**ANNE ARUNDEL COUNTY**
**MARYLAND**

**DEPARTMENT OF PUBLIC WORKS**

# CHAPTER 1

# REFERENCE PUMPING STATION SPECIFICATIONS

April 2024

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## SEWER PUMPING STATION SPECIAL PROVISIONS

APPENDICES

# SECTION 02641

# BITUMINOUS CONCRETE PAVING

Add the following to Section 02641.03 of the Anne Arundel County Standard Specifications:

## 02641.03 EXECUTION

A. Preparation

1. Surface Condition

    a. Forming for Paving

        1. Form perimeter of all paving with 1/8" x 6" bituminous coated steel strip where paving abuts landscaped, stoned or vegetative areas.

END OF SECTION

# SECTION 02710

# SITE FENCES AND GATES

Delete Specification Section 02710 - FENCES from the Anne Arundel County Standard Specifications and replace with the following:

## 02710.01 GENERAL

A. Description

1. This division includes requirements for steel fences, gates, and mowing strips with expansion joints on each side of posts, or ten feet maximum.

B. Description of Work

1. The extent of steel fences and gates is shown on the Drawings.

2. Steel fences and gates includes vinyl coated, galvanized steel systems and aluminum sliding gates.

C. Quality Assurance

1. Work shall comply with the standards of the Chain Link Fence Manufacturers Institute for "Galvanized Steel Chain Link Fence Fabric," and "Industrial Steel Specifications for Fence Posts, Gates and Accessories," and as herein specified.

2. Provide steel fence and aluminum gates as a complete unit produced by a single manufacturer, including necessary erection accessories, fittings, slats (as required), and fastenings.

3. Examine the conditions under which the fence and gates are to be installed. Notify the Engineer 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.

4. Damage to the vinyl coating of any element of the fence system which compromises the corrosion protection and/or aesthetic qualities will result in rejection of the affected material. Determination by the Project Engineer is final and not subject to appeal.

D. Submittals

1. Submit certificates of compliance for all fencing materials.

2. Submit shop drawings in accordance with the General Provisions for fencing materials and components. The shop drawings shall show dimensional information, coating materials, methods, and details, and other information that may be required to determine conformance with

these Specifications. Submit material samples of fabric, wire and accessories if requested by the Engineer.

## 02710.02 MATERIALS

A. General

1. Pipe sizes indicated are commercial pipe sizes. H-section sizes are nominal flange dimensions.

2. Galvanized finish shall be in conformance with the following:

   a. Pipe: ASTM A120 (1.8 oz. zinc per square foot)

   b. H-Sections: ASTM A123 (2 oz. zinc per square foot)

   c. Hardware and accessories: ASTM A153 (zinc weight per Table I)

3. Other items not specifically covered: ASTM A153 and ASTM A386.

B. Fabric

1. Chain link fabric shall be as follows:

   a. One-piece fabric widths, for fabric height of seven (7) feet.

2. No. 9 gauge (0.148") wires. Fabric wire shall be galvanized and vinyl coated after weaving. The vinyl coating shall be a minimum of 7 mil thickness, color black.

3. 2- inch diamond mesh.

4. Top selvage twisted, bottom selvage knuckled.

C. Posts and Braces

1. End, corner and pull posts shall be a minimum size of 2.875 inches O.D. pipe weighing 5.80 pounds per linear foot.

2. Line posts shall be a minimum size of 2.375 inches O.D. pipe weighing 3.65 pounds per linear foot. Space posts 10 feet on center maximum unless otherwise indicated.

3. Gate posts shall be 4.0 inches O.D. pipe weighing 9.12 pounds per linear foot.

4. Provide bracing assemblies at end and gate posts and at both sides of corner and pull posts, with the horizontal brace located at mid-height of the fabric. Use 1.660 inches O.D. pipe weighing 2.27 pounds per linear foot for horizontal brace and 3/8 inch diameter rod with turnbuckle for diagonal truss.

5. Tension wire at top and bottom of fabric shall consist of No. 7 gauge galvanized coiled spring wire, vinyl coated as specified for the chain link fabric. Tension wires shall be fastened to fabric with galvanized pig rings on two (2) foot centers.

6. Stretcher bars shall be one piece lengths equal to full height of fabric, with a minimum cross-section of 3/16 inches by 3/4 inches. Provide one stretcher bar for each gate and end post, and two (2) for each corner and pull post, except where fabric is integrally woven into the post.

7. Stretcher bar bands shall be steel, wrought iron, or malleable iron, spaced not over 15 inches on center to secure stretcher bars to end, corner, pull and gate posts.

8. Posts, bracing assemblies, stretcher bars and all accessories shall be vinyl-coated as specified for fence fabric.

D. Gates

1. Fabricate gate perimeter frames of tubular members in accordance with ASTM F 1184, Class 2, using 2-inch square aluminum members complying with ASTM B221-91, alloy 6063-T6, 0.94 pounds per foot. Provide additional horizontal and vertical members to ensure proper gate operation and for attachment of fabric, hardware and accessories. Space so that frame members are not more than nine (9) feet apart.

2. Assemble gate frames by welding or with special malleable or pressed steel fittings and rivets for rigid connections. Use same fabric as for fence, unless otherwise indicated. Install fabric with stretcher bars at vertical edges. Bars may also be used at top and bottom edges. Attach stretcher bar bands to gate frame at not more than 15 inches on center. Attach hardware with rivets or by other means which will provide security against removal or breakage.

3. Provide diagonal cross bracing consisting of 3/8 inch diameter adjustable length truss rods on gates where necessary to provide frame rigidity without sag or twist.

4. Gate assemblies and all accessories shall be vinyl-coated as specified for fence fabric.

5. Slide gates shall utilize two roller truck assemblies, one mounted on the gate support post and the other mounted on the overhang post. The track section of the top frame member shall slide over both truck assemblies.

6. Cantilever slide gates shall be by Anchor Fence, Inc. or approved equal.

E. Swing Gate

1. Gate Frame: Fabricate in accordance with ASTM F900. Nominal 2 inch tubular horizontal and vertical members and truss members (if required) assembled by welding. Galvanize and PVC coat as fence frame members. Use same fabric as fence and install with stretcher bars and bar ties at 15 inches O.C. Provide diagonal cross bracing of 3/8-inch diameter adjustable length truss rods. Attach gate hardware with rivets or by other

means to provide security against removal.

2. Gate hardware as follows:

    a. Hinges: Pressed steel or malleable iron to suit gate size, non-lift-off type, and offset to permit 180 degree swing in or out. Provide one pair (top and bottom) per gate leaf.

    b. Latch: Forked or plunger bar type to permit operation either side of gate. Provide padlock eye as integral part of latch. Provide gate stops for pair of gates designed to accept drop rod or plunger bar.

    c. Keeper: Provide keeper for each gate leaf to hold gate leaf in open position until manually released.

F. Miscellaneous Materials and Accessories

1. For tying fabric to line posts, use nine (9) gauge wire ties spaced 12 inches on center. For tying fabric to rails and braces, use nine (9) gauge wire ties spaced 24 inches on center. For tying fabric to tension wire, use 11 gauge hog rings spaced 24 inches on center. Manufacturer's standard procedures will be accepted if of equal strength, durability, and appearance. All wire ties and hog rings shall be vinyl-coated as specified for fence fabric.
2. Provide concrete consisting of Portland cement complying with ASTM C 150, aggregates complying with ASTM C33, and clean potable water per Section 3300. Mix materials to obtain concrete with a minimum 28-day compressive strength of 2500 psi, using at least four (4) sacks of cement per cubic yards, 1-inch maximum size aggregate, maximum 3 inches slump, and two (2) percent to four (4) percent entrained air.
3. Padlocks shall be provided for each gate. Padlocks shall be Best 4 1B Series, keyed to the County master key system. Provide padlocks per Section 08700.
4. Slats shall be provided where shown on the drawings at a length that fully covers fence mesh. Slats shall have a fixed width, spacing, and thickness compatible with 2-inch diamond mesh. Slat color shall be approved by the owner.

G. Pipe Bollards

1. Pipe bollards shall be 6-inch diameter Schedule 40 steel pipe. Pipe bollards shall extend three (3) feet above finished grade. Pipe bollards shall be anchored in concrete to a depth of 3 feet, and the concrete anchorage shall have a diameter of 18 inches. The concrete fill shall extend one (1) inch above the top of the bollard, and shall be domed at the top to shed water. The entire finished bollard assembly shall be covered with a safety yellow vinyl sleeve. The vinyl sleeve shall be dome top low-density polyethylene thermoplastic material. Bollard locations as shown on the Contract Drawings.

H. Grounding

1. Grounding shall be provided in accordance with the requirements of the National Electrical Code and as specified in Standard Section 02730 and/or indicated on the Plans.

I. Portland Cement Concrete

1. Portland cement concrete for fence post and bollard encasement shall be Mix No. 2 as specified in Section 03310.

**02710.03 EXECUTION**

A. General

1. Do not begin fence installation and erection before the final grading is completed, with finish elevations established, unless otherwise permitted.

2. Concrete footings for corner, end, and line posts shall be 12-inch diameter, minimum, and three (3) feet deep, minimum. Gatepost footings shall be 16-inch diameter, minimum, and three (3) feet deep, minimum. Corner, gate and end posts shall be embedded a minimum of 32 inches in the concrete. Line posts shall be embedded a minimum of 26 inches. Concrete mowing strip beneath fence shall be as shown on the drawings.

B. Setting Posts

1. Remove all loose and foreign materials from sides and bottoms of holes, and moisten soil prior to placing concrete.

2. Center and align posts in holes.

3. Place concrete around posts in a continuous pour, and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hold in position during placement and finishing operations. Do not set posts or concrete in frozen ground.

4. Trowel finish tops of mowing strip or exposed post fittings, and slope or dome to direct water away from fence posts.

5. Keep exposed concrete surfaces moist for at least seven (7) days after placement, or cure with membrane curing material, or other acceptable curing method.

C. Assembly

1. Allow concrete to attain at least 75 percent of its minimum 28-day compressive strength, but in no case sooner than seven (7) days after placement, before rails, tension wires, or fabric is installed. Do not stretch and tension fabric and wires, and do not install gate until the concrete has attained its full design strength.

2. Leave approximately two (2) inches between finish grade and bottom selvage. Pull fabric taut and tie to posts, rails, and tension wires. Install fabric on secure side of the fence, and anchor to framework so that fabric remains in tension after pulling force is released.

3. Install tension wires to the fabric with hog rings and tie to each post with not less than nine (9) gauge galvanized wire.

4. Repair damaged coatings in the shop or during field erection by recoating with hot applied repair compound, applied per manufacturer's recommendations.

5. Stretcher bars shall be threaded through or clamped to fabric four (4) inches on center and secured to posts with metal bands spaced 15 inches on center.

6. Use U-shaped wire, conforming to diameter of pipe to which attached, clasping pipe and fabric firmly with ends twisted at least two (2) full turns. Bend ends of wire to minimize hazard to persons or clothing.

7. Install nuts for tension band and hardware bolts on side of fence opposite fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

8. Special bottom closures shall be installed where fences cross ditches and swales.

9. Install gates plumb, level and secure for full opening without interference. Attach hardware to prevent unauthorized removal, and adjust for smooth operation.

END OF SECTION

# SECTION 04200

# UNIT MASONRY

Delete Specifications Sections 04200 – UNIT MASONRY from the Anne Arundel County Standard Specifications and replace with the following:

## 04200.01 GENERAL

A. Description of Work

The work to be done under this section includes everything necessary and incidental to executing and completing all masonry work shown on the Drawings or hereafter specified.

B. Related Sections:

Special coatings, Spec Section 09800, for interior building and drywell coating.

C. Sample Panel

The Contractor shall erect prior to the beginning of any masonry work, a sample panel of a typical wall 3 feet 4 inches high by 4 feet wide. The sample panel shall be erected on the building site at a location to be selected by the Engineer. The panel shall include the brick, block, reinforcing, mortar and joint treatment to be used on the project. Samples required by this Specifications section shall be cleaned and pointed prior to approval. After approval, the sample wall section shall serve as a standard for all masonry work on the project.

D. Quality Assurance

1. Fire Rated Masonry: Wherever a fire-resistant classification is shown or scheduled for unit masonry construction, comply with applicable requirements for materials and installation established by the American Insurance Association and other governing authorities.

2. Codes: Comply with applicable requirements of governing authorities and codes for the types of masonry construction shown.

3. Coordination: Review installation procedures and coordinate with other work that must be integrated with masonry.

E. Submittals

1. Submit samples of all material to be used for the Engineer's Approval before any purchasing. All samples shall be clearly marked as to the manufacturer, job, date, contractor, and quality.

2. Submit certificates of compliance for masonry materials.

## 04200.02 MATERIALS

A. Materials

1. Brick, General:

   a. Provide modular size brick (7-1/2 inches long x 2-1/4 inches high x 3-3/4 inches wide) ASTM C-216, Grade SW, Type FBS, color as selected by the Owner.

   b. Manufacturer: Obtain masonry units from one manufacturer of uniform texture and color for each kind required, for each continuous area and visually related areas.

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

2. Building or Common Brick: ASTM C62-84, Grade SW. Concealed units, Grade MW.

3. Concrete Masonry Units: Nominal face size 8 inches by 16 inches by thickness required for walls and partitions indicated of actual size to achieve 8-inch coursing as approved by the Engineer for appearance and strength, conforming to all State and Local codes, and to following ASTM specifications except as modified herein.

   a. Aggregates in units: Lightweight, expanded shale, clay or slate conforming to ASTM C331-80.

   b. Hollow Load-Bearing Units: ASTM C90-70, Grade N-1.

   c. Units shall be thoroughly air cured a minimum of 28 days under proper care.

   d. Maximum moisture content of all units at delivery, and at installation shall not exceed 30 percent of their total absorption capacity. Written certification is required as specified. Units not meeting same at delivery shall be returned to manufacturer or set aside on-site until moisture limit is met, as shown by retesting. Testing shall be at no additional cost to the Owner.

   e. Walls and partitions shall meet fire resistance requirements of all applicable codes, ordinances; all such units shall be the rated product of a manufacturer listed in the current Fire Protection Equipment List, published by the U.L. and shall comply with all State and Local Code requirements.

   f. Units to remain exposed or to receive paint or coating finish shall be "facing unit" type having a uniform "fine ground" texture finish. Installed units shall equal in all respects the submitted samples approved by the Engineer.

   g. Units shall not contain iron or other substances which might cause surface staining or pop-outs or will stain paint or corrode metals. Only units true to size, with no spalls, cracks, splits, etc., will be accepted.

h. Provide bull nose units for outside corners constructed in concrete masonry units.

4. Mortar Materials

   a. Aggregate for Mortar: Clan, graded sand per ASTM C144-81.

   b. Aggregate for Grout: Fine and coarse aggregate conforming to ASTM C404.

   c. Portland Cement: Type I, conforming to ASTM C150.

   d. Hydrated Lime: Type S, conforming to ASTM C207.

   e. Water: Clean and free of deleterious amounts of acids, alkalis or organic material.

5. Reinforcement, Anchors and Ties:

   a. Joint Reinforcement: Heavy weight, truss type, prefabricated, mill galvanized in accordance with ASTM A1 16-71, Class 3, welded wire conforming to ASTM A82-72, masonry joint reinforcement; A.A. Wire Products Co. "Adjustable Blok-Trus", Dur-O-Wal "Dur-O-Eye", National Wire Products "Uni-Tie", or equal. Reinforcement shall have 3/16-inch deformed side rods and No. 9 gauge smooth crossrods with drip and shall be of proper width to extend to within one inch of both faces of wall. Prefabricated corner and tee sections of same type and design as reinforcement shall be provided.

   b. Anchors and Ties: Shall be zinc-coated steel or copper-coated steel. Except for steel wire, zinc coating shall conform in accordance with ASTM A1 16-71 Class 2 coating. Copper-coated steel shall conform to ASTM B227-70, Grade 30HS. Extent, location, size and shapes of anchors and ties shall be as indicated and/or as herein specified, and in accordance with best practice of the trade.

      i. Rigid Steel Ties: For anchoring interior CMU walls to exterior walls shall be 3/16-inch thick, 1-1/2 inches wide, and 16 inches long, with one end bent up 2 inches and one end bent down 2 inches.

      ii. Wire Mesh Ties: Shall be 16-gauge steel wire, 1/2-inch mesh, of the required width.

      iii. Dovetail Anchors: Shall be flat bar type, minimum 16-gauge steel, 1 inch wide, end turned up 1/4-inch or with 1/2-inch hole located within 1/2-inch of end; or wire type, minimum 9-gauge steel, looped and closed Dovetail slots are provided in Section 03100, CONCRETE FORMWORK.

6. Miscellaneous Materials:

   a. Weepholes: Shall be 3/8-inch outer diameter clear, nonstaining plastic tubing.

   b. Masonry Sealer: Shall be mineral gum-based material containing approximately 7 percent solids, "Hydrozo Clear Special Light" as manufactured

by Hydrozo Coating Co., Lincoln, Nebraska, or equal. It shall pass ASTM C67-73 and C 140-70 submersion tests with a repellency rate of 96 percent and be applied as per manufacturer directions; have a moisture vapor transmission rate of 37.5 percent and, after 2,500 hours weatherometer testing, a repellency rate of 95.3 percent. It shall have the manufacturer's 10-year material warranty against moisture penetration or peeling and flaking.

c. Masonry Cleaner: Shall be Sure-Klean “Vana-Trol”, as manufactured by Process Solvent Co., Inc., or an equal.

d. Through-Wall Flashing: Shall be 0.020-inch gauge Nervasteel H-D or equal.

7. Precast Lintels (Texture to Match Exactly Lightweight Masonry Units): Provide reinforced block lintels over openings where other lintels do not occur. Cast lintels at least 28 days before setting in place. Submit shop drawings and obtain approval of precast lintels and reinforcing before casting. Face shall be scored to match standard size of unit to simulate mortar joints at 16 inches on center.

B. Mortar and Grout Mixes

1. Mortar: All mortar shall be Type M, conforming to ASTM C270-73, with the materials and mortar proportions limited to the following:

a. Portland Cement Mortar: One part Portland cement, 1/4-part hydrated lime and 2 1/4 to 3 parts of masonry sand measured relative to the total volume of cement and lime used.

b. Masonry Cement Mortar: One part masonry cement, 1 part Portland cement and 2 1/4 to 3 parts of masonry sand measured relative to the total volume of the two cements used, or manufacturer's pre-formulated mortar.

c. Mortar for face brick shall be nonstaining, waterproof, colored flamingo masonry cement, utilizing a hydrated hydraulic lime base, color to be selected by the Engineer to blend with color of face masonry selected. Sample shall be mixed with local sand to ensure a color match with that selected and used in sample panel for approval with face masonry.

2. Mixing Mortar: Proportions of materials shall be measured by the bucketful and not the shovelful. Materials shall be mixed in mechanical batch mixers for a period of 5 minutes. The consistency of the mortar may be adjusted for satisfactory workability of the mortar. If mortar begins to stiffen from evaporation of or from absorption of a part of the mixing water, retemper the mortar immediately by adding water and remix the mortar. All mortar shall be used within two hours of initial mixing and shall not be used or retempered after such period. Any mortar that has started an initial set shall be discarded

## 04200.03 EXECUTION

A. Precautions

1. Do not lay masonry in freezing weather unless suitable means are provided to heat materials, protect work from cold and frost, and ensure that mortar will harden without freezing. No anti-freeze shall be used without the Engineer's written approval. Freezing weather is interpreted to be any weather when temperature is below 34 degrees F., or 40 degrees F., on a falling thermometer.

2. Cold weather masonry construction and its quality control requirements shall be as follows:

| Working Day Temperature | Construction Requirements |
|---|---|
| Above 40 F | Normal masonry procedures. |
| 40 F - 32 F | Heat mixing water to produce mortar temperatures between 40 F and 120 F. |
| 32 F– 0 | Mortar on boards should be maintained above 40F. |

3. Protect facing material against staining and keep top of walls covered with nonstaining waterproof coverings when work is not in progress; this is a must requirement. When work is resumed, top surface of work shall be clean of all loose mortar.

