation will be required or allowed for the baffle curtains.

END OF SECTION