4. Do not wet concrete masonry units.

5. Mortar joints that have been weakened by freezing shall be replaced at no additional cost and if walls are weakened, they shall be rebuilt at no increase to the Contract.

6. It shall be the responsibility of the Contractor to properly brace walls to prevent them from being blown over by storms, wind, etc., prior to the wall being tied into the structure.

B. Scaffolding

The Contractor shall provide all required scaffolding to complete the work under this section, including all hanging scaffolding and supports.

C. Masonry Saw

Where cutting of masonry units is required, use motor driven masonry saw. Do all cutting to accommodate other trades. Material with shipped or irregularly cut surface will not be accepted.

D. Installation

1. Masonry facing, both interior and exterior, shall be protected against staining. During construction tops of walls shall be covered with non-staining waterproof coverings when

work is not in progress. No water shall be allowed to enter walls during their construction. When work is resumed, top surface of masonry walls shall be cleaned of all loose mortar and, in drying weather, thoroughly wetted, except that concrete masonry units shall not be wetted. Do not lay masonry while frost or excess water remains on the surface. Before closing up any pipe, duct or similar inaccessible spaces with masonry, remove all rubbish and sweep out the area to be enclosed, ensure that all piping has been tested.

2. Where fresh masonry join masonry that is partially set or totally set, clean the exposed surface of the set masonry, and wet it lightly so as to obtain the best possible bond with the new work. Remove all loose masonry and mortar. If it is necessary to "stop off" a horizontal run or masonry, this shall be done by raking back one brick length in each course. Toothing will not be permitted.

3. Provide safe adequate scaffolding, centering and other equipment necessary for the proper execution of masonry work. Maintain a minimum of 3 inches clearance between all scaffolding and exterior wall faces.

4. All masonry units shall be laid plumb, level, and true to line. Lay out all facing coursing before setting to minimize cutting closures or jumping bond. Build in all metal items and anchors as work progresses.

5. All exterior masonry shall be laid-up from exterior side with outside scaffolding, no such work shall be laid from inside.

6. Control Joints and Expansion Joints: Shall be provided where indicated on the Drawings.

7. Bond and coursing shall be as follows, using joint reinforcement for bond as herein specified.

    a. Brick: Shall be laid in running bond, with 1 course in 8 inches to level off with each course of CMU.

    b. CMU's: Shall be laid to achieve the appearance of running bond.

    c. Story Pole: All course shall be accurately spaced with story pole.

8. Brick Units

    a. All joints between bricks shall be completely filled with mortar: Bed joints shall be formed of a thick layer of smooth or slightly furrowed mortar, applied to the units previously laid, with the brick then shoved in place; or bed joints may be formed as specified for cross joints. Cross joints shall be formed by applying to the brick to be laid, a full coat of mortar on the entire end or the entire side, as the case requires, and then shoving the mortar-covered end and/or side of the brick tightly against the bricks previously laid. The practice of buttering the corners of brick and then throwing mortar scrapings into the empty joints will not be permitted. All brick shall be laid without disturbing the brick previously laid. Dry or butt joints will not be permitted. Grouting shall be done only as necessary.

b. Wetting: Brick having absorption rate of more than 0.025 ounce per square inch per minute shall be wetted sufficiently so that the rate of absorption when laid does not exceed this amount. All units shall be free from water adhering to their surfaces when they are laid in the wall. Do not wet concrete masonry units.

9. Concrete Masonry Units

a. Concrete masonry unit walls and partitions shall be laid up with the following strength units, unless otherwise indicated on the drawings.

b. Hollow Load-Bearing Walls: All other load bearing and non-load bearing walls and partitions.

c. Units shall be dry when laid (within moisture limits herein specified).

d. Units shall be laid with full mortar coverage on horizontal and vertical face cells, except that webs also shall be bedded at starting courses in piers, columns, and pilasters.

e. Lay-up units plumb and true to line, in bond specified and bonded or anchored to adjoining construction. Do not expose open ends.

f. All CMU walls and partitions shall extend to underside of floor or roof construction above, except where otherwise indicated on the drawings.

g. Where possible, masonry unit walls and partitions shall be built after all overhead ducts, pipes and conduits are in place and tested. Masonry shall be neatly built around the items above. Walls and partitions shall be plumb, true to line and free from defects such as open cells, voids, dry joints, and other similar defects. In rooms and spaces scheduled to have CMU finish, all such surfaces, including upper wall surfaces up to termination at structural ceiling in spaces without suspended ceilings, shall be made suitable for paint application. Coordination between the trades shall be the responsibility of the Contractor. Cutting of openings in walls and partitions in place shall be done only with the approval of the Engineer.

10. Bonding and Anchoring

a. Units in partitions, walls, etc., shall be laid in running bond with vertical joints broken at center of block below. Wherever possible, walls and partitions shall be masonry bonded as they are built up, and corners and intersections of same shall be bonded together by alternate lapping of blocks. Where masonry bonding into walls and partitions is not possible, same shall be anchored with rigid steel anchors extending 4 inches into exterior walls and 8 inches into intersecting walls or partitions. Anchors into concrete beams, columns, etc., shall be of type to fit slots in concrete.

b. Metal frames and other built-in work shall be maintained in proper position and hollow metal doorframes spreader backing shall not be removed until walls are fully installed around frames and in proper position and mortar has fully set. Block

shall be bedded against all built-in work with full mortar. The cells of a block adjoining built-in work requiring anchors shall have cells filed solid with mortar.

c. Fill cells of units for three courses below and two on each side of any concentrated loads with 1:2 Portland cement mortar. Where anchor bolts or expansion bolts occur in concrete masonry unit walls and partitions, such units shall have the cells filled with mortar as specified above.

11. Horizontal Joint Reinforcement: Unless otherwise noted on the drawings, all masonry walls and partitions, both interior and exterior, including brick faced cavity walls, shall be reinforced with welded wire joint reinforcement. Reinforcement shall be installed in the first and second bed joints immediately above all lintels and below sills at all openings, at other locations as may be noted on the drawings, at 8 inches vertical intervals in all foundation walls; and at 16 inches vertical intervals in all other wall and partition areas. Reinforcing in the second bed joint above and below wall openings shall extend 24 inches beyond the jambs. All other reinforcement shall be continuous except that it shall not pass-through vertical masonry expansion joints. Side rods shall be lapped at least 6 inches at splices, and splices shall be staggered. Reinforcement shall be so placed as to obtain a minimum of 1-inch mortar cover on the exterior face of walls and 1/2-inch mortar cover on interior faces. Reinforced masonry walls shall conform to the applicable building code requirements.

12. Walls of all CMU's shall have concave joints, tooled smooth. Face joints in all other walls and partitions, including face brick and masonry below grade, shall be tooled concave, with the mortar thoroughly compacted and pressed against the edges of the masonry unit. Tooling shall be done when the mortar is thumbprint hard. Tooled joints shall be finished to uniformly straight and true lines and surfaces, smooth and free of tool marks. Joints in cavity wall wythe receiving rigidboard insulation shall be cut flush.

E. Cavity Walls

All exterior walls, unless otherwise indicated, shall be cavity walls of thickness indicated, with continuous 2-inch cavity, except for returns at windows, columns, control joints and as detailed, indicated.

1. Two wythes of cavity walls shall be securely tied together by joint reinforcement as herein specified.

2. Cavity between facing and backing wythe shall be kept clean and clear of all mortar droppings, and no mortar ledges shall project into the cavity. Temporary wood strips, cut to width of cavity and fitted with lift-up wires, shall be laid on the joint reinforcement and carefully lifted out before placement of the next layer or reinforcement. Any projecting mortar shall be spread over the back of the outer wythe immediately following the setting of the masonry unit.

3. Weepholes shall be provided in mortar joints of the exterior wythe of all cavity walls in the first course above top of flashing along the bottom of cavity walls, over foundations,

bond beams, shelf angles and water stops by placing 3/8-inch nominal diameter plastic weephole tubing 32 inches on center in each row.

F. Coordination With Other Trades

1. Consult other trades in advance and make provisions for installation of their work in order to avoid cutting and patching. Build in work specified under other sections of the Specifications as the work progresses. Provide recesses at walls where required for piping, louvers, ducts, etc., install and set all bolts, plates, anchors, flashing reglets and items to support other work to follow masonry.

2. Set steel lintels which bear on masonry. Lintels shall have beds of mortar and flashed as required by Drawings.

G. Pointing and Cleaning

Point all holes in exposed masonry. Cut out defective joints and repoint them with matching mortar. All exposed masonry shall be cleaned thoroughly. Remove foreign material; excess masonry shall be cleaned thoroughly. Remove foreign material, excess mortar, and stains. Apply the specified cleaning agent in strict accordance with the manufacturer's printed instructions. Before applying any cleaning agent to the entire wall, it shall be applied to a sample wall area of approximately 20 square feet in a location approved by the Engineer. No further cleaning work shall proceed until the sample area has been approved by the Engineer, after which time the same cleaning materials and method shall be used on the remaining wall area. At the end of each day's work, thoroughly clean faces of all work below, continue same until cleaning is completed. The use of muriatic acid for cleaning masonry will not be permitted.

H. Wall Flashing

Shall be set with full bed of mortar above and below flashing and installed in strict accordance with manufacturer's specifications. Flashing shall extend a minimum of 8 inches beyond all masonry openings of each jamb at head and sill. Flashing shall be laid in all cases, extending down one course minimum from the back-up course and out to within 1/2- inch of face of wall.

I. Access Panels

Access panels shall be furnished by the Contractor where required.

J. Clean-Up

All wasted mortar, scrapings, broken masonry units, cement bags and all other scrap materials in connection with masonry work, shall be removed from the site as the work progresses. All scaffolding shall be removed upon completion of the work.

END OF SECTION

# SECTION 05200

# MISCELLANEOUS METALS

## 05200.01 GENERAL

A. Description

The requirements of this Section apply to the miscellaneous metal fabrications shown on the Drawings and as specified herein, including anchors, fasteners, hardware, castings, gratings, and other miscellaneous specialty items.

B. Quality Assurance

1. Codes and Standards

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

American Society for Testing and Materials (ASTM) Publications:

A36-84a Structural Steel

A53-90a Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

A193-90 Alloy Steel and Stainless-Steel Bolting Materials for High Temperature Service

A194-90 Carbon and Alloy Steel Nuts for Bolts for High- Pressure and High-Temperature Service

A123-78 Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed and Forged Steel Shapes, Plates, Bars, and Strip

A307-90 Carbon Steel, Externally and Internally Threaded Standard Fasteners

B26-91 Aluminum-Alloy Sand Castings

B108-91 Aluminum-Alloy Permanent Mold Castings

B209-90 Aluminum-Alloy Sheet and Plate

B211-90 Aluminum-Alloy Bars, Rods, and Wire

B221-91 Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes

B308-90a Aluminum-Alloy Standard Structural Shapes, Rolled and Extruded

b. American National Standards Institute (ANSI) Publications: A14.3-74 Safety Requirements for Fixed Ladders

c. National Association of Architectural Metal Manufacturers (NAAMM) Publications: Metal Finishes Manual (January 1976)

d. American Welding Society (AWS) Publication: D1.1-80 Structural Welding Code

e. American Institute of Steel Construction (AISC) Publications: Manual of Steel Construction (8th Edition)

f. Aluminum Association Publication: “Aluminum Construction Manual - Specifications for Aluminum Structures”

g. Steel Structures Painting Council (SSPC) Publications:

i. SSPC-SP3 Surface Preparation Specification No. 1, Solvent Cleaning

ii. SSPC-SP6 Surface Preparation Specification No. 6, Commercial Blast Cleaning

2. Qualifications for Welding Work: Quality welding processes and welding operators in accordance with AWS "Standard Qualification Procedure".

3. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication, where possible, to ensure proper fitting of the work. However, do not delay job progress; allow for trimming and fitting wherever the taking of field measurements before fabrication might delay the work.

4. Shop Assembly: Preassemble items in the shop to the greatest extent possible, so as to minimize field splicing and assembly of units at the project site. Disassemble units only to the extent necessary for shipping and handling limitations. Clearly mark units for re-assembly and coordinated installations.

C. Submittals

1. Manufacturer's Data: Submit manufacturer’s specifications, load tables, dimension diagrams, anchor details and installation instructions for products to be used in miscellaneous metal work, including paint products.

2. Shop Drawings

a. Submit shop drawings for the fabrication and erection of all assemblies of miscellaneous metal work. Include plans, elevations, and details of sections and connections. Show anchorage and accessory items.

b. Include setting drawings for location and installation of miscellaneous metal items and anchorage devices.

3. Samples: Submit representative samples of materials and finished products as may be requested by the Engineer. Engineer's review will be for color, texture, style, and finish only. All other requirements for the work are the Contractor's responsibility.

## 05200.02 MATERIALS

**A.** General

For the fabrication of miscellaneous metal work items which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness. Remove such blemishes by grinding, or by welding and grinding, prior to cleaning, treating and application of surface finishes including zinc coatings.

**B.** Materials

1. Threaded-Type Concrete Inserts (T-Concin): Galvanized ferrous castings, internally threaded to receive 3/4-inch diameter machine bolts; either malleable iron complying with ASTM A47 or cast steel complying with ASTM A27; hot dip galvanized.

2. Fasteners: All fasteners should be corrosion resistant. Provide fasteners of 316 series stainless steel in all areas subject to corrosive atmosphere.

3. Bar Rack

   a. Bar rack shall be of all aluminum construction unless otherwise noted. The bar rack (minimum bar rack size = 2'-4" x 2'-3 3/8") shall be fabricated into a single unit with the end of each 2-inch x 3/8-inch aluminum bar welded to a stationary aluminum member at 1-1/2-inch centers to maintain uniform bar spacing. A bar rack rake of stainless steel and aluminum construction with stainless steel bolted connections shall be provided. The rake handle shall be 1-1/4-inch minimum O.D. pipe, aluminum alloy type 6061-T6. The handle length shall be 4 foot minimum. The rake head shall be 1/8-inch-thick type 316 stainless steel plate with a rake width of 12 inches minimum but not to exceed the bar rack width minus 1 inch.

   b. The rake head shall have teeth spaced to accurately engage the bar rack with rake teeth a minimum of 1-1/4 inch long.

4. Wet Well Grating Platform

   a. The wet well grating platform and bar rack assembly support shall consist of all aluminum structural shapes of sufficient section to withstand the loading specified herein. All grating platform support members shall be connected or anchored with stainless steel fasteners. The grating support members shall be completely removable and shall include anchored perimeter angle supports and fabricated, wall-mounted

beam pockets as necessary.

b. The Contractor shall submit shop drawings consisting of detailed design calculations and drawings for the grating and grating support system. The Contractor's attention is drawn to the requirements of removable grating sections located and sited to accommodate float mast, bubbler tube, and sewage pump removal or portable submersible sewage pump installation on the floor of the wet well. All grating sections shall have perimeter banding and shall be limited to a size which can be safely handled by any individual. All grating sections shall have serrated edges or other approved non-skid top surface.

c. The grating and grating support system shall be aluminum construction and designed for a maximum point load of 600 pounds and a uniform load of 150 pounds per square foot with a suitable factor of safety. Grating sections shall be locked down except for removable access sections.

5. Paint

Primer selected must be lead free and compatible with the required finish coats of paint. Coordinate selection of metal primer with finish paint requirements specified in Section 09900 of these Specifications.

**05200.03 EXECUTION**

A. Inspection

Examine the areas and conditions under which miscellaneous metal items are to be installed and notify Engineer 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.

B. Preparation

Furnish setting drawings, diagrams, templates, instructions and directions for the installation of anchorages, such as concrete inserts, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate with the delivery of such items to the project site.

C. Fabrication

1. Workmanship: Use materials of the size and thickness shown, or if not shown, of the required size and thickness to produce adequate strength and durability in the finished product for the intended use. Work to the dimensions shown or accepted on shop drawings, using proven details of fabrication and support. Use type of materials shown or specified for the various components of work.

2. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 1/32-inch unless

otherwise shown. Form bent-metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.

3. Weld corners and seams continuously and in accordance with the recommendations of AWS. At exposed connections, grind exposed welds smooth and flush to match and blend with adjoining surfaces.

4. Form exposed connections with hairline joints which are flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of the type shown, or if not shown, use Phillips flat head (countersunk) screws or bolts.

5. Provide for anchorage of the type shown, coordinate with the supporting structure and the progress schedule. Fabricate and space anchoring devices to provide adequate support for the intended use of the work.

6. Cut, reinforce, drill, and tap miscellaneous metal work indicated to receive finish hardware and similar items of work.

D. Shop Painting

1. Shop paint miscellaneous metal work except aluminum, stainless steel, or those members or portions of members to be embedded in concrete or masonry, surfaces, and edges to be field welded and galvanized surfaces, unless otherwise indicated.

2. Remove scale, rust, and other deleterious materials before the shop coat of paint is applied. Clean off rust and mill scale in accordance with SSPC SP- 6 "Commercial Blast Cleaning". Remove oil, grease, and similar contaminants in accordance with SSPC SP-1 "Solvent Cleaning".

3. Apply one shop coat of metal primer paint to fabricated ferrous metal items, except apply two (2) coats of paint to surfaces which are inaccessible after assembly or erection. Change the color of the second coat to distinguish it from the first.

4. Immediately after surface preparation, brush, or spray on metal primer paint, applied in accordance with the manufacturer's instructions and at a rate to provide a uniform dry film thickness of 1.5 mils for each coat. Use painting methods which will result in full coverage of joints, corners, edges, and all exposed surfaces.

E. Installation

1. Refer to other sections of the Specifications for installation requirements for specific metal materials, products, and systems.

2. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal items to in-place construction, including threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, wood screws and other connectors as required. Coat all aluminum in contact with concrete with bituminous coating prior to installation.

3. Cutting, Fitting and Placement: Perform cutting, drilling, and fitting required for the installation of the miscellaneous metal items. Set the work accurately in location, alignment, and elevation, plumb, level, true and free of rack, measured from established lines and level. Provide temporary bracing or anchors in formwork for items which are to be built into concrete, masonry, or similar construction.

4. Fit exposed connections accurately together to form tight hairline joints. Weld connections which are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Grind joints smooth and touch-up shop paint coat. Do not weld, cut or abrade the surfaces of exterior units which have been hot dip galvanized after fabrication, and are intended for bolted or screwed field connections.

5. Field Welding: Comply with AWS Code for the procedures of manual shielded metal-arc welding, the appearance and quality of welds made, and the methods used in correcting welding work.

6. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of the shop paint, and paint all exposed areas with the same material as used for shop painting. Apply by brush or spray to provide a minimum dry film thickness in accordance with Section 09900.

7. The Contractor shall provide shims, washers, anchors, etc. as necessary to achieve a well-constructed installation.

END OF SECTION

# SECTION 06100

# ROUGH CARPENTRY

Delete Specification Section 06100 - ROUGH CARPENTRY from the Anne Arundel County Standard Specifications and replace with the following:

## 06100.01 GENERAL

A. Description of Work

This section includes the requirements for rough carpentry work shown on the Drawings and whatever rough carpentry may be required to properly construct the project. Materials and installation requirements shall be as specified and accepted practices of the trade for work and materials commonly assigned to rough carpentry and as specified in other sections of the work.

B. Rough carpentry work includes, but is not limited to, the following:

1. Wood framing and/or blocking of walls, roofs, parapets and decks.

2. Wood grounds, nailers, blocking and sleepers.

3. Temporary railings, enclosures, forms and rough hardware and anchoring devices.

4. Installation of hollow metal frames.

C. Quality Assurance

1. Lumber Standards: Shall comply with PS-20 for each indicated use, including moisture content not to exceed 19 percent, and actual size related to the indicated nominal sizes, except as otherwise indicated.

2. Plywood Standards: Shall comply with PS-1 and APA's requirements, except as otherwise indicated for each use.

3. Factory mark each piece of lumber and plywood with type, grade, mill and grading agency identification; except omit marking from surfaces to receive transparent finish and submit mill certificate that material has been inspected and graded in accordance with requirements if it cannot be marked on a concealed surface.

4. Certificate of inspection and grading by a recognized agency may be submitted with each shipment, in lieu of factory marking at Contractor's option.

D. Submittals

1. Wood Treatment Data: Submit chemical treatment manufacturer's instructions for proper use and handling of treated material.

2. Submit certification of drying to 19 percent moisture content after treatment.

3. For pressure treatment of each type specified, submit certificates of compliance from the treating plant stating chemicals and process used, net amount of salts retained and conformance to the following specifications:

   a. Wolmanized (CCA), meeting AWPA

   b. Standard P-5 and conforming to AWPA

   c. Standard LP-2

E. Product Handling

Keep rough carpentry materials dry during delivery, storage, and handling. Store lumber and plywood in stacks with provisions for air circulation within stacks. Protect bottom of stacks against contact with damp surfaces. Protect exposed materials against weather.

F. Job Conditions

1. Time delivery and installation of carpentry work to comply with protection and storage requirements.

2. Examine substrates and supporting structure and conditions under which work is to be installed and notify Engineer in writing of conditions detrimental to work. Do not proceed with installation until unsatisfactory conditions have been corrected.

3. Correlate location of furring, nailers, blocking, grounds and similar supports so that attached work will comply with design requirements.

## 06100.02 MATERIALS

A. Materials

1. All materials that could be exposed to moisture, such as roof blocking, plates, grounds, etc., shall be wolmanized treated.

2. Light Framing: For framing 2 inches to 4 inches thick and not exceeding 6 inches in width, provide:

   a. Southern Pine, Grade Number 2.

   b. Douglas Fir-Larch, Grade Number 2.

3. Board Lumber:

   a. Where lumber less than 2 inches in nominal thickness is shown or specified, provide boards dressed S4S, Grade Number 2, Southern Pine.

b. Moisture Content: 19 percent maximum, mark boards "S-DRY".

4. Miscellaneous Lumber:

a. Provide wood for support or attachment of other work such as cant strips, bucks, nailers, blocking, furring, grounds, stripping and similar members. Provide lumber of the sizes shown or specified, worked to shapes shown and as follows:

b. Grade: Construction Grade light framing size lumber of any species or board size lumber as required. Provide Construction Grade boards or Number 2 boards (SPIB or WWPA).

5. Anchorage and Fastening Materials: Select proper type, size material and finish for each application. Comply with the following:

a. Nails and Staples: FS FF-N-105.

b. Wood Screws: FS FF-S-111.

c. Bolts and Studs: FS FF-B-575.

d. Nuts: FS FF-N-836.

e. Washers: FS FF-W-92.

f. Lag Screws or Lag Bolts: FS FF-B-561.

g. Masonry Anchoring Devices: For expansion shields, nails, and drive screws, comply with FS FF-S-325.

h. Bar and Strap Anchors: ASTM A575 carbon steel bars.

i. Framing Anchors: Shall be of the type best suited for the connection or detailed as manufactured by Simpson, Silver, Hickman, or equal, having IBC approval, or proper gauge and galvanized metal.

## 06100.03 EXECUTION

A. Installation

1. General

a. Discard units of material which are unsound, warped, bowed, twisted, improperly treated, not adequately seasoned or too small to fabricate work with a minimum of joints or the optimum joint arrangement.

b. Fit carpentry work to other work. Scribe and cope as required for accurate fit.

c. Set carpentry work accurately to required levels and lines with members plumb and true.

d. Shim with metal or slate for bearing on concrete and wood shakes at masonry substrates. Where indicated, grout with one part Portland cement to three (3) parts sand for full bearing.

e. Securely attach carpentry work to substrates by anchoring and fastening as shown and as required such as Hilti pneumatic fastening, or equal.

i. Provide washers under bolt heads and nuts in contact with wood.

ii. Nail plywood to comply with the recommendations of the American Plywood Association.

iii. All fasteners exposed to exterior shall be galvanized or cadmium plated.

f. Store all timber open-stacked in piles at least one foot above the ground surface, properly supported to prevent warping. Timber shall be covered to shed water and for protection from weather. Timber shall not be stored in flood prone areas.

2. Fasteners: Use common wire nails, except as otherwise shown or specified herein. Use finishing nails for exposed work. Do not wax or lubricate fasteners that depend on friction for holding power. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood; pre-drill as required. Do not drive threaded friction type fasteners; turn into place. Tighten bolts and lag screws at installation and retighten as required for tight connections prior to closing in or at completion of work.

3. Wood Grounds, Nailers, Blocking and Sleepers:

a. Provide wherever shown and where required for screeding or attachment of other work. Form to shapes as shown and cut as required for true line and level of work to be attached or screeded.

b. Coordinate location with other work; refer to shop drawings of such work if applicable.

c. Attach to substrates securely with anchor bolts or other attachment devices as shown and as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry as work progresses, cutting to fit masonry unit size involved. Anchor to formwork before concrete placement.

d. Provide grounds of dressed, key bevelled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material involved. Remove temporary grounds when no longer required. Where indicated as permanent grounds, provide treated lumber.

4. Wood Furring:

    a. Install plumb and level with closure strips at edges and openings. Shim with wood as required.

    b. Fire stop furred spaces on walls at each floor level with wood blocking or incombustible materials accurately fitted to close furred spaces. Comply with governing regulations. Use only as necessary.

    c. Tolerance: Shim and level wood furring to a tolerance of 1/8-inch in 10 feet.

    d. Installation shall be provided where shown and as necessary for facing materials specified. Except as shown otherwise, furring strips shall be 1- inch by 3-inches continuous, and spaced 24 inches on center. Furring shall be erected vertically or horizontally as necessary. Furring strips shall be nailed to trusses and to masonry. Wood plugs shall not be used. Furring strips shall be anchored near ends and at a 2 foot interval between. Furring strips shall be provided around openings, behind bases, and at angles and corners. Furring shall be plumb, rigid and level, and shall be shimmed as necessary to provide a true, even plane with surfaces suitable to receive the finish required. Furring for cornices, offsets and breaks in walls or ceilings shall be formed on 1-inch by 3-inch wood strips spaced 16 inches on center.

5. Plywood: Comply with recommendations of American Plywood Association for fabrication and installation of plywood work. Provide thickness shown, or if not shown, provide as recommended by APA "Guide to Plywood Sheathing for Floors, Walls, and Roofs" for spacing of supports and types of substrates involved in the work.

END OF SECTION

# SECTION 06192

# PREFABRICATED WOOD TRUSSES

## 06192.01 GENERAL

A. Description

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

B. Quality Assurance

1. Comply with applicable requirements and recommendations of the following Truss Plate Institute (TPI) publications:

   a. Design Specification for Metal Plate Connected Wood Trusses

   b. Commentary and Recommendations for Handling and Erecting Wood Trusses
   Commentary and Recommendations for Bracing Wood Trusses

   c. Quality Control Manual

2. Comply with applicable requirements of "National Design Specification for Wood Construction" published by N.F.P.A.

3. Comply with PS 20 and with applicable rules of the respective grading inspecting agencies for species and grade of lumber indicated.

4. Provide truss connector plates manufactured by a firm which is a member of TPI and which complies with TPI quality control procedures for manufacture of connector plates published in TPI "Quality Control Manual".

5. Provide trusses by a firm which has a record of successfully fabricating trusses similar to type indicated and which practices a quality control program which complies with, or is comparable to the TPI "Quality Control Manual" and which involves an independent inspection and testing agency acceptable to the Engineer.

6. Provide metal connector plates from a single manufacturer.

C. Submittals

1. Submit fabricator's technical data covering lumber, metal plates, hardware, fabrication process, treatment (if any), handling and erection.
2. Submit certificate of compliance signed by an officer of fabricating firm, indicating that trusses to be supplied for project comply with indicated requirements.

3. If fire retardant is used, a. Submit certificate of compliance from the treating plant that required fire- retardant treatment complies with specified standard and other requirements.

4. Submit certificate of compliance from the metal connector plate manufacturer that fire-retardant formulation is approved for use with plates for truss exposure indicated.

5. Submit shop drawings species, sizes and stress grades of lumber to be used; pitch, span, camber, configuration and spacing for each type of truss required; type, size material, finish, design value, and location of metal connector plates; and bearing and anchorage details.

6. Submit design analysis and test reports indicating loading, section modulus, assumed allowable stress, stress diagrams and calculations, and similar information needed for analysis and to ensure that trusses comply with requirements for roof system dead loads and 30 pounds per square foot snow loads.

7. Provide shop drawings which have been signed and stamped by a structural engineer licensed to practice in Maryland.

D. Delivery, Storage and Handling

1. Handle and store trusses with care, and in accordance with manufacturer's instructions and TPI recommendations to avoid damage from bending, overturning or other cause for which truss is not designed to resist or endure.

2. Time delivery and erection of trusses to avoid extended on-site storage.

## 06192.02 MATERIALS

A. Acceptable Manufacturers

1. Subject to compliance with requirements, manufacturers offering metal connector plates which may be incorporated in the work include, but are not limited to, the following:

Alpine Engineered Products, Inc.

Clary Corporation Gang Nail Systems, Inc.

Hydro-Air Engineering, Inc.

Inter-Lock Steel Co., Inc.

Link-Wood Construction Systems

Lumbermate Company

Robbins Manufacturing Co.

The Panel-Clip Company

Structomatic, Inc.

Tee-Lok Corp.

Truss Connectors of America

Truswall Systems Corp.

Woodco Ltd.

B. Materials

1. Lumber

   a. Factory mark each piece of lumber with type, grade, mill and grading agency.

   b. Any softwood, at Fabricator's option, as required to comply with other requirements.

   c. Any grade of lumber fulfilling requirements indicated for species, stress ratings, and moisture content.

   d. Provide lumber which has been graded or tested and certified, at indicated moisture content, to be in compliance with stress ratings shown on drawings.

2. Metal Connector Plates, Fasteners and Anchorages

   a. Metal complying with following requirements, unless otherwise indicated: not less than 0.036" thick, coated thickness (Contractor's option if more than one metal indicated).

   b. Galvanized Sheet Steel, ASTM A653/A653M, Grade A, Coating G60.

   c. Electrolytic Zinc Coated Steel Sheet, ASTM A 591, Coating Class C, with minimum structural quality equivalent to ASTM A 446, Grade A.

   d. Stainless Steel, ASTM A 167, Type 316, with minimum structural quality equivalent to ASTM A 446, Grade A.

3. Fasteners and Anchorages

   Provide size, type, material, and finish indicated, complying with applicable Federal Specifications for nails, screws, bolts, nuts and washers and anchoring devices.

C. Wood Treatment

1. Kiln-dry lumber after treatment to a moisture content of 19% or less.

2. Inspect each piece of treated lumber after drying and discard damaged or defective pieces.

D. Fabrication

1. Cut truss members to accurate lengths, angles and sizes to produce close fitting joints with wood-to-wood bearing in assembled units.

2. Fabricate metal connector plates to size, configuration, thickness and anchorage details required for types of joint designs indicated.

3. Assemble truss members in design configuration indicated using jigs or other means to ensure uniformity and accuracy of assembly with close fitting joints. Position members to produce design camber indicated.

## 06192.03EXECUTION

A. Erect and brace trusses to comply with recommendations of manufacturer and the Truss Plate Institute.

B. Erect trusses with plane of truss webs vertical (plumb) and parallel to each other, located accurately to design spacings indicated.

C. Hoist units in place by means of lifting equipment suited to sizes and types of trusses required, applied at designated lift points as recommended by fabricator, exercising care not to damage truss members or joints by out-of-plane bending or other causes.

D. Provide temporary bracing as required to maintain trusses plumb, parallel and in location indicated, until permanent bracing is installed.

E. Anchor trusses securely at all bearing points to comply with methods and details indicated.

F. Install permanent bracing and related components to enable trusses to maintain design spacing, withstand live and dead loads including lateral loads, and to comply with other indicated requirements.

G. Do not cut or remove truss members.

END OF SECTION

# SECTION 07200

# THERMAL INSULATION

## 07200.01 GENERAL

A. Description of Work

The work to be included under this section includes everything necessary for and incidental to execution and completing of all building thermal insulation work.

B. General

1. All insulation shall be installed in accordance with the manufacturer's recommendations for the type to be supplied under this section.

2. All necessary clips, adhesives, staples, wire, nails, etc., shall be supplied under this section for proper installation.

3. All material shall comply with the fire resistance, flammability ratings indicated and local codes.

C. Submittals

1. Manufacturer's Data: Submit manufacturer's specifications and installation instructions for each type of insulation required. Include data substantiating that the materials comply with specified requirements. Indicate by copy of transmittal form that installer has received copy of manufacturer's instructions.

2. Submit samples of all materials proposed to be used to the Engineer for acceptance.

D. Product Handling

a. Protection from Deterioration: Do not allow insulation materials to become wet or soiled, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storage, and protection during installation.

b. Protect plastic insulation from exposure to sunlight.

E. Job Conditions

a. Examination of Substrate:

i. The Contractor shall examine the substrate and the conditions under which the insulation work is to be performed, and notify the Engineer in writing of any

unsatisfactory conditions. Do not proceed with the insulation work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

b. Do not proceed with the installation of insulation until subsequent work which conceals the insulation is ready to be performed.

## 07200.02 MATERIALS

A. Materials

1. Batt Insulation: Shall be R-30 Kraft-faced fiberglass conforming to FS HH-1- 521E, Type II and Type III. Foil-faced insulation shall be used if shown on the drawings or specified in the Contract Documents.

2. Material shall be that of one of the following manufacturers:

   a. Owens-Corning

   b. Johns-Manville

   c. Zonolite

   d. Or equal

3. Cavity Wall Insulation: Shall be polystyrene board Federal Specification ASTM C578

4. Perimeter Insulation: Shall be polystyrene board 2" thick meeting B, ASTM C578-01.

5. Concrete Masonry Insulation: Shall be "Perlite" loose fill insulation.

## 07200.03 EXECUTION

A. Installation

1. Batt installation shall be friction fit. Batt insulation shall be stapled in place if so directed by the Engineer.

2. Cavity Wall Insulation: Installed as masonry walls are constructed.

3. Perimeter insulation shall be installed from top of footing, up masonry wall and extend 2'-0" under building floor slab as shown on drawings.

4. Perlite insulation shall be poured directly from sealed bags into concrete block cavities or via a hopper on top of the wall. The height of the pour shall not exceed 16 feet. Alternately, perlite insulation may be placed with a pneumatic gun. Do not tamp or vibrate the insulation material.

END OF SECTION

# SECTION 07310

# SHINGLES

## 07310.01 GENERAL

A. Description of Work

1. Extent of shingles is shown on drawings and is hereby defined to include units employed as weather protection for roofs.

2. Types of shingle applications specified in this section include the following: Asphalt shingle roofing.

B. Quality Assurance

1. UL Listing: Provide labeled materials which have been tested and listed by UL for Class and Rating indicated for each shingle type required.

2. Submittals

   a. Product Data: Submit technical product data, installation instructions, and recommendations from shingle manufacturer, including data that materials comply with requirements.

   b. Samples: Submit full range of samples for color and texture selection by the Owner. After selection, submit 2 full-size shingles for verification of each color/style/texture selected.

3. Maintenance Stock: 2% of each type/color/texture shingle used in the work.

C. Delivery, Storage and Handling

1. Deliver materials in manufacturer's unopened, labeled containers.

2. Store materials to avoid water damage, and store rolled goods on end. Comply with manufacturer's recommendations for job-site storage and protection.

D. Job Conditions

1. Substrate: Proceed with shingle work only after substrate construction and penetrating work have been completed.

2. Weather Conditions: Proceed with shingle work only when weather conditions are in compliance with manufacturer's recommendations and when substrate is completely dry.

E. Specified Product Warranty

Provide shingle manufacturer's warranty on installed work, agreeing to pay for repair or replacement of defective shingles as necessary to eliminate leaks. Period of warranty is thirty (30) years from date of substantial completion and shall be registered to Anne Arundel County.

**07310.02 MATERIALS**

A. Asphalt Shingle Materials

1. Square Tap Strip Shingles, UL Class "A", Standard Weight: Mineral-surfaced, self-sealing, architectural asphalt fiberglass strip shingles complying with ASTM D 3018, bearing UL Class "A" external fire exposure label. Color as selected by Engineer.

2. Products: Subject to compliance with requirements, provide one of the following:

Glass Bilt Firescreen; Bird Corporation

Glassguard 25; Certainteed Corp.

Brigade; Flintkote Company.

Fireglass III; Manville Building Materials Corp.

Classic Plus; Owens Corning

GAF Roofing

Or Equal

B. Asphalt-Saturated Roofing Felt: No. 15, unperforated organic felt, complying with ASTM D 226, 36" wide, approximate weight 18 lbs./square. Two layers shall be provided.

C. Asphalt Plastic Cement: Fibrated asphalt cement complying with ASTM D 2822, designed for trowel application.

D. Hip and Ridge Shingles: Job-fabricated units cut from actual shingles used.

E. Nails: Aluminum or hot-dip galvanized 11 or 12-gauge sharp-pointed conventional roofing nails with barbed shanks, minimum Y2-inch diameter head, and of sufficient length to penetrate minimum 3/4-inch into solid decking or to penetrate through plywood sheathing.

F. Metal Drip Edge: Minimum 0.024-inch pre-finished aluminum sheet, brake- formed to provide 4-inch roof deck flange, and 7Y2-inch fascia with 1Y2-inch at drip edge and 1-inch vertical return. Tapered edge is also acceptable. Furnish in eight foot or ten-foot lengths. Color as selected by the Engineer.

G. Ridge Vent: Vent shall be Shingle Ridge Vent. Color to be selected by Engineer.

H. Vent-A-Ridge shall be 0.019-inch-thick aluminum, contain 18 square inches net free area per foot, baffle strip with 1/4-inch by 3/4-inch drain holes. Install PVC connector plugs with fastener holes at 8 inches on center.

## 07310.03 EXECUTION

A. Inspection

The Contractor shall examine substrate and conditions under which shingling work is to be performed and shall notify the Engineer in writing of unsatisfactory conditions. Do not proceed with shingling work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

B. Preparation of Substrate

Clean substrate of any projections and substances detrimental to shingle work. Cover knotholes or other minor voids in substrate with sheet metal flashing secured with roofing nails. Coordinate installation of shingles with flashing and other adjoining work to ensure proper sequencing. Do not install shingle roofing until all vent stacks and other penetrations through roofing have been installed and are securely fastened against movement.

C. Installation

1. General: Comply with instructions and recommendations of shingle manufacturer, except to extent more stringent requirements are indicated.

2. Underlayment: Apply two layers of felt horizontally over the entire surface, lapping succeeding courses two inches minimum and fastening with sufficient nails to hold in place until shingle application.

3. Shingles:

   a. Install starter strip of roll roofing or inverted shingles with tabs removed; nail shingles in manufacturer's recommended pattern, weather exposure and number of fasteners per shingle. Use horizontal and vertical chalk lines to ensure straight coursing.

   b. Comply with installation details and recommendations of shingle manufacturer and NRCA Steep Roofing Manual.

4. Flashing and Edge Protection:

   Install metal flashing, leaf guard, vent flashing and edge protection as shown and in compliance with details and recommendations of the NRCA Steep Roofing Manual.

5. Extra Stock: Provide a minimum of two percent of installed quantity of each type/color/texture shingle used in the work. Provide in unopened clearly labeled bundles or containers.

END OF SECTION

# SECTION 07600

# FLASHING AND SHEET METAL

## 07600.01 GENERAL

A. Description of Work

1. The work under this section shall include but not be limited to the following items:

   a. Metal base flashing, rain gutters and leaders

   b. Flashing through wall pipes and masonry openings.

B. General Requirements

1. Schedule and coordinate sheet metal installations with the work or other trades where it is integral or contiguous therewith. Materials furnished under this section shall be delivered to the site in sufficient time to avoid delays to construction progress.

2. Surfaces to which sheet metal is to be applied shall be even, smooth, sound, thoroughly clean, dry and free from projecting nail heads or other defects that would affect the application. Report in writing any unsatisfactory surfaces to the Engineer.

3. Where flashing or sheet metal abuts or members into adjacent dissimilar metals, the juncture shall be executed in a manner that will facilitate drainage and thus minimize the possibility of galvanic action. Materials shall be protected by coating as specified within this section.

4. All accessories or other items essential to the completeness of the sheet metal installation, though not specifically shown or specified, shall be provided. All such items, unless otherwise indicated on drawings or specified, shall be the same kind of material as the kind to which applied, and the gauges shall conform to recognized industry standards of sheet metal practice.

5. Architectural Sheet Metal Manual as published by the Sheet Metal and Air Conditioning Contractors National Association, Inc., is hereinafter referred to as the "SMACNA Manual".

6. Provide expansion joints in sheet metal work at intervals as indicated or specified. Expansion joints shall be fabricated in accordance with applicable details as indicated in the SMACNA Manual.

C. Submittals

1. Shop drawings shall be submitted for Engineer's acceptance on all flashing details. No work shall proceed without accepted drawings. Manufacturer's Data: Submit manufacturer's specifications, installation instructions and general recommendations for flashing and trim applications.

2. Include manufacturer's certification or other data substantiating that the materials comply with the requirements.

3. Samples of all materials under this section shall be submitted to the Engineer for acceptance before fabrication. Sample shall bear a label indicating material, gauge, manufacturer, project name, contractor name and date submitted.

## 07600.02 MATERIALS

A. Materials

1. Stainless Steel Flashing: Provide sheet stainless steel of AISI Type 304 complying with ASTM A167, with No. 2D conventional annealed finish, except as otherwise shown; of soft temper unless required to be harder temper for proper forming and performance for application indicated; thickness of 0.018 inch except as otherwise shown.

2. Copper flashing: Sixteen-ounce weight conforming to requirements of FS QQ-C- 576, by Cheney Flashing Company or equal.

3. Roofing Felts: Asphalt saturated, unperforated felt, complying with ASTM D226, 15 pounds.

4. Aluminum Extrusion Units

   Extruded Aluminum Rain Gutters and Downspouts: Rain gutters shall be 5 inches by 33/4 inches and downspouts shall be 23/4 inches by 4 inches. Fabricate extruded aluminum in running units with formed or extruded aluminum joint covers for installation behind main members where possible. Provide manufacturer's standard baked on acrylic shop finish 1.0 mil. dry film thickness. Finish color to be selected by Engineer.

5. Sealant Compound: Single component synthetic, one component type conforming to FS TT-S-230; see Section 07900, "Sealants".

6. Bituminous Plastic Cement: Shall meet FS SS-C-153, Type 1 for asphalt roofing felts.

7. Fasteners: Shall be of the same material or a metal compatible with the item fastened.

8. Solder: Lead-free solder used with resin flux.

## 07600.03 EXECUTION

A. Dissimilar Contact Surfaces

Where aluminum is shown contacting concrete, masonry, mortar or plaster materials, or is fastened to steel supports or members or to other dissimilar metals, a coating of bituminous paint shall be applied to a thickness of 14 mils, between the dissimilar surfaces.

B. Fabrication

Sheet metal items shall be fabricated to the gauge thickness or weight as specified herein, and multiple lengths of items shall be joined together.

C. Installation

Surface to receive sheet metal shall be plumb and true, clean, even, smooth, dry and free from defects and projections which might alter the application. Installation of items not shown in detail or not covered by specification shall meet the applicable requirements of the SMACNA Manual.

D. Workmanship

Sheet metal work shall be installed with lines, arises, and angles sharp and true. Exposed surfaces shall be free from visible wave, warp, and buckle and tool marks. Exposed edges shall be folded back neatly to form a Y2-inch hem on the concealed side. Sheet metal exposed to the weather shall be watertight with provisions for expansion and contraction.

E. Nailing

Nailing of sheet metal shall be confined generally to sheet metal having a width of less than 18 inches, except as indicated or specified otherwise. Nailing of flashings shall be confined to one edge only. Nails shall be evenly spaced not over 3 inches on center and approximately Y2-inch from edge unless otherwise specified or indicated. Nailing will not be permitted where sheet metal is applied to other wood surfaces. Detailed shop drawings shall include locations for sleepers and nailing strips required to properly secure the work. Sleepers and nailing strips are specified in another section.

F. Cleats

Cleats shall be provided for sheet metal, 22 gauge, 18 inches and over in width, except as indicated or specified otherwise. Cleats shall be evenly spaced not over 36 inches on center unless otherwise specified or indicated. Unless otherwise specified, cleats shall be not less than 2 inches wide by 3 inches long and shall be of the same material and thickness as the sheet metal being installed. One end of the cleat shall be secured with two (2) nails and the cleat folded back over the nailheads. The other end shall be locked into the seam.

G. Bolts, Rivets and Screws

Bolts, rivets, and screws shall be installed where indicated or required. Compatible washers shall be provided where required to protect the surface of sheet metal and to provide a watertight connection.

H. Seams

1. Seams shall be straight and uniform in width and height. Solder shall not show on the face.

2. Flat lock seams shall finish not less than 3/4-inch wide.

3. Lap seams, when soldered, shall finish not less than one inch wide. Lap seams, not soldered, shall overlap not less than 3 inches.

4. Loose lock expansion seams shall be not less than 3 inches wide and shall provide not less than one-inch movement within the joint. Joint shall be completely filled with sealant, applied at not less than 1/4-inch-thick bed.

5. Flat seams shall be made in the direction of the flow.

I. Cleat type anchorages for metal flashing and trim wherever practical, arranged to relieve stresses from building movement and thermal expansion.

1. On vertical surfaces, lap two-piece flashings a minimum of 3 inches.

2. On sloping surfaces, for slopes of not less than 6 inches in 12 inches, lap unsealed flashings a minimum of 6 inches.

3. For embedment of metal flashing flanges in roofing or composition flashing or stripping, extend flanges for a minimum of 4-inch embedment.

J. Provision for Expansion and Contraction

Expansion and contraction joints shall be provided at not more than 40-foot intervals, except as specified otherwise. Where the distance between the last expansion joint and the end of the continuous run is more than half the required interval spacing, additional joint(s) shall be provided. Joints shall be evenly spaced.

K. Cleaning

All exposed sheet metal work shall be cleaned at completion of installation. Grease and oil films, handling marks, contamination from steel work, filings and drilling debris shall be removed and the work scrubbed clean. All exposed metal surfaces shall be free of dents, creases, waves, scratch marks, and solder or weld marks.

L. Repairs to Finish

Scratches, abrasions and minor surface defects of finish shall be repaired in accordance with the manufacturer's printed instructions and as approved by the Engineer. Finish repaired surfaces shall be uniform and free from scratches, blemishes and from variations of color and surface texture.

END OF SECTION

# SECTION 07900

# SEALANTS

Delete Specifications Section 07951 – SEALANTS AND CAULKING from the Anne Arundel County Standard Specifications and replace with the following:

## 07900.01 GENERAL

A. Description of Work

The work to be done under this Section includes everything necessary for and incidental to executing and completing sealants, both interior and exterior shown on the drawings and hereafter specified.

B. Submittals

1. Manufacturer's Data, Joint Sealers: Submit manufacturer's specifications, recommendations, and installation instructions for each type of material required. Include manufacturer's published data or letter of certification or certified test laboratory report indicating that each material complies with the requirements and is intended generally for the applications shown.

2. Submit samples of all materials proposed to be used to Engineer for acceptance prior to use on the project; also submit color cards for color selection by the Engineer.

C. Job Conditioning

1. Examine the joint surfaces and backing and their anchorage to the structure and the conditions under which the joint sealer work is to be performed and notify the Engineer in writing of conditions detrimental to the proper and timely completion of the work and performance of the sealers. Do not proceed with the joint sealer work until unsatisfactory conditions have been corrected.

2. Weather Conditions: Do not proceed with installation of sealants under adverse weather conditions, or when temperatures are below or above manufacturer's recommended limitations for installation. Proceed with the work only when forecasted weather conditions are favorable for proper curing and development of high early bond strength. Wherever joint width is affected by ambient temperature variations, install elastomeric sealant only when temperatures are in the lower third of the manufacturer's recommended installation temperature range.

3. Choice of sealant shall be made by the Contractor from the listed manufacturers, except that materials used shall be compatible with materials to be sealed, and the Engineer will be sole judge of the best material for each joint condition based on the manufacturer selected.

## 07900.02 MATERIALS

A. Materials

1. Sealant Compounds: Shall be gun grade, elastic waterproof adhesive, colors to be selected by Engineer, to match adjacent materials. Products of one of the following approved manufacturers, or equal will be considered:

   a. Sonneborn

   b. Pecora

   c. Dow Corning

   d. Thiokol

   e. Tremco

   f. Memeco International

   g. General Electric

   h. Or Equal

2. General purpose exterior sealant of flashing, control/expansion joints, exterior joints at windows, doors, glazing, louvers, and coping joints, etc.-- one part Thiokol Polysulfide Liquid Polymer or one part Acrylic Terpolymer Sealant. Material shall meet or exceed FS TT-S-00230c, Class A, Type II or FS TT-S00230a requirements.

3. Interior Sealant: Unless otherwise noted on the drawings, shall be a one-part acrylic latex polymer sealant. Interior means within building, exterior walls and below ceiling lines indicated. Material shall meet or exceed ASTM C834.

4. Interior Sealant, (wet areas): Shall be a one-part silicone rubber sealant especially designed to resist repeated exposure to high humidity, and to resist mold growth. For use in joints in walls/floors. Material shall meet or exceed FS TT-S-001543C and FS TT- S-00230C, and ASTM C920 Type S.

5. Traffic Joints: For sealing of horizontal joints at exterior sidewalks, aprons, decks and at joints where the vertical walls abut the surrounding sidewalls, etc., use Perma-Joint, a two-component PDT (Polyditremzene) - based sealant, or equal. Material shall meet or exceed FS TT-S-00227e when tested on concrete or masonry.

   Within seven days, compounds shall form a tough elastic skin or film on the surface but remain permanently plastic underneath; they shall contain no acid or ingredients that will stain, corrode metal, or have an injurious effect on painting. Compound shall be colored as required to match adjacent work. Secure approval of color and materials from the Engineer prior to installation.

6. Primer: For concrete and masonry surfaces shall be type recommended by the sealant manufacturer.
7. Sealer: Quick-drying liquid type as recommended by sealant manufacturer.

8. Backing Material and Joint Filler: Joint backer rod and/or reglet joint backing where noted on drawings, shall be closed cell neoprene tubing or cord or resilient foam (closed cell polyethylene) of the proper size and configuration to fit the joint condition. Joint filler/gasket at control joints shall be coated on one side with pressure-sensitive adhesive for placement such as Everlastic by Williams Products, Inc., or equal, conforming to the requirements of ASTM D1056.

    a. Tubing and/or Backer Rod: Shall be provided at all joints 1/4" or larger as back-up for sealant. Tubing or rod shall be a minimum of 3/8" back from face of material to allow for sealants and be of proper size for joint shown on Drawings.

    b. In no case shall the width or depth of the joints be less than 1/4-inch.

    c. The following schedule shall be followed for joint width and depth of sealant with backing set to the depth required:

        1/4-inch-wide x 3/8-inch deep
        3/8-inch-wide x 3/8-inch deep
        1/2-inch-wide x 1/2-inch deep

    d. Joints over 1/2-inch in width shall be as follows:

        3/4-inch-wide x 3/8-inch deep
        1-inch-wide x 1/2-inch deep
        1 1/2-inch-wide x 3/4-inch deep

**07900.03 EXECUTION**

A. Application

1. Thoroughly clean all joints, removing dust, oil, grease, water surface dirt, frost. Remove protective coatings from metal items prior to applying sealant.

2. Porous materials such as concrete shall be cleaned by grinding, blast-cleaning, mechanically abrading. Solvent may be necessary to facilitate removal of oil or other residue.

3. Non-porous surfaces such as metal or glass shall be cleaned either mechanically or chemically. Protective coatings on metallic surfaces shall be removed by solvent that leaves no residue. When solvent is used, wipe it off with clean cloths before it dries. Previously applied primer must adhere permanently or be entirely removed.

4. Joints between concrete, or masonry and frames in exterior walls that are less than minimum

width or depth shall be ground to required width, depth. Minor variations in width that are not noticeable shall not be corrected. Damaged adjacent or connection work resulting from curing or grinding shall be restored to satisfaction of the Engineer. Do not seal joints until they are substantially in compliance with details indicated.

5. No sealant shall be applied in temperatures below 40 degrees F. or above 85 degrees F. without prior approval of Engineer. Sealants shall not be applied to any surface where water, ice or visible moisture is present.

6. Sealants shall be forced into joints mechanically, with pressure to expel all air, provide solid filling against backing. Superficial pointing of joints with a skin bead will not be accepted. Surface shall be uniformly smooth and free of wrinkles. Joints adjacent to painted work shall be sealed before final coat of paint is applied. All sealed joints shall be watertight and guaranteed for a period of three years.

7. If joint detail is not obtainable with conventional sealing gun, use knife or appropriate tool for working surface of joint to profile indicated.

8. Joints to be sealed with sealant shall be cleaned out, full width, raked to depth sufficient to accommodate required backing material or premolded expansion joint filler and sealant. Depth of joint back of sealant shall be filled with backing material as specified for sealant. Do not apply sealant without backing material. When using joint filler of hose or rod stock, take care to roll filler into joint.

9. Apply masking tape, where required, in continuous strips, in straight, true alignment with joint edge. Remove tape immediately after joints have been primed, sealed, tooled to desired contour.

10. Follow sealant manufacturer's instructions closely regarding mixing, surface preparation, priming, application life, and application procedures.

11. All joint surfaces shall be neatly pointed or tooled to provide contour as indicated. When tooling white or light-colored sealants use either dry or water-wet tool only. Seal all joints between interior door bucks and walls of exposed masonry and all other openings between adjacent materials.

B. Cleaning

Surfaces of materials adjacent to sealed joints shall be cleaned free of smears of compound or other soiling due to sealing operations as work progresses. Use masking tape to prevent smears on materials such as stone or masonry, which would be difficult to clean.

END OF SECTION

# SECTION 08210

# ALUMINUM DOOR FRAMES

## 08210.01 GENERAL

A. Description

The work of this section includes furnishing and installing aluminum door frames as shown on Drawings and as specified herein.

B. Quality Assurance

1. Referenced Standards:

2. American Society for Testing and Materials (ASTM) Publications

3. ASTM B209-90 - Aluminum and Aluminum Alloy Sheet and Plate

4. ASTM B221-90 - Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Shapes and Tubes

5. National Association of Architectural Metal Manufacturer's Publication (NAAMM): Metal Finishes Manual

C. Submittals

1. Shop Drawings:

   a. Submit shop drawings of frames showing details, dimensions and method of anchoring, details of construction, shape and thickness of frame, details of joints and hardware location.

2. Compliance Statement:

   a. Submit a statement of compliance attesting frames meet or exceed specification requirements.

3. Manufacturer's Instructions: Manufacturer's installation instructions shall be submitted for approval.

D. Product Handling and Storage

1. Materials delivered to the jobsite shall be inspected for damage and unloaded with a minimum of handling.

2. Store in a dry location and in an area free from water, weather and contaminants.

3. Store on a level platform out of contact with the ground. Store in a manner to prevent racking or distortion of the frames.

4. Frames shall not be covered with tarps, polyethylene film or any covering which will permit the buildup of moisture.

## 08210.02 MATERIALS

A. Materials

1. Frames shall be aluminum extrusions complying with ASTM B22 1, Alloy 6063- TS. Aluminum sheets and strips shall comply with ASTM B209, alloy and temper best suited for the purpose.

2. Minimum metal wall thickness shall be 0.107 inch.

3. Fasteners stainless steel Type 316.

B. Finish

Finish shall be Dark Duronodic Bronze meeting finish designation AA-M10622 A41 of the NAAMM Metal Finishes Manual unless otherwise noted and approved by the County.

C. Anchors

1. Stainless steel, Type 316 of the size and shape required for securing aluminum frames to adjacent construction.

2. Plant anchors near top and bottom of each jamb and at intermediate points not more than 25 inches apart. Weld stainless steel angle clips to the bottom of each jamb to permit anchoring bottom of frame to floor.

D. Fabrication

1. Frames shall be fabricated of extruded aluminum shapes to contours shown on the Drawings. Shapes shown are representations of design, function and required profile. Shapes of equivalent design may be used subject to Owner's approval.

2. Welds shall be located on unexposed surfaces to the maximum extent. Any weld on an exposed surface shall be smoothly dressed. Welding shall produce a uniform texture and color in the finished work, free of flux and splatter.

3. Exposed screws or bolts shall be permitted only at inconspicuous locations and shall have heads countersunk.

4. Concealed reinforcements for hardware shall be welded in place.

5. Joints shall be milled to a hairline watertight fit, reinforced, and secured mechanically by steel clip arrangement or by screw spline attachment.

6. Frames shall be cut, reinforced, drilled, and tapped at the factory to receive template hardware. Hardware reinforcements shall be stainless steel secured by welding or stainless-steel screws.

## 08210.03 EXECUTION

A. Protection

1. Frames in contact with masonry shall be protected by one of the following methods:

   a. Paint - Solvent clean aluminum surfaces contacting masonry and coat with zinc-chromate primer and one coat of aluminum paint.

   b. Non-absorptive tape or gasket - non-absorptive tape or gasket shall be placed between the adjoining surfaces and shall be cemented to the aluminum surface using a cement compatible with aluminum.

B. Installation

1. Frames shall be accurately set in position to receive doors.

2. Bottom of frame shall be anchored to the floor with stainless steel angle clips secured to the back of each jamb and to the floor. Stainless steel bolts and expansion sleeves shall be used for fastening clip anchors.

3. Frames shall be plumb, square, level and in alignment and securely anchored to masonry and floor.

4. Metal to metal joints between frame and connecting work shall be sealed.

C. Clean Up

Remove all stains and blemishes from frames. Removal agents shall not cause discoloration in frames. Agents with abrasives shall not be used to remove foreign matter.

END OF SECTION

# SECTION 08211

# FIBERGLASS REINFORCED DOORS

## 08211.01 GENERAL

A. Description

The work under this section includes furnishing and installing fiberglass-reinforced polystyrene flush doors in aluminum door frames installed by others. Work shall be in accordance with contract drawings and as specified herein.

B. Quality Assurance

1. Referenced Standards:

   a. American Society for Testing and Materials (ASTM) publications: ASTM B221, ASTM D256, ASTM E84

   b. NAAMM Metal Finishes Manual

C. Submittals

1. Product Data:

   Submit door manufacturer's product data, specification to include core materials, stile and rail construction and face sheets.

2. Shop Drawings:

   Submit shop drawings of half-size detail sections of composite members, face sheet to rail and tile sections and all pertinent details required to fabricate and install door.

3. Templates:

   Submit hinge templates and other hardware templates to allow frame manufacturer to properly position holes for hinges and all other hardware as shown or as specified in Section 08700 - Finish Hardware.

D. Product Delivery, Storage and Handling

1. Deliver materials to the job site in original, unopened packages with labels intact. Inspect materials for damage and immediately advise manufacturer of any defective components.

2. Doors shall be floated within cartons with no portion of the door having contact with the outer shell of the container.

E. Warranty

1. Manufacturer of doors shall provide a written warranty agreeing to replace, at no cost to the Owner, door(s) that fail in materials or workmanship for a period of four years after the contractor's one year warranty expires.

2. Failure of materials or workmanship includes excessive deflection, faulty operation, deterioration of finish in excess of normal weathering and defects in weatherstripping.

F. Manufacturer

Door shall be manufactured by Special-Lite, Inc., Decatur, Michigan.

**08211.02 MATERIALS**

A. Materials

1. Aluminum Rails and Stiles: ASTM B221, 6063-T6 aluminum, minimum thickness 0.125".

2. Face Sheets of Doors:

Fiberglass reinforced polyester, 0.120-inch thick with pebble-like embossed finish. Color to be Dark Duronodic Bronze or alternative approved by the County. Face sheets when tested in accordance with ASTM E84 shall have a flame spread not greater than 10 with smoke developed not more than 340.

3. Fasteners:

Aluminum or non-magnetic stainless-steel fasteners, compatible with the doors and items being fastened.

B. Fabrication

1. Doors shall be 1 and 3/4-inch thick constructed of aluminum alloy rails and stiles, joined with steel tie rods, inner core of foamed-in-place urethane with fiberglass reinforced polyester face sheets locked in with extruded interlocking edges.

2. Stiles shall be tubular shape with top and bottom rails to be extruded with legs for interlocking rigidity weather bar.

3. Joinery shall be 3/8-inch galvanized tie rods, top and bottom bolted through and extruded spline and 3/16-inch riveted reinforcing angles and secured with aircraft type nuts.

4. Core shall be urethane foam of 3 pounds per cubic foot density. Doors shall be properly reinforced for hardware prior to urethane core foaming in door.

5. All doors shall be pre-machined in accordance with templates from the hardware supplier. For surface applied hardware reinforce as required. With the exception of door closers,

doors are to be shipped with hardware attached. Comply with hardware manufacturer's instructions and template requirements.

6. Phillips flat head screws with finish matching the item to be fastened shall be used for exposed fasteners. Exposed fasteners shall not be used except where unavoidable for the assembly of the door or hardware fastening.

7. Finish for exposed aluminum surfaces shall be Dark Duronodic Bronze or alternative approved by the County, meeting finish designation AA-M10C22A41 of the NAAMM Metal Finishes Manual.

C. Door shall be Model SL-17 as manufactured by Special-Lite, Inc., Decatur, Michigan. No substitutions will be considered by the Engineer.

**08211.03 EXECUTION**

A. Installation

1. Install all hardware, except surface mounted closers at the fabrication plant. Hardware shall be removed as required for final finishing or delivery to jobsite. Package and identify such hardware and ship with doors for installation at the project site.

2. Comply with manufacturer's recommendations and specifications for door installation.

B. Clean aluminum surfaces properly after door installation exercising care to avoid damage to the protective coating.

END OF SECTION

# SECTION 08700

# FINISH HARDWARE

## 08700.01 GENERAL

A. Description

1. The extent of finish hardware is shown on the drawings. Finish hardware is hereby defined to include all items known commercially as builder's hardware, as required for swing doors, except special types of hardware specified in the same section as the door and door frame.

2. Finish Hardware:

   a. Hinges

   b. Closers

   c. Panic Devices

   d. Wall Stops

   e. Master keyed cylinders for hollow metal doors

   f. Thresholds and Weatherstripping

3. Installation: Hardware for hollow metal doors, except as noted.

B. Quality Assurance

1. Manufacturer: To the greatest extent possible, obtain each kind of hardware (latch and lock sets, hinges, closers, etc.) from only one manufacturer, even though several may be specified as acceptable manufacturers.

2. Supplier: Furnish hardware supplied only by a recognized builder's hardware supplier who has been furnishing hardware in the same area as the project for a period of not less than two years and who has in his employment an experienced hardware consultant who is available at all reasonable times during the course of the work, for project hardware consultation to the Owner, Engineer, and Contractor.

3. Assign the installation of hardware to experienced tradesmen in compliance with trade union jurisdictions; either at the door and frame fabrication plant or at the project site. Coordinate with the requirements of Section 08210 and Section 08211.

4. Scheduled Designations: Except as otherwise indicated, the use of one manufacturer's numeric designation system in schedules does not imply that another manufacturer's products will not be acceptable, unless they are not equal in design, size, weight, finish, function or other quality or significance. However, do not make substitutions after

Engineer's acceptance of the offered hardware schedule.

5. Where panic exit devices are required on fire-rated doors, provide supplementary marking on door UL label indicating "Fire Door to be Equipped with Fire Exit Hardware", and provide UL label on exit device indicating "Fire Exit Hardware".

C. Submittals

1. Submit copies of manufacturer's data for each item of finish hardware in accordance with Section 5.04 of the General Provisions. Include whatever information may be necessary to show compliance with requirements and include instructions for installation and for maintenance of operating parts and exposed finishes. Wherever needed, furnish templates to fabricators of other work which is to receive finish hardware.

2. Hardware Schedule, Finish Hardware

   a. Finish hardware schedules and project data shall be submitted for acceptance. Hardware schedules shall list each door by opening number along with hardware used for that opening. Hardware schedule shall have a summary list showing all hardware items and quantities. Review and acceptance by the Engineer or Owner does not relieve the Contractor of his exclusive responsibility to fulfill the requirements as shown and specified.

   b. Hardware Schedule: Based on finish hardware requirements as indicated (including drawings, schedules, and specifications), organize schedule into "hardware sets," indicating complete designation of every item required for each door or opening. Furnish schedule with samples and manufacturer's data sheets.

3. Product Handling

   a. Provide secure lock-up for hardware delivered to the project, but not yet installed.

   b. Control the handling and installation of hardware items which are not immediately replaceable so that the completion of the work will not be delayed by hardware losses, both before and after installation.

4. Job Conditions

   a. Coordination: Coordinate hardware with other work. Tag each item or package separately with identification related to the final hardware schedule and include basic installation instructions on the package. Furnish hardware items of proper design for use on doors and frames of the thicknesses, profile, swing security and similar requirements indicated, as necessary for proper installation and function, regardless of omissions or conflicts in the information in the contract documents.

   b. Templates: Furnish hardware templates to each fabricator of doors, frames and other

work to be factory-prepared for the installation of hardware. Upon request, check the shop drawings of such work to confirm that adequate provisions will be made for the proper installation of hardware.

## 08700.02 MATERIALS

A. Materials and Fabrication

1. Produce hardware units of the basic metal indicated, using the manufacturer's standard metal alloy, composition, temper, and hardness, but in no case of lesser (commercially recognized) quality than specified for the applicable hardware units by FS FF - H - 106, FS FF - H - 111, FS FF - H - 116, and FS FF - H - 121. Do not substitute "optional" materials for those indicated, except as otherwise permitted by other sections of these specifications.

2. Form the base metal into the required shapes and sizes by the method indicated (cast, wrought, forged, rolled, pressed, etc.) or, if not indicated, by the manufacturer's standard production method for the class or quality of hardware units required.

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

4. Furnish screws for installation with each hardware item. Provide Phillips flathead screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match the hardware finish or, if exposed in surfaces of other work, to match the finish of such other work as closely as possible, except as otherwise indicated.

5. Provide concealed fasteners for hardware units which are exposed when the door is closed, except to the extent no standard-manufactured units of the type specified are available with concealed fasteners. Do not use through bolts for installation where the bolt head or the nut on the opposite face is exposed under any condition, except where it is not possible to adequately reinforce the work and use machine screws or concealed fasteners of another standard type, to satisfactorily avoid the use of through bolts.

6. Provide fasteners which are compatible with both the unit fastened and the substrate and which will not cause corrosion or deterioration of hardware, base material, or fastener.

7. Hand of door: The drawings show the swing or hand of each door leaf, (left, right, reverse level, etc.). Furnish each item of hardware for proper installation and operation of the door swing as shown.

B. Finishes

1. General

a. Match the finish of every hardware unit at each door or opening, to the greatest extent possible and except as otherwise indicated. Reduce differences in colors and textures as much as commercially possible where the base metal or metal forming process is different for individual units of hardware exposed at the same door or opening. In

general, match all items to the manufacturer's standard finish for the latch and lock set (or push- pull units if no latch-lock sets) for color and texture.

b. The Engineer will be the sole judge of whether hardware units match the accepted samples and match each other satisfactorily.

c. 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 for the applicable units of hardware by FS FF-H-106, FS FF-H-116, and FS FF-H-121.

d. Provide protective lacquer coating on all exposed hardware finishes of brass, bronze, and aluminum, except as otherwise indicated. The suffix "ND" is used with standard finish designations to indicate "no lacquer".

e. The following designations are used to indicate the standard commercial finishes required for finish hardware (general description, base metal under finish, limitations, and other requirements);

i. US26D: Dull chromium plated; for nickel coated metals; on plain surfaces.

ii. US32D: Satin stainless steel; for stainless steel; on smooth and polished surfaces.

f. Finishes shall be as follows:

i. Hinges – US32D

ii. Locks - US26D plated on brass

iii. Exit devices US26D plated on brass

iv. Closers - sprayed aluminum enamel

v. Wall Stops - US32D floor brass C US226D on brass

vi. Thresholds and weatherstrip – aluminum

C. Detailed Product Requirements

1. Requirements for locks and latch sets (BHMA Series 4000, Grade 1):

a. Locks and latch sets shall be supplied as BEST removable, interchangeable 7-pin core that is keyed to the County's existing master keyed system.

b. Locks and latch sets shall conform to ANSI 156.2, Series 4000, Grade 1 and be UL listed. Locks and latch sets with knobs shall meet ANSI 156.2 door preparation. Locks and latch sets with levers shall meet modified ANSI 156.2 door preparation. Locksets and core shall be of the same manufacturer to maintain complete lockset warranty.

c. Locksets shall be extra heavy-duty cylindrical type with 2 and 3/4-inch backset, or as specified, with a 9/16-inch throw latchbolt.

d. Knobs must be of brass or bronze material and a minimum 0.100-inch thick at the thinnest point of the knob wall. The lockset shall be available with a tactile or knurled knob or lever for identification of hazardous areas.

e. Locksets shall have solid shank with no openings for access to keyed knob keeper. Keyed knob or lever shall be removable only after core is removed, by authorized control key, to allow access to knob keeper.

f. Keyed knob shall be protected from forced entry by means of a "break away" mechanism.

g. Knob locksets shall be constructed to be capable of changing hand before and after installation by rotation of face of knob.

h. Permanent core face must have the same finish as the lockset.

2. Requirements for exit devices (ANSI Grade 1):

a. Exit devices shall be supplied with a BEST rim cylinder and removable 7-pin core keyed to the existing master keyed system, function and type as specified in hardware sets.

3. Requirements for padlocks:

a. Padlocks shall have a 3/8-inch diameter steel shackle 1 1/2 inches high, with a removable 7-pin core keyed to the existing County master keyed system.
b. Padlock case shall be of corrosion-resistant construction, machined from solid extruded brass.
c. Padlock shackle shall be hardened, multiple plated steel for corrosion resistance, and shall lock at heel and toe, conforming to the requirements of ASTM F883-84, Grade 4.

4. Requirements for hinges: Hinge shall be stainless steel continuous hinge.

D. Acceptable Manufacturers

1. Manufacturers: Hardware items specified are as follows with acceptable substitutes where allowed:

a. Butts: (BHMA types A8111, A8112 and A8133)

McKinney Mfg. Company TB27 1 4-T4A3 3 86-T4B3786

Stanley FBB 179-BB199-BB168 Hager 1279-BB1 199-BB1 168

b. Locks and Latchsets: (BHMA Series 4000, Grade 1)

i. At exterior door: Best Lock #35H7FW16J x 630 x LH Mortise set; no substitutions allowed.

ii. At interior door: Best Lock #35HON16J x 630 x RH Mortise set; no substitutions allowed.

c. Exit Devices: (BHMA types 2 and 6)

i. Van Duprin 88 series trim to match locksets, function and type as specified in hardware sets.

ii. Allowable Substitutes: BEST 2R Series, trim and functions per hardware sets.

d. Door Closers: (BHMA type C02062)

i. LCN 40-40 non-handed door closer equipped with hold-open device, mounted as required by opening conditions.

ii. Allowable Substitutes: Dorma 7600

e. Wall and Floor Door Stops: (BHMA types L32401 and L32142, and type C05512)

i. Shall be as manufactured by the H.B. Ives Company. Wall stops are preferred. Use 405-1/2 series as required by wall conditions and knob function.

ii. Where wall stop cannot be used, use H.B. Ives floor stop 436 or 438 as conditions require.

f. Provided substitutes are the same design finish, material and are fastened identically to those specified, allowable substitutes as manufactured by: Russwin Sargent Or equal

g. Thresholds and weatherstripping: Shall be as manufactured by National Guard Products.

i. Provided substituted items are identical in composition, function and appearance, allowable substitutes are as manufactured by:

ii. Zero

iii. Pemko

iv. Rese

h. Padlocks: Shall be BEST Series 41B; no substitutions allowed.

2. Templates: It shall be the responsibility of the hardware supplier to furnish templates of all items of hardware as soon as practical after receipt of approved hardware schedule and hollow metal shop drawings.

3. Marking, Packing, Delivery, and Storage: Hardware shall be delivered to the job site in manufacturer's original packages, marked to correspond with the approved hardware schedule.

4. Keying: Match existing County system. All locks shall be master keyed and sub- mastered and construction master keyed as directed by Engineer and/or Owner, utilizing BEST Lock

Company or Medeco High Security Lock components. Supply six (6) master keys and ten (10) construction master keys.

## 08700.03 EXECUTION

A. Hardware Mounting Heights

1. Hardware locations:

   a. Hinges - shall be installed at door and frame manufacturer standard location.

   b. Locksets - centerline of lock shall be 40-5/16" from finished floor.

   c. Exit Devices - shall be located as per manufacturer's templates.

   d. Door Closers - shall be located as per manufacturer's templates.

   e. Wall Stops - shall be located so center of knob or pull strikes center of stop.

2. Installation

   Install each hardware item in compliance with the manufacturer's instructions and recommendations. Wherever cutting and fitting is required to install hardware onto or into surfaces which are later to be painted or finished in another way, install each item completely and then remove and store in a secure place during the finish application. After completion of the finish, re-install each item. Do not install surface-mounted items until finishes have been completed on the substrate.

3. Adjustment and Cleaning

   Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Lubricate moving parts with the type of lubrication recommended by the manufacturer (graphite-type or as otherwise recommended). Replace units that cannot be adjusted and lubricated to operate freely and smoothly as intended for the application.

END OF SECTION

# SECTION 09250

# GYPSUM DRYWALL

## 09250.01 GENERAL

A. Description of Work

The work to be done under this section includes everything necessary for and incidental to executing and completing all drywall work as shown on the Drawings and all associated metal framing indicated or required to complete the work.

B. General

1. All drywall work shall be done to meet Anne Arundel Building Code requirements for fireproofing of structural members, fire walls, etc. Work in this section shall be done in accordance with the recommendations of the United States Gypsum Company and the best standards of the trade.

2. This section of the specification is based on the products and specifications (by reference) of the United States Gypsum Company. Products of the following manufacturers which meet the specifications shall be considered as equals.

    a. Gold Bond

    b. Flinkote

    c. Georgia-Pacific

    d. Or Equal

3. Provide metal access door in drywall ceiling if shown on the plans.

C. Submittals

1. Submit shop drawings for approval prior to installation of work in accordance with Section 5.04 of the "General Provisions". Shop drawings shall indicate complete construction details, gauges and sizes of members, and relationship of drywall work to adjacent work.

2. Submit samples of materials specified including each type of wallboard and metal accessories.

## 09250.02 MATERIALS

A. Materials

1. Drywall: 48 inches wide, sheetrock SW, 1/2-inch thick regular.

2. Metal Framing: USG metal furring channels, DWC hat-shape, 1 1/2 inches and 3/4- inch cold rolled furring channel.

3. Screws: One inch, 1 1/4 inches, and 1 5/8 inches, Type S, bugle head metal framing. 1/2-inch Type S-12 low-profile head steel studs to runner and door frames.

4. Joint Treatment: USG Perf-A-Tape joint system and Durabond "90" and all- purpose ready to use joint compound, all non-asbestos type.

5. Metal Trim: Standard USG metal trim No. 200 and 400 series and Dura-A-Bead corner reinforcement.

6. Metal access door for drywall surfaces. Provide 30-inch x 36-inch metal access door Model WB-DW as manufactured by the Williams Corporation, or equal.

## 09250.03 EXECUTION

A. Preparation

1. Inspect all surfaces to receive drywall construction before beginning work and report any defects which affect the satisfactory execution and stability of work.

2. Coordinate with work of other sections to provide for the necessary stiffeners, bracing and additional studding for the proper attachment of carpentry and other items of drywall construction.

3. During taping, spackling and laminating, and during the full curing period, maintain a temperature of not less than 65 degrees F., with adequate ventilation.

B. Application of Wallboard (Mechanical Fastening)

1. Wallboard application shall be in accordance with recommendations of ANSI A 97.

2. Fasten single layers of wallboard to furring members with 1-inch-long Type S drywall screws. Space screws not more than 12 inches on center in the field of the board and 8 inches on center staggered along abutting edges.

3. Provide metal trim, accessories and reinforcement as required for conditions and completed installation.

C. Upon completion, gypsum wallboard surfaces exposed to view shall be visually flat, smooth, and without visible joints, screw heads or cracks. Metal trim shall be undamaged and in-line.Joint Treatment

Shall be in accordance with U.S. Gypsum bulletin SA-923 and/or manufacturer's standard instructions.

D. Pre-fill Application:

1. Mixing: Durabond "90" non-asbestos joint compound shall be mixed according to the directions on the bag. Caution should be used to prevent over mixing, use of extremely cold water and extremely cold compound.

2. All V-grooves formed by abutting wrapped eased edges of sheetrock SW shall be pre- filled with Durabond "90" compound. Application shall be with a flexible 5 to 6 inch joint finishing knife or an Ames pre-fill tool. The "V" shall be filled flush with the plane of the tape depression and any excess beyond the groove shall be wiped clean, leaving a clear depression to receive tape. The pre-fill shall have hardened prior to the next application (tape or embedding coat).

E. Joint Treatment Application

1. Taping or Embedding: USG already mixed joint compound shall be applied with a suitable tool in a thin, uniform layer to all joints and angles to be reinforced. Perf-A-Tape reinforcement shall be applied immediately and centered over the joint and seated into the compound. Sufficient compound must remain under the tape to provide proper bond. A skim coat shall immediately follow tape embedment but not to function as fill or second coat.

2. Tape shall be properly folded and embedded in all angles to provide a true angle. The tape or embedding coat must be thoroughly dry prior to application of the fill coat.

3. Filling: USG ready mixed joint compound non-asbestos shall be applied over the embedding coat, filling the board tape flush with the surfaces. On joints, the fill coat shall cover the tape and feather out at least 4 inches on either side of the tape. The fill coat shall be thoroughly dry prior to application of the finish coat.

4. Finishing: USG ready mixed joint compound non-asbestos topping shall be spread evenly over and extended slightly beyond the fill coat on all joints and feathered to a smooth uniform finish. The finish coat shall not protrude beyond the plane of the surface.

5. All taped angles shall receive a finish coat to cover the tape and taping compound providing a true angle.

6. Where necessary, sanding shall occur between coats and following the final application of compound to provide a smooth surface ready for decoration.

7. Install metal access panel in accordance with manufacturer's recommendations.

END OF SECTION

# SECTION 09800

# SPECIAL COATINGS

## 09800.01 GENERAL

A. Description

1. The extent of glazed coating systems (special coating) work is shown on the drawings and schedules, and as herein specified.

2. This work includes the application of glazed coating systems to surfaces as scheduled, including surface preparation, priming and topcoats.

B. Quality Assurance

Coordination: Provide finish coats which are compatible in all respects with the prime paints used. Upon request from other subcontractors, furnish information on characteristics of specified finish materials, to ensure that compatible prime coats are used. Notify Engineer in advance of construction of any anticipated problems using coating systems as specified.

C. Submittals

1. Manufacturer's Data: For information only, submit the manufacturer’s technical information indicating that their product complies with Federal Specification TTC-550C, including basic materials analysis and installation instructions for each material specified. List each material and cross-reference to the specific coating and finish system and application. Identify each item by manufacturer’s catalog number and general classification.

2. Samples: Submit samples for Owner's approval of color and texture only. Compliance with all other requirements is the exclusive responsibility of the Contractor. Provide a listing of the material and application for each coat of each finish sample.

   a. On 4-inch square sample of the substrate, provide two samples of each type of system and color; define filler, prime and finish coat.

   b. One room or area of the project will be selected by the Engineer to represent typical job surfaces and conditions. Apply special coatings in this room or area in accordance with the schedule and as specified. After finishes are accepted, this room will be used for comparison in evaluation of other coating systems of a similar nature.

D. Delivery and Storage

1. Deliver materials to the job site in original, new and unopened packages and containers bearing manufacturer's name and label, and the following information:

    a. Name or title of material

    b. Federal specification number

    c. Manufacturer's stock number and date of manufacture

    d. Manufacturer's name

    e. Contents by volume, for major pigment and vehicle constituents

    f. Thinning instructions

    g. Application instructions

    h. Color name and number

2. Take precautions to ensure that workmen and work areas are adequately protected from fire hazards and health hazards resulting from storage of special coatings.

## 09800.02 MATERIALS

A. Material Quality

1. Provide the best quality grade of the various types of coatings as regularly manufactured by acceptable coating material manufacturers. Use only materials displaying the manufacturer's identification as a standard, best-grade product.

2. Provide primer recommended by manufacturer of finish coat. Use only thinners approved by coating manufacturer and use only within recommended limits.

B. Colors and Finishes:

1. The Owner will select from standard colors available from the manufacturer of materials systems as specified.

2. Color Pigments: Pure, non-fading, types applicable to suit substrates and service indicated. Lead content in the pigment, if any, is limited to contain no more than 0.5% lead, as lead metal based on the total non-volatile (dry film) of the paint by weight.

C. Interior Special Coating System

1. Provide special coatings for the interior substrates as manufactured by the following manufacturer, or equal:

a. Carboline - Sanitile 550 CB-2 (3 coat system) for masonry walls, Sanitile 550 DW (3 coat system) for drywall ceilings and Sanitile 550 PC (3 coat system) for precast concrete pump station dry wells.

## 09800.03 EXECUTION

A. Inspection

1. Examine the areas and conditions under which the coating is to be applied and notify the Engineer in writing of conditions detrimental to proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

2. Do not apply coatings over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to the formation of a durable coating film.

B. Work Safety and Conditions

1. Take precautions to ensure that workmen and work areas are adequately protected from fire hazards and health hazards resulting from handling, mixing, and application of special coatings.

2. Do not apply coatings when the temperature of surfaces to be painted and the surrounding air temperatures are below 45 degrees F., unless otherwise permitted by the coating manufacturer's printed instructions.

3. Do not apply coatings in snow, rain, fog, or mist, nor when the relative humidity is in excess of 85%, nor to damp or wet surfaces, unless otherwise permitted by the manufacturer's printed instructions.

4. Coating work may be continued during inclement weather only if the areas and surfaces to be painted are enclosed and heated within the temperature limits specified by the manufacturer during application and curing periods.

C. Surface Preparation

1. General

a. Perform preparation and cleaning procedures in compliance with the coating manufacturer's instructions for particular substrate conditions, and as herein specified.

b. Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items which are not to be coated, or provide surface-applied protection prior to surface preparation and coating operations. Remove, if necessary, for complete coating of items and adjacent surfaces.

c. Following coating completion in each space or area, reinstall the removed items, using workmen skilled in the trades involved.

d. Clean surface to be coated before applying coatings or surface treatments.

e. Schedule the cleaning and application so that dust and other contaminants from the cleaning process will not fall on wet, newly coated surfaces.

2. Cementitious Surfaces

Prepare cementitious surfaces of concrete and concrete masonry to receive special coatings by: removing chalk, dust, dirt, undesirable compounds used in manufacture, grease, oils, and by roughening if required to remove glaze.

D. Material Preparations

1. General

a. Carefully mix and prepare the materials in compliance with manufacturer's directions.

b. Do not mix materials produced by different manufacturers, unless otherwise permitted by the manufacturer's instructions.

c. Store materials in tightly covered containers. Maintain containers used in storage, mixing, and application of paint in a clean condition, free of foreign materials residue.

E. Application

1. General

a. Apply special coatings by roller, spray, or other applicators in accordance with the manufacturer's directions. Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for material and texture required.

b. The number of coats and paint file thickness required is same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by coating manufacturer.

c. Apply additional coats when undercoats or other conditions show through final coat until cured film is of uniform finish, color and appearance.

d. Coat surfaces behind movable equipment and furniture the same as similar exposed surfaces.

e. Apply each material at not thinner than manufacturer's recommended spreading rate. Provide a total dry film thickness of entire coating system as recommended by manufacturer, unless otherwise indicated.

f. Prime Coats

i. Before application of finish coats, apply prime coat(s) to substrate.

ii. Re-coat primed and sealed substrates where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn- through or other defects due to insufficient sealing.

g. Mechanical Applications

i. Use mechanical methods for coating applications when permitted by coating material manufacturer's recommendations.

ii. Wherever spray application is used, apply each coat to provide the equivalent hiding of brush-applied coats. Do not double-back with spray equipment for the purpose of building up film thickness of two coats in one pass, unless recommended by coating material manufacturer.

2. Completed Work

a. Match approved samples for color, texture and coverage. Remove, refinish, or re- coat work not in compliance with specified requirements.

3. Clean-Up and Protection

a. Clean Up: During work, remove from project all rubbish, cans, and rags resulting from the work.

b. Upon completion of work clean all coating-spattered surfaces. Remove spattered materials by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

c. Protection: Protect work of other trades, whether to be coated or not, against damage by work. Correct damage by cleaning, repairing, or replacing, and re- coating, as directed by Engineer. Leave all work in undamaged condition.

END OF SECTION

# SECTION 09900

# PAINTING

Delete Specification Section 09900 - PAINTING from the Anne Arundel County Standard Specifications and replace with the following:

## 09900.01 GENERAL

A. Description of Work

1. The Contractor shall furnish all material, labor, equipment, and services necessary for and incidental to the finishing and application complete of all field painting.

2. The Contractor shall, under this section, paint to completion all items and surfaces left unfinished by the requirements of other sections and normally requiring painting for either protection, identification and/or decoration. The sole determination to be by the Engineer.

3. The Contractor shall examine the Contract Drawings and Specifications and thoroughly familiarize himself with all provisions regarding required painting of work done under other sections.

4. All designated surfaces shall be painted and finished as part of this section. This includes, but is not limited to, equipment, fans, ducts, etc.

5. The specialty items which are delivered with a prime coat shall be finished as part of this section.

6. The painting of all exposed uncovered pipe, non-corrosive pipe hangers, convertors, grills, and other mechanical work, requiring paint shall be included in this section.

7. The submission of a Proposal by the Contractor confirms an understanding of all conditions pertaining to this work and proper application of materials specified.

8. NOTE: Painting of exterior concrete walls and surfaces is not permitted. If a special situation exists which require painting of exterior concrete prior approval must be obtained from Engineering and also the Chief of the Bureau of Operations.

B. Related Work Specified Elsewhere

1. In addition to the work specified in this section, requirements for painting and other coatings are included in the following section:

2. Forms and Framework; Section 03010.

3. Precast Structural Concrete; Section 03050.

4. Miscellaneous Metals; Section 05200.
5. Elastomeric Membrane Waterproofing; Section 07110.
6. Flashing and Sheet Metal; Section 07600.
7. Special Coatings; Section 09800.
8. Louvers; Section 10200.
9. Heating and Ventilating; Section 15600.
10. Electrical; Section 16100.

C. Quality Assurance

1. Include on label of containers: manufacturer's name, type of paint, manufacturer's stock number, color number and instructions for reducing where applicable.
2. Samples of materials, when requested by the Engineer, are to be obtained from material stored at project site or source of supply.
3. Field Quality Control: Request review of first finished room, space and workmanship. This room to be held as a standard of performance and quality. For spray application, paint surface not smaller than 100 square feet as project standard.

D. Submittals

1. Furnish manufacturer's label or other printed product literature for each material to be used on the project for acceptance by the Engineer.
2. The manufacturer’s representative shall certify that the paint systems to be used are proper for the type of exposure and service and that all coats in each system are compatible with each other.
3. Furnish sample of all opaque finishes on primed cardboard and stained wood samples on type and quality of wood specified for use on project. Make all samples in triplicate not less than 20 square inches each.
4. Contactor shall submit a complete schedule of paint systems and surface preparations proposed as follows:
    a. List all interior and exterior surfaces and major equipment to be painted.
    b. Schedule shall reflect approved paint manufacturer’s recommendations for their systems.
    c. Schedule shall itemize each painted item or surface and contain the following information in tabular format:

i. Type of surface preparation

ii. Paint system

iii. Prime coat (product, number of coats, dry mil thickness per coat, average square feet coverage per gallon).

iv. Intermediate coat, if required (same info as above).

v. Finish coat (same info as above).

vi. Color

E. Products Delivery, Storage and Handling

1. Deliver in original sealed containers with seals unbroken and labels intact.

2. Deliver to project site or segregate at source of supply in advance of need so as to allow four (4) working days for testing.

3. Store only acceptable project material on project site.

4. Store in suitable location, restricting storage to paint materials and related equipment.

5. Comply with all applicable health and fire regulations.

F. Job Conditions

1. Comply with manufacturer's recommendations as to environmental conditions under which coatings and coating system can be applied. Unless otherwise recommended by the manufacturer, finishes and coatings shall not be applied when surface temperatures are above 85 degrees F.

2. Do not apply finishes in areas where dust is being generated. All materials shall be applied free of runs, sags, wrinkles, streaks, skinners, and brush marks.

3. Cover or otherwise protect finishes of other trades and surfaces not being painted concurrently or not to be painted. All materials shall be applied uniformly. If any reduction of the coating viscosity is necessary, it shall be done in accordance with manufacturer's label directions.

4. The subcontractor shall be held responsible for the finished appearance and satisfactory completion of his work and, therefore, he shall not commence any painting until surfaces to be finished are in proper condition in every respect. New masonry surfaces shall not be primed until it has been determined that the substrates have dried sufficiently to safely accept paint material. A moisture meter shall be used to make this determination. Report to Engineer any area that does not meet the requirements.

5. A minimum interior temperature of 65 degrees F. shall be maintained during the actual

application and drying of the paint, and until occupancy of the structure occurs. Adequate ventilation shall be maintained at all times to control excessive humidity which will adversely affect the curing and coatings. The Contractor is solely responsible for maintaining suitable temperatures and ventilation.

6. Before painting begins, all other crafts shall have completed their work, and shall have removed all dirt and debris resulting therefrom. The rooms or areas are to be left in broom clean condition.

7. Enamel undercoats are to be sanded smooth prior to recoating. Top and bottoms of doors are to be finished in the same manner as door facing, after the carpenters complete the fitting of them.

8. No exterior painting shall be undertaken if air or surface temperature is below 50 degrees F. nor immediately following rain or until frost, dew or condensation has evaporated. Surfaces shall always be tested with a moisture meter before proceeding.

## 09900.02 MATERIALS

A. Acceptable Manufacturers

1. Except as otherwise specified, materials shall be the products of the following manufacturers:

   a. Tnemec Company, Inc.

   b. Carboline

   c. PPG Coatings

   d. Or Equal

2. Materials selected for a coating system for each type of surface shall be the products of a single manufacturer, except where required by the Contract Documents.

B. Materials

1. Products specified are as manufactured by Tnemec Company, Inc., (designated Tn.), unless otherwise indicated; equivalent or superior products of acceptable manufacturers listed in this Specification may be used in lieu of those listed.

2. All paints must meet current ecological standards and lead hazard regulations

   a. All paints must conform to COMAR 26.11.33 including the VOC content limits under 26.11.33.05 and OTC Phase II. Under this standard industrial maintenance coating volatile organic compounds are limited to 250 grams per liter.

   b. No paints will be permitted on the job site with lead contents in excess of 0.06%

by weight. If the Contractor applies any paints or coatings with lead content in excess of 0.06% by weight, then he shall be responsible for the proper removal and recoating, at no cost to the County, of the affected surface(s) to conform with this specification.

C. Colors

1. Colors of paints shall match control samples. All colors not designated on the Drawings or in the Specifications will be selected by the Owner. All primers and undercoats are to be tinted to the approximate shade, but not the same, as the selected finish color.

2. Check finish schedules for areas to be treated with accent colors (deep colors), or special materials. Where deep tones are used it is the responsibility of the Contractor to utilize the appropriate deep base primer as recommended by the paint manufacturer for use on the surface for which they are intended.

D. Mixing and Tinting

1. Deliver paint and enamels ready mixed to job site, in manufacturer's original labeled containers.

2. Accomplish job mixing and job tinting only when acceptable to the Engineer. These should be limited to primers, sealers, and undercoats.

3. Use tinting colors recommended by manufacturer for the specific type of finish.

## 09900.03 EXECUTION

A. Inspection

1. Examine surfaces scheduled to receive paint and finishes for conditions that will adversely affect execution, permanence, or quality of work and which cannot be put into acceptable condition through preparatory work as included in this Specification.

2. Do not proceed with surface preparation of coating application until conditions are suitable.

3. All unfinished surfaces and material except those excluded by the Contract Documents shall be painted. See painting schedule herein for types and locations of the various surface requiring painting or finishing and the number of coats. Basically, this project will be a three (3) coat installation. Consult the documents for work that will require more than three. An additional coat will be required on any surface when, in the sole judgment of the Engineer, the finish surface is not satisfactory; this will be done at no increase in Contact price.

B. Preparation of Surface

1. Ferrous Metal Surfaces (except stainless steel): SSPC-SP6 Commercial Blast Cleaned

Steel or SP11 Power Tool Cleaning to Bare Metal with a (1) mil profile. Remove all rust, paint, and mill scale. Prime immediately with Series 394 Perime-Prime applied at 2.5 to 3.5 mils DFT. Feather edges of damaged shop coat to achieve smooth finish.

2. Galvanized Metal: SSPC-SP7 Abrasive Brush-off Blast Cleaning – uniformly scarify the surface. If SP7 is impractical uniformly scarify using power grinders.

3. Concrete – Immersion & Non-Immersion & Severe Exposure Services: Abrasive Blast Cleaning per SSPC SP13/NACE 6, ICRI CSP 5-7. Apply a parge coat of Tnemec Series 218 Mortar-Clad (New) @ 1/16 inch thickness. (Existing) ¼ to ½ inch thickness (the parge coat is intended to minimize out gassing in the concrete that produces blow holes in the coating film when applied directly over abrasive blasted concrete).

C. Application

1. Do not apply coating until moisture content of surface is within limitations recommended by the paint manufacturer's test with moisture meter.

2. Apply paint coatings with suitable brushes, rollers or spray equipment which has been kept clean, free from contamination and suitable for finish required.

3. Rate of application of coating shall be as recommended by the paint manufacturer for the purpose and surface involved.

4. Comply with required drying time between coats as directed by manufacturer.

5. Sand and remove dust between each coat to remove defects visible from 5 feet. Finish coats shall be smooth, free from brush marks, streaks, laps, sags, skips, holidays, etc.

6. Do not apply additional coats until completed coat has been inspected and accepted by the Engineer. Only inspected coats of paint will be considered in determining number of coats applied.

D. Cleaning

1. Touch up and restore where finish is damaged.

2. Remove spilled, splashed, or spattered paint from all surfaces.

3. Do not mar surface finish of item being cleaned.

4. Leave storage space clean and in condition required for equivalent spaces in project.

E. Exterior Painting Schedule

1. Metals (Except Aluminum and Stainless Steel)

a. Semi-Gloss finish/Epoxy Polyamidoamine- Aliphatic Acrylic Polyurethane Coating

b. First Coat: Metal Primer (if any, factory applied) Field: Tnemec Series 394 Perime-Prime applied at 2.5 mils DFT

c. Second Coat: Tnemec Series N69 Hi-Build Epoxoline (Tn.) @ 4.0 mil minimum dry film thickness.

d. Third Coat: Tnemec Series 1095 EnduraShield (Tn.) @ 3.0 mil minimum dry film thickness.

F. Interior Painting Schedule

1. Metals, (General usage except Aluminum and Stainless Steel)

a. Semi-Gloss Finish/Alkyd Enamel

b. First Coat: 1224 Epoxoline WB (Tn.) @ 4.0 mil minimum dry film thickness for metals and galvanized or non-ferrous surfaces.

c. Second and Third Coats: Tnemec Series 1029 Enduratone (Tn.) @ 2.0 mil minimum dry film thickness per coat.

G. Pumping Station Schedule

1. Buried Exterior Concrete (wet wells, dry wells, and valve vaults): Asphaltic elastomeric membrane waterproofing - See Section 07110.

2. Exposed Exterior Concrete: Uncoated.

3. Interior exposed concrete:

a. Wet Wells and Emergency Connection Vaults

i. The following coating specification is for new construction and shall be incorporated in all projects (effective immediately). Note that floors in emergency connection vaults shall not be painted.

a) Modified Polyamine Epoxy coating for interior surfaces of the concrete sewage pump station wet well or any structure which may come in contact with raw sewage.

b) Surface preparation - Provide brush-off abrasive blast cleaning to remove loose surface concrete and contaminants and provide "tooth" for good coating adhesion. Surfaces includes ARV Vaults. Repair all interior surface imperfections with epoxy mortar in accordance with the manufacturer's recommendations. Remove all

dust from surface to receive the interior coating. All concrete surfaces shall be dry.

c) Parge Coat/Sealer: Tnemec Series 218 Mortar-Clad (Epoxy Modified Cementitious Mortar applied at (New) @ 1/16-inch thickness. (Existing) ¼ to ½ inch thickness

d) First coat – Tnemec Series 435 Perma-Shield Modified Polyamine Epoxy; apply to prepared surface via brush air spray, airless spray, or as allowed by the coating manufacturer. Apply at a rate that results in a thickness of 15.0-20.0 dry mils.

e. Second coat – Tnemec Series 435 Perma-Shield Modified Polyamine Epoxy Apply unthinned coating at rate that results in a thickness of 15.0 – 20 dry mils. Observe the manufacturer's recommended recoat time. The first coat shall be a lighter color than the second coat. The total dry film thickness shall be 30.0 to 40.0 mils. All manufacturers' instructions shall be strictly followed. Note: One coat can be spray applied at 30.0 to 40.0 mils *(Corrosive & High Impact) Tnemec Series 436 Perma- Shield FR Fiber Reinforced Modified Polyamine Epoxy Spray applied in one coat at 80.0 mils.

b. Dry Wells

i. Special coating - See Section 09800

4. Wet Well Sewage Piping and Equipment Components

a. Coal Tar Epoxy:

i. First and Second Coats: Tnemec Series 46H-413 @ 16.0-20 mil minimum dry film thickness total.

5. Dry Well and Valve Vault Sewage Piping and Valves

a. Semi-Gloss Finish/Epoxy Polyamine:

i. First Coat: Tnemec Series V69 Epoxoline II Primer (Tn.) @ 3.0 mil minimum dry film thickness.

ii. Second and Third Coats: Series V69 Hi-Build Epoxoline II (Tn.) @ 4.0 mil minimum dry film thickness per coat.

H. Mechanical Work

1. Factory finish coats are specified elsewhere for certain items of mechanical equipment. Field painting will not be required for such items which have factory finish, except where finish is damaged by handling, weather, or other reasons. Damaged portions shall be field

primed and finished with sufficient finish coats to give a smooth, unmarred finish, with primer and finish being of the same type and color paint as originally used in the factory applications. Damaged portions shall either be field refinished or replaced, subject to the approval of the Engineer. Finish coat shall be uniform for factory painted equipment.

2. Prime coat paint used on mechanical equipment shall be compatible, so as not to be lifted by subsequent coats or cause other undesirable effects, with the field finish coats hereinafter specified. The equipment manufacturer's standard shop prime coat may be used only if compatibility is proven to the Engineer's satisfaction. For any equipment delivered to the site with a shop prime coat not compatible with the finish coats, the Contractor may be ordered to sandblast or otherwise restore the equipment to the bare metal condition. A field prime coat, conforming to these specifications, shall then be applied to the equipment.

3. Color and marking of various exposed piping systems shall be as specified hereinafter or as subsequently furnished to the Contractor prior to the beginning of work. Valves, fittings, and accessories located in a particular pipeline shall be painted the same color as the line piping, unless otherwise specified.

4. Galvanized pipe and equipment shall be pre-treated with Kopper No. 888 cleaner and 1 coat Kopper No. 40 passivator or equal and prime coated with one coat Kopper No. 654 primer or equal and finished with 2 coats Koppers No. 200 Epoxy or equal.

I. Exposed Piping Color and Marking Schedule

| LOCATION/PROCESS | COLOR | MARKING |
|---|---|---|
| Emergency connection vault | Interior – ivory | |
| Wet well concrete | Light grey | |
| Sewage lines | Pale mint green | Sewage |
| Sewage pumps | Dark green | N/A |
| Valve handles and lid | Safety Yellow | N/A |
| Potable water lines | Safety Blue | Potable water |
| Sump Pump Lines | Safety Orange | Sump pump |
| Air lines | Aqua green | Air |
| Vent Pipes | Brown | N/A |

Exposed pipe installed under this contract shall be finished painted and marked in accordance with the above color and marking schedule.

J. Electrical Work

1. Major items of electrical equipment shall be furnished with factory finish. Field painting will not be required for such items except when finish is damaged. Damaged portions shall be field primed and finished with one finish coat, with primed and finish being of the same type and color paint as originally used in the factory application. Repainting shall be performed using the same methods as used by the manufacturers of the equipment. Damaged portions shall be refinished to give uniform color and texture. Finish coat shall be uniform for factory painted equipment.

2. Exposed electrical items of work which do not have a factory painted finish such as pull boxes, junction boxes, terminal boxes, conduits, racks, supports and ferrous accessories, shall be painted in an identical manner to that specified for mechanical work items.

3. Bright metal parts such as stainless steel or chrome plate device plates, knobs and items provided with a plastic base or painted finish and trim shall not be painted. PVC-coated conduit systems shall not be painted.

K. Piping Identification Schedule

1. The exposed piping systems shall be identified by lettered legends clearly indicating the contents of the system as indicated in this Section.

2. Lettered legends shall be stenciled on the piping at the horizontal or vertical centerline thereof, except where pipe lines are too close together or above the operator's normal line of vision. In these situations, the lettering shall be placed above or below the horizontal centerline as directed by the Engineer. The legends shall indicate the contents of the pipe and, when required for clarity, the associated process. All legends shall be submitted to the Engineer for acceptance. As a guideline some examples are listed in the piping system paint schedule, in this section.

3. Lettered legends shall be located at points where pipes enter and leave the rooms, buildings, or spaces; at junction points of distribution; close to valves and equipment; at changes in direction; and at intervals along the piping at least every fifteen feet.

4. Arrows indicating normal direction of flow shall be stenciled on the piping adjacent to the legends. The arrows shall be the same size as the letters and shall be located so that the arrow points away from the legend. Letter sizes are given in the schedule below:

| Outside Diameter of Pipe Covering | Height of Letters |
|---|---|
| 3/4to11/4inches | 1/2-inch |
| 1 1/2 to 2 inches | 3/4-inch |
| 3 to 6 inches | 11/4 inches |
| 7 to 10 inches | 11/2 inches |
| Over 10 inches | 31/2 inches |

5. In lieu of stenciled legends and flow arrows, snap-on type labels will be allowable substitutes. Labels shall be Set Mark System, manufactured by Seton Name Plates Corp., or equal.

END OF SECTION

# SECTION 10027

# HATCHES

## 10027.01 GENERAL

A. The work required under this section shall be furnished and installed complete in place, as shown on the Drawings.

B. Submittals

Submit shop drawings for all hatches in accordance with Section 5.04 of the General Provisions.

## 10027.02 MATERIALS

A. Wet Well, Dry Well and Valve Vault Hatch Leave and Frames

1. Door leaves shall be 1/4-inch aluminum diamond pattern plate to withstand a live load of 300 lb/square foot, with a maximum deflection of 1/150th of the span. Channel frame shall be 1/4-inch aluminum with an anchor flange around the perimeter and shall have a minimum cross-section area of 7-1/2 inches to allow for adequate water drainage. Door shall be equipped with heavy duty stainless steel hinges having 3/8" minimum diameter stainless steel pins and pivot so that the cover does not protrude into the channel frame. Compression spring operators enclosed in stainless steel telescopic tubes shall be provided for smooth, easy and controlled door operation throughout the entire arc of opening and closing. Operation shall not be affected by temperature. The door shall automatically lock in the vertical position by means of a heavy steel automatically locking hold-open arm with release handle to allow the leaf to lay open flat. A Type 316 stainless steel snap lock with a gasketed cover plug and removable turn handle shall be provided. A ½- inch drainage coupling shall be located in the front right corner of the channel frame. All hatches shall have recess padlocks.

2. Hatch frames shall be an aluminum extrusion of alloy 6063-T6. Hatch frame surfaces shall be "mill finish;" those in contact with concrete shall be bituminous coated. The hatch and frame shall be Bilco type J-AL or JD-AL with Type 316 stainless steel hardware or approved equal.

3. Aluminum hatch leaves and frame finish shall be "mill finish".

## 10027.03 EXECUTION

A. General

1. Preassemble and check the operation of all hatch components prior to incorporating this item into the work.

2. Store and handle the hatch assembly so as to avoid damage to the hatch frame or any accessory assemblies.

B. Installation

1. Installation shall be in accordance with manufacturer's instructions.

2. Prior to installation of the hatch frame into the cast concrete slab, remove to the extent possible hatch leaves, latches and other accessory items. Coat all aluminum surfaces in contact with concrete with an asphaltic compound to prevent corrosion of aluminum.

3. Adequately and firmly block the hatch frame to ensure that the frame members remain true and straight during the pouring of concrete.

4. Coat all surfaces not intended to be in contact with concrete with a substance which will prevent the adhesion of any concrete spillage or overpour.

5. Extend hatch drain through concrete slab or wall with 1 1/2-inch PVC Schedule 80 DWV pipe to drain above grade.

6. Exercise extreme care in placing concrete around the hatch frame to ensure that the frame is neither twisted nor deflected in any manner. Adequately work the concrete around the frame to ensure that no voids occur.

7. Completely clean all hatch frame surfaces of tramp concrete and concrete release coating previously applied. Reassemble and check the operation of all hatch components.

END OF SECTION

# SECTION 10028

# ALUMINUM LADDERS

## 10028.01 GENERAL

A. Description Of Work

Furnish and install aluminum ladders and accessories as specified herein.

B. Submittals : Submit shop drawings for ladders and accessories.

## 10028.02 MATERIALS

A. Ladders

1. Vertical ladders shall be as manufactured by Washington Aluminum Company, Inc. Or approval equal. Ladders shall have stringers, square non slip serrated rungs. The ladder shall withstand a 300 pound point load without deformation or failure. Ladders shall be aluminum alloy 6061-T6. A load rating tag shall be installed on or near the ladder.
2. All necessary epoxy anchor bolts will be 316 stainless steel and furnished with ladder. All material will have a standard mill finish. The portion of the ladder in contact with the concrete shall have a heavy shop coat of bituminous paint. The standoff brackets shall have minimum 2 inches in contact with concrete.
3. Ladder rungs shall be spaced 12” on center, and 1’-4” in width. The ladder shall be installed 7 inches off the wall. The lowest rung of the ladder shall be minimum 12” off the ground with standoff brackets.
4. Stringers shall be hole punched to allow snug fit to ends of ladder rungs. Rungs shall rest on strings and be welded to stringers. Welding of rungs to flat surface of stringers is not allowed
5. Ladder rungs shall have non-slip serrations which are extruded. Knurling of rungs is not allowed.

## 10028.03 EXECUTION

A. General

1. Preassemble ladder and check the operation of all components prior to incorporating this item into the work.

2. Store and handle the ladder assembly so as to avoid damage to the ladder or any accessory assemblies.

B. Installation Ladders are to be installed in such a way that they shall conform to and support loads required by the current regulations published by the Occupational Safety and Health Administration.

END OF SECTION

# SECTION 10100

# INSULATED FIBERGLASS ENCLOSURES

## 10100.01 GENERAL

### A. Description of Work

1. Furnishing and installing the insulated fiberglass enclosure shall include, but not necessarily be limited to, furnishing, and installing all equipment and appurtenances of the size and type, as shown on the Plans and in accordance with the Contract Specifications.

2. Related Work Included Elsewhere

   a. Cast in Place Concrete; Section 03030.

   b. Soil Odor Filter Blower; Section 11230.

3. Quality Assurance

4. Materials

   The Engineer will inspect all materials before and after installation to ensure compliance with the Contract Documents. When specific materials test are called for in the referenced standards and specifications, the Engineer will have the option of requiring that any or all of these tests be performed for materials furnished for a specific project. When testing is required, it will be specified herein.

### B. Field Tests

   a. None this section.

2. Submittals

   a. Shop drawings will be submitted as specified in the "General Provisions" for the following materials and shall include the following information:

      i. Fiberglass Enclosure: product information, technical specifications, description of the fabrication process, and color selection chart.

      ii. Soundproofing: product information, technical specifications, and installation recommendations.

   b. Fabrication drawings will be submitted showing the proposed method and procedures for fastening the soundproofing to the enclosure.

3. Supplemental References

    a. Fiberglass Tensile Strength ASTM D-638.

    b. Fiberglass Flexural Strength ASTM D-790.

    c. Fiberglass Compressive Strength ASTM D-695.

    d. Fiberglass Water Absorption ASTM 570-59 T.

    e. Fiberglass Charpy Impact Test ASTM D-256.

    f. Fiberglass Impact Resistance Test ASTM D-244.

    g. Fiberglass Flammability Test ASTM D-635.

## 10100.02 MATERIALS

A. Materials Furnished by The County

The County will not furnish any materials for the fiberglass enclosure system.

B. Contractor's Options

None this section.

C. Material Requirements

1. Soil Odor Filter Blower Enclosure

    a. Construction: Molded in one piece including base and door frame; doors shall be of identical material and construction as the enclosure; provide 8" X 10" aluminum louvers on two opposite sides, one high and one low to allow air circulation inside the enclosure; enclosure size to suit equipment, provide two removable, lockable access doors of size 27-3/4" X 25" (H); enclosure shall be Model 41-2 as manufactured by Western Power Products, Co., Atlanta, Georgia, or equal.

    b. Fabrication: Constructed to meet requirements of ANSI C57-12-28 standard for pad mounted equipment enclosure integrity, an attachment to ANSI C37-72; visual standards of the finished laminate shall conform to Table 5, ASTM C-582.

    c. Materials: Thermosetting resins of medium reactivity, rigid fire resistant polyester containing maximum monometer content of 42% and maximum Thixotropic additive content of 1%; glass fiber reinforcement shall be K filament Type E Borosilicate glass having high performance chrome complex or silicone finish compatible with polyester resin; exterior structure coating shall be ultraviolet light stabilized, weather resistant, polyester base containing fade resistant color pigments and the maximum total pigment volume concentration shall be less than 20%; enclosure shall be "greenland" green, interior coating shall be pigmented heat resistant high.

d. Properties for Enclosure Construction: See table below:

| PROPERTY | UNIT | VALUE |
|---|---|---|
| Tensile Strength ASTM D-638 | psi | 8180 |
| Flexural Strength ASTM D-790 | psi | 6040 |
| Tangent Modulus of Elasticity | ksi | 407.3 |
| Compressive Strength ASTM D-695 | psi | 19,350 |
| Water Absorption ASTM 570-59 T | % | 5 |
| Charpy Impact Test ASTM D-256 | ft-lb | 3 |
| Impact Resistance ASTM D-244 | ft-lb | 37.5 |
| Flammability Test ASTM D-635 | - | Self-Extinguishing |
| Ultraviolet Protection | - | Nominal 0.014" Gelcoat |

2. Enclosure Sound Proofing Material

a. Sound proofing material shall be fixed to the inside faces and top of fiberglass blower enclosure using self-adhesive backing and mechanical fasteners. The sound proofing material should not be fixed to the louvers. The sound protection material shall be a multilayer of barrier and isolation material. The material used shall be tough, flexible, flame resistant, and shall be suitable to be used in moist areas and high temperatures.

b. Absorption/isolation layer shall be made of polyester or polyether foam and shall be temperature rated in the range of -45°F to 225°F. It shall have thermal conductivity coefficient of 0-25 and maximum compression set of max. 10% in conformance with ASTM D-882.

c. The exposed face of foam shall have a black matte film finish and it shall not impair the acoustical characteristics of the foam. It shall be chemical resistant and fungus resistant and shall meet the requirements of ASTM 1924-63. It shall have tensile strength of 20 psi and flame resistant in conformance with UL 94 HF- 1.

d. The barrier material shall be modified copolymer vinyl and shall be heat resistant. It shall have specific gravity of 2.75 grams per cubic centimeter and weight of 16 oz/$ft^2$.

e. The self-adhesive backing shall be pressure sensitive and shall have minimum peel strength of 6 lbs/in. width as per ASTM D903-49. The adhesive shall be temperature rated for the range of 0°F to 225°F.

f. The sound protection material shall have sound absorption coefficient of 50 to 220 Hz and average noise transmission loss shall be 30 dB.

g. The sound protection material shall be SoundMat® PBM as manufactured by SoundCoat, Santa Ana, CA., or Type Acoustical Composites as manufactured by O'Neill Industrial Corp., Milford, Ct., or equal.

**10100.03 EXECUTION**

The fiberglass enclosure and soundproofing shall be installed in accordance with the manufacturer's recommendations and as shown on the Plans.

END OF SECTION

# SECTION 10200

# LOUVERS

## 10200.01 GENERAL

A. Description

This section includes requirements for providing combination and fixed acoustical louvers, and screens.

B. Quality Assurance

1. Obtain louvers from a single source.

2. Design, engineer, fabricate, and install exterior metal wall louvers to withstand the effects of loads and stresses from wind and normal thermal movement, without evidencing permanent deformation of louver components including blades, frames, and supports; noise or metal fatigue caused by louver blade rattle or flutter; and permanent damage to fasteners and anchors.

3. Wind Load shall conform to a uniform pressure (velocity pressure) of 20 pounds force per square foot acting inward or outward.

4. Normal thermal movement is defined as that resulting from the following maximum change (range) in ambient temperature. Base design calculations on actual surface temperatures of metals due to both solar heat gain and nighttime sky heat loss. Temperature Change (Range) shall be 100 degrees F (55.5 degrees C).

5. Air performance, water penetration, and air leakage ratings shall provide louvers complying with performance requirements indicated as demonstrated by testing manufacturers stock units, of height and width indicated, according to Air Movement and Control Association (AMCA) Standard 5.

C. Submittals

1. Submit shop drawings as specified in the General Provisions.

2. Provide shop drawings of louver units and accessories. Include plans, elevations, sections, and details showing profiles, angles, spacing of louver blades; unit dimensions related to wall openings and construction; free areas for each size indicated; and profiles of frames at jambs, heads and sills.

3. Where installed products are indicated to comply with certain structural design loading, include structural computations, material properties, and other information needed for

structural analysis which has been prepared by, or under the supervision of, a qualified professional engineer.

4. Submit wiring diagrams for motor operators.

5. Provide product test reports evidencing compliance of units with performance requirements indicated.

6. Provide product certificates signed by louver manufacturers certifying that their products which comply with Project requirements are licensed to bear AMCA Seal based on tests made in accordance with AMCA Standard 500 and complying with AMCA Certified Ratings Program.

## 10200.02 MATERIALS

A. Materials

1. Manufacturers

   Available manufacturers shall be subject to compliance with requirements. Manufacturers offering products which may be incorporated in the Work include, but are not limited to, the following Fixed, Combination, and Gravity Louvers:

   a. Construction Specialties, Inc.

   b. Ruskin.

   c. Or Equal.

2. Fabrication

   a. Fabricate louvers and vents to comply with requirements indicated for design, dimensions, materials, joinery, and performance.

   b. Pre-assemble louvers in shop to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

   c. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

   d. Fabricate frames, including integral sills, to fit in openings of size indicated with allowances made for fabrication and installation tolerances of louvers, adjoining construction, and perimeter sealant joints.

   e. Include supports, anchorages, and accessories required for complete assembly.

f. Provide vertical mullions of type and at spacings indicated but not further apart than recommended by manufacturer. At horizontal joints between louver units provide horizontal mullions except where continuous vertical assemblies are indicated.

g. Provide sill extensions and loose sills made of same material as louvers, where indicated, or required for drainage to exterior and to prevent water penetrating to interior.

3. Detailed Material Requirements

a. Aluminum Extrusions shall conform to ASTM B 221, Alloy 6063-T-52.

b. Fasteners shall be of the same basic metal and alloy as fastened metal, unless otherwise indicated. Do not use metals which are corrosive or incompatible with materials joined.

i. Use types, gages, and lengths to suit unit installation conditions.

ii. Use Phillips flat-head machine screws for exposed fasteners, unless otherwise indicated.

c. Anchors and Inserts shall be of a type, size, and material required for type of loading and installation indicated. Use nonferrous metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or expansion bolt devices for drilled-in-place anchors.

d. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.

e. Jamb gasket shall be provided as the gasket between blade ends and louver jamb.

f. Combination Louvers

i. Provide adjustable blade louvers with manufacturer's recommended bearings and operating mechanisms to suit louver sizes and actuator indicated.

ii. Provide motor actuator for damper rated for 120 VAC, single phase, 60 Hz motor with integral overload where indicated on the drawings. Louver actuation shall be motor to open, spring to close. Actuator and actuator mounting plate shall be mounted outside of the free area of the louver. Actuator linkage to the damper/louver shall be provided as required to meet this requirement.

iii. Provide gravity actuator for damper where indicated on the drawings. Actuator linkage to damper/louver shall be field adjustable for flow and static pressure of louver. Louver shall be adjusted based on application and close via weight system when airflow through louver is not required. Normal outside or inside air movement shall not cause damper/louver to open.

iv. The single frame combination drainable fixed/adjustable acoustical louvers shall be drainable fixed blades and adjustable blades combined in single frame; with both blades and frames fabricated from aluminum extrusions; designed to collect and drain water to exterior at sill by means of gutters in front edges of fixed blades and of channels in jambs and mullions; complying with following requirements:

a. The total louver depth shall be coordinated with building wall depth and be flush mounted on interior and exterior wall.

b. The frame thickness shall be 0.125 inch.

c. Fixed louver blade thickness shall be 0.081 inch.

d. The adjustable louver blade thickness shall be 0.125 inch.

e. Louver blade angle shall be 45 degrees.

f. Louver performance criteria shall be based on physical data indicated in items (1) and (2) below, and testing data based on item (3) below. Physical data shall be based on a 48"x48" louver. Testing data shall be based on tests performed on a 48"x48" louver in accordance with AMCA Standard 500 and shall be used as a basis for selection of the louvers to be provided.

i. Louver free area = 6.78 square feet.

ii. Percent free area = 42.4.

iii. Free area velocity at the point of beginning water penetration (.02 oz./square foot) = 1241 fpm.

g. Fixed Louvers

i. Louvers shall be fabricated from aluminum extrusions, designed to collect and drain water to exterior at sill by means of gutters in front edges of blades and of channels in jambs and mullions, complying with the following requirements:

ii. Louver depth shall be coordinated with wall thickness and be flush mounted on interior and exterior walls.

iii. The louver frame shall be one-piece structural member of 6063-T52 Alloy, 0.064" thick with interior caulking slot and retaining beads.

iv. Mullions shall be sliding interlock type with integral drain.

v. Fixed blade thickness shall be 0.064 inch.

vi. Fasteners shall be stainless steel or aluminum.

vii. Structural supports shall be designed to carry a wind load of not less than 20 pounds per square foot.

viii. Louver performance criteria shall be based on physical data indicated in items (1) and (2) below, and testing data based on item (3) below. Physical data shall be based on a 48"x48" louver. Testing data shall be based on tests performed on a 48"x48" louver in accordance with AMCA Standard 500 and shall be used as a basis for selection of the louvers to be provided.

a. Louver free area = 7.70 square feet.

b. Percent free area = 48.1.

c. Free area velocity at the point of beginning water penetration (.02 oz./square foot) = 835 fpm.

h. Louver Screens

i. Provide louvers with screens at locations scheduled on the Drawings.

a. Screen Location for Fixed Louvers shall be on the interior face.

b. Screen Location for adjustable louvers shall be on the interior face.

c. Secure screens to louver frames with stainless steel machine screws, spaced at each corner and at 12-inch o.c. between.

d. Fabricate screen frames with mitered corners to louver sizes indicated.

i. Metal shall be the same kind and form of metal as indicated for louver frames to which screens are attached. Reinforce extruded aluminum screen frames at corners with clips.

ii. The finish shall be the same finish as louver frames to which louver screens are attached.

iii. Provide re-wireable frames with a driven spline or insert for securing screen mesh.

ii. Fit aluminum louver screen frames with screening covering louver openings and complying with the following requirements:

a. Bird Screening shall be 1/2-inch square mesh formed with 0.063-inch diameter aluminum wire.

b. Insect screening shall be 18 mm x 14-mm aluminum mesh formed with 0.0123- inch diameter aluminum wire.

i. Blank-Off Panels

i. Fabricate blank-off panels from materials specified and to sizes indicated.

ii. The finish shall match finish applied to louvers with respect to coating type, color and gloss.

iii. Attach blank-off panels to back of louver frames with stainless steel sheet metal screws.

iv. Insulated blank-off panels shall be fabricated from laminated metal-faced panels consisting of insulating core surfaced on back and front with metal sheets; complying with the following requirements:

v. The thickness shall be 1 inch.

vi. Metal facing sheets shall be aluminum sheet, 0.032 inch thick.

vii. Insulating core shall be extruded polystyrene insulation board insulation complying with ASTM C 578, Type VII (2.2 lb/cu. ft. density).

viii. Trim perimeter edges of blank-off panels with louver manufacturer's standard extruded aluminum channel frames 0.081 inch thick, with corners mitered and with same finish as panels.

j. Aluminum Finishes

i. Finish designations shall conform to the system established by the Aluminum Association for designating aluminum finishes.

ii. The high-performance organic coating shall be the Fluorocarbon 2-Coat Coating Systems using the manufacturer's standard 2-coat thermo-cured system, composed of specially formulated inhibitive primer and fluorocarbon color topcoat containing not less than 70 percent polyvinyldene resin by weight; complying with AAMA 605.2.

iii. Color and gloss shall be PPG Duranar Low Gloss, color to be selected by the Engineer.

k. Louvers shall be acoustical type.

## 10200.03 EXECUTION

A. Installation

1. Preparation

a. Coordinate delivery of drawings, diagrams, templates, instructions, and directions for installation of anchorages which are to be embedded in concrete or masonry

construction.

b. Locate and place louver units' plumb, level, and in proper alignment with adjacent work.

2. Use concealed anchorages where possible. Provide brass washers fitted to screws where required to protect metal surfaces and to make a weather tight connection.

3. Form closely fitted joints with exposed connections accurately located and secured.

4. Provide perimeter reveals and openings of uniform width for sealant and joint fillers, as indicated.

5. Repair finishes damaged by cutting, welding, soldering, and grinding operations require for fitting and jointing. Restore finishes so there is no evidence of corrective work. Return items which cannot be refinished in field to shop, make required alterations and refinish entire unit, or provide new units.

6. Install concealed gaskets, flashing, joint fillers, and insulation, as louver installation progresses where required to make louver joints weather tight.

7. Contractor shall coordinate size and locations with new fans and ductwork.

B. Adjusting and Protection

1. Protect louvers from damage of any kind during the construction period including use of temporary protective coverings where needed and approved by the louver manufacturer. Remove protective covering at time of Substantial Completion.

2. Restore louvers damaged during installation and construction period, so that no evidence remains of correction work. If results of restoration are unsuccessful, as judged by the Engineer, remove damaged units and replace them with new units.

C. Cleaning

1. Periodically clean exposed surfaces of louvers and vents that are not protected with temporary covering to remove dirt and fingerprints during the construction period. Do not let soil accumulate until final cleaning.

2. Before final inspection, clean exposed surfaces with water and mild soap or detergent not harmful to finishes. Rinse surfaces thoroughly and dry.

END OF SECTION

# SECTION 10520

# FIRE EXTINGUISHERS

## 10520.01 GENERAL

A. Description of Work

Furnish and install fire extinguishers, brackets and accessories as specified herein.

B. Submittals

Product Data: Submit manufacturer's technical data and installation instructions for all fire extinguishers required, in accordance with Section 5.04 of the "General Provisions".

## 10520.02 PRODUCTS

A. Fire Extinguishers

1. Provide 2 fire extinguishers for the project. Mounting locations shall be determined by the Engineer.

2. Fire extinguishers shall be mounted and equipped with gauges that indicate degree of change.

3. The fire extinguishers shall be 20 lb capacity, dry chemical type and be effective on Class A, B and C fires. The fire extinguishers shall be the Kidde Model Pro 20, TCM-2 or equal.

## 10520.03 EXECUTION

A. Inspection

Examine the substrates and conditions under which the firefighting devices are to be installed, and notify the Engineer 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. Comply with the requirements of NFPA 10.

B. Installation

Install fire extinguishers in locations as directed by Engineer. Securely fasten to structure, square and plumb, in accordance with manufacturer's instructions.

C. Mounting height, no more than 5 feet to top of bracket from the ground but no lower than 4” above the floor.

END OF SECTION

# SECTION 10600

# SAFETY EQUIPMENT

## 10600.01 GENERAL

A. Description

This section includes the requirements for providing climbing safety devices for ladders, where required by OSHA regulations, 29 CFR Parts 1910, and first aid kit to the extent indicated in the Contract Documents. A ladder safety or personal fall protection system is required when ladder height is greater than 24 feet.

B. Submittals

1. Submit certification that climbing safety devices comply with all applicable sections of OSHA Regulation 1910.27 (requirement for fixed ladders).

2. Submit first aid kit shop drawings in accordance with Section 5.04 of the General Provisions.

C. Delivery, Handling and Storage

1. Identify, and match mark if applicable, all materials, items and fabrications for installation and field assembly.

2. Whenever practicable, deliver items to the job site as complete units, ready for installation or erection, with all anchors, hangers, fasteners and miscellaneous metal items required for installation.

3. Provide adequate storage facilities at the job site for the protection and storage of all delivered materials. Handle and store in such a manner as to not damage factory finishes. Repair damaged finishes at no cost to the Owner.

## 10600.02 MATERIALS

A. Materials

1. Ladder Climbing Safety Device
   All materials of construction for climbing safety devices shall be new and of the highest grade. All materials shall be free from defects prior to installation. Ladder safety rail system shall be Railok Safety Rail by Research & Trading Corporation, Saf- T-Climb by Norton, Co., TS Fall Prevention System by TS Products Incorporated or equal.

2. Rail Fittings
   a. Rail and fittings shall be fabricated from aluminum.

b. Splices in rail shall be located at 6 foot intervals minimum, 20 foot intervals maximum.

c. Splices shall be formed with no less than 4 fasteners to assure a rigid and true connection. Splice shall not interfere with ascent or descent of traveling rail sleeve.

d. Rail mounting brackets shall be shaped to fit the rung diameter of ladders as shown on the Contract Documents.

e. Fasteners and lock washers shall be made from type 18-8 stainless steel.

f. Rail system shall be designated to withstand a 300-pound weight dropping through 24 inches of free fall.

3. Rail Extension

a. Provide a removable rail extension complete with all required fittings and connectors.

b. Rail extension system materials shall be aluminum.

c. A mandrel shall be permanently affixed to the ladder supported climbing rail. The rail extension shall engage the mandrel for a minimum of 6-inches.

d. When in place the extension rail shall extend 3 feet 6 inches above top ladder access level.

4. Rail Sleeve (when required by safety regulations)

a. Rail sleeves shall be designed to move freely both up and down on the rail. A maximum of 5 lbs. upward pull shall be exerted to slide the sleeve over the rail. Stainless steel roller bearings shall be mounted integrally with the sleeve where sleeve contacts the rail during ascent.

b. Sleeve shall lock positively to the rail by any downward force of greater than 50 pounds in not more than 6 inches of fall.

c. Sleeve shall have a snap hook device made of drop forged steel proof load tested to 5,000 pounds. Snap hook shall be permanently connected to the sleeve.

d. Two rail sleeves shall be furnished.

5. Safety Belt (when required by safety regulations):

a. Safety belt shall be a Class 1 body belt conforming to ANSI A10.14.

b. Belt shall be constructed of a polyester or nylon webbing attached to a 3" body pad. A 3/8" D-ring located at the 10 o'clock position shall be constructed of a drop forged steel capable of withstanding a 5,000 pound force without failure.

c. Two safety belts shall be furnished.

2. Grab Tree

a. Provide a safety grab tree with schedule 40 stainless steel with base plate.

b. Minimum three grab bars at both directions, 1" dia. with machine knurled surface for slip resistance, total height not to exceed 3 feet.

c. Stainless steel base plate shall be with 4 ½" Hilti KWIK Bolts TZ, stainless steel expansion anchor bolts or approved equal.

## 10600.03 EXECUTION

A. Installation

1. Rail system shall be installed in accordance with manufacturer's recommendations.

   Rail shall be fastened to the ladder at the top, bottom and at 4 foot intervals, maximum. Rail shall be located along outside vertical center of all ladders.

2. First aid kit shall be wall mounted, square and plumb a distance of 40 inches from bottom of kit to floor.

B. Testing

1. Each sleeve shall be tested to ensure positive locking and strength under a 500 pound static load. Dynamic test of each sleeve shall subject the sleeve to a force of 300 pounds falling through 24 inches.

2. Replacement of safety devices not fulfilling test requirements shall be at no cost to the County.

3. The Contractor shall furnish the Engineer certification that all safety equipment has been tested as described hereinbefore.

END OF SECTION

# SECTION 11310

# SOLID HANDLING SEWAGE PUMPS

## 11310.01 GENERAL

A. Description

1. Work performed under this section includes furnishing and installing non-clog sewage pumps and accessories.

2. Vibration design and installation requirements for rotating equipment in accordance with Section 15990 shall also apply to work performed under this section.

3. Field vibration testing shall be performed on the sewage pumps in accordance with Appendix F of these specifications.

4. Pump and major components specified herein shall be the product of a single manufacturer. The pumps shall not overload the motors at any point on the pump curve within the operating limits recommended by the pump manufacturer.

B. Submittals

1. Shop Drawings

   a. Submit shop drawings for the sewage pumps in accordance with Section 5.04 of the General Provisions. Shop drawings for the sewage pumps shall include pump performance curves by the pump manufacturer for the pumps to be supplied, showing model number, pump size, impeller diameter, RPM, head, horsepower and efficiency versus capacity for the specified operating conditions. Design point shall be clearly marked on the curves. Shop drawings must clearly show that pump impeller supplied is capable of passing a minimum 3-inch solid sphere.

   b. Shop drawings for the sewage pump motors shall include motor performance data, certified by the manufacturer, including manufacturer, model number, voltage and Hertz rating, full-load amperage, motor enclosure type, insulation class, efficiency and power factor at 50, 75, 100 and 115 percent of rated full load for each motor.

   c. Shop drawings for the sewage pumps and motors shall also include shaft dimensions.

2. Operating and Maintenance Data

   Operation and maintenance data shall be submitted for the sewage pumps in accordance with GP5.04.8 of the General Provisions.

3. Manufacturer's Instruction/Field Services

    a. Manufacturer's instructions shall be provided for the sewage pumps as follows:

    b. Provide the services of a manufacturer's representative experienced in the installation, maintenance, and operation of the equipment supplied under this specification for installation inspection, start-up, the specified testing, and for instructing the Owner's personnel in the operation and maintenance of the equipment.

    c. The number of man days of these services and trips to the project site shall be as required to successfully complete all of the installation, start-up, and testing requirements specified herein.

    d. Instruction of the Owner's personnel in the operation and maintenance of the equipment shall be performed over two (2) 8-hour workdays.

4. Submit certificates of compliance that materials comply with the requirements stipulated herein.

5. Manufacturers special requirements regarding vibration considerations/data or instructions shall be submitted as part of the shop drawing review.

1. Certified factory pump performance curves shall be provided and approved by the Engineer before the pumps are shipped. Testing for certification shall be in accordance with Hydraulic Institute Level IU.

2. Submit factory certifications that pump impellers and motor rotors have been dynamically balanced in accordance with Section 15990 or as otherwise specified herein. These certifications shall be provided and approved by the Engineer before the pumps are shipped. The certifications shall include the standard to which the items were balanced and the shop balancing results. All measurements shall be presented in ounce-inches, inches/second vibration velocity, or vibration amplitude displacement in mils.

3. Manufacturer's Certificates that the installation of the equipment is in accordance with the manufacturer's recommendations shall be secured by the Contractor and submitted to the Engineer.

## 11310.02 MATERIALS

A. Wet Pit Submersible Sewage Pumps (where indicated)

The pumps shall be capable of handling raw, unscreened sewage. The discharge connection elbow shall be permanently installed in the wet well. The pumps shall be automatically connected to the discharge elbow when lowered into place. Sealing of the pump to the Class 35 cast iron discharge connection elbow shall be accomplished by a downward motion of the pump. A sliding guide bracket shall be an integral part of the pump, and the entire weight of the pump shall be guided by two 316 stainless steel guide bars pressed tightly against the discharge connection elbow. No portion of the pump shall bear directly on the

floor of the wet well. The pump, with its appurtenances and cable, shall be capable of continuous submergence underwater to a depth of 65 feet without loss of watertight integrity.

1. Design Conditions for Submersible Wastewater Pumps

    a. Number of Units

    b. Discharge size, minimum

    c. Minimum spherical solids pump will pass three inches

    d. Efficiency at design capacity, minimum

    e. Pump speed (1800 RPM Max.)

    f. Motor horsepower

    g. Design Capacity – flow (GPM)

    h. Design Pressure – head (Feet)

    i. Normal operating range

    j. Minimum submergence required to meet NPSH requirements.

2. Pump Construction

    a. Major pump components shall be of gray cast iron Class 35 (minimum), the smooth surfaces devoid of blow holes and other irregularities. All exposed nuts and bolts shall be of 316 stainless steel construction. All surfaces coming into contact with sewage, other than stainless steel shall be protected by an approved sewage resistant coating.

    b. The pump-motor shaft shall be of high-strength stainless steel turned, ground and polished. Shaft rotation shall be clockwise when the installed pump is viewed from above. Shafts shall be of ample strength and stiffness to avoid excessive shaft deflection or vibration throughout the specified service range. Shaft design shall be such that the amplitude of shaft deflection shall not exceed 0.002 inches at the lower shaft seal under the specified operating condition.

    c. Each pump shall be provided with a double mechanical shaft seal system. The upper seal shall be running in an oil reservoir. The upper seal shall be a stationary tungsten-carbide or silicon-carbide seal with rotating tungsten-carbide or silicon- carbide ring. The lower seal shall be tungsten-carbide or silicon-carbide running in the pumped fluid.

    d. The impeller shall be of ASTM A-48 cast iron, minimum Class 35, statically and dynamically balanced as specified in Section 15990, double shrouded non-

clogging design having a long thru-let without acute turns. The impeller shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in normal sewage applications. The impeller shall be a one or two vane design. The impeller shall be capable of passing a minimum three inch solid sphere. The fit between the impeller and the shaft shall be a sliding fit with one key and shaft end cap bolt. The impeller shall be fitted with a replaceable non-galling heat-treated 400 series stainless steel wear ring with a Brinell Hardness Number (BHN) of not less than 300.

e. The pump volute case shall have a replaceable non-galling heat-treated 400 series stainless steel wear ring to maintain accurate suction end clearances between the impeller shroud and pump case. The casing ring hardness shall exceed the impeller ring hardness by at least 100 BHN.

f. The bearing nearest the impeller shall be designed to carry the maximum hydraulic radial loads encountered under the service conditions. The thrust bearing shall be designed to carry the maximum pump hydraulic axial thrust and dead load thrust. All bearings shall be rated in accordance with AFBMA L-10 life of not less than 50,000 hours at the most severe loads imposed by the specified continuous duty conditions.

g. Pump Motor

The pump motor shall be a squirrel-cage, induction, cast iron shell type design with Class F insulation, housed in an air-filled, or positive oil circulated watertight cooling jacket. The motor shall be constructed meet Class I Division I, Group D requirements. The motor shall be designed for continuous duty, capable of sustaining a minimum of 10 starts per hour and have a minimum service factor of 1.15. Within the normal operating range, the motor shall not draw more than ____amps at nominal voltage at utility supply quality. At full load speed, the motor shall deliver its rated horsepower at an efficiency not less than_ and a power factor not less than____. The motor shall be suitable for____ volt, 3- phase, 60 Hertz service as indicated on the drawings. The pump motor shall be statically and dynamically balanced as specified in Section 15990.

3. Slide Rail Pump Removal System

a. Guide rails shall be Schedule 40, 316 stainless steel pipe. The pumps shall be automatically and firmly connected to the discharge connection by no less than two guide rails extending from the top of the wet well to the discharge elbow connection.

b. The discharge elbow connection assembly shall be of Class 35 (minimum) cast iron. Anchor bolts shall be 316 stainless steel and shall be epoxy encapsulated anchor bolts. No portion of the pump shall bear directly on the wet well floor.

c. Provide stainless steel lifting cable of adequate strength to lift pumps. Lifting cable shall be strung between a 316 stainless steel hook mounted at the top guide rail bracket and the pump lifting bail. Cable ends shall be readily removed and reattached. All

attachment hardware shall be 316 stainless steel.

d. Guide rail brackets and fasteners shall be 316 stainless steel.

4. Manufacturer

Submersible wastewater pumps shall be Model _____, with Code manufactured by ITT Flygt Corporation, KSB, or WILO.

5. Spare Pump

Provide a complete spare pump. The spare pump shall be provided with a stamped or engraved stainless steel tag with the project name and month/year of delivery. The tag shall be ¾" wide by 2" long with ¼" high lettering and attached to the pump lifting bail with a stainless steel wire tie.

6. Nameplate Data

Each pump and motor shall be supplied with a stainless steel nameplate listing the following motor data:

a. Manufacturer

b. Model number

c. Serial number

d. Date of manufacture

e. Capacity and Head

f. Horsepower rating

g. Nominal speed, RPM

h. NEMA code letter

i. Insulation Class

j. Operating voltage and running amperage

k. Final impeller diameter and impeller code

7. Pumps, slide rail assemblies and discharge connection elbows shall be installed in conformance with the manufacturer's recommendations.

B. Vertical Built-Together Dry Well Sewage Pumps

1. The pumps shall be vertical built together type where the impeller is directly mounted to the motor shaft. The pumps shall be non-clog type of heavy cast iron construction and specially designed for the use of mechanical seals. Suction and discharge flanges shall be flanged, faced and drilled to 125-lb American Standard.

2. The pumps shall be capable of handling raw, unscreened sewage and meet the following design criteria:

    a. Discharge size, (minimum 4-inches)

    b. Suction size

    c. Minimum spherical solids pump will pass (minimum 3-inches)

    d. Efficiency at primary design capacity, minimum

    e. Pump speed (1800 RPM Max.)

    f. Motor horsepower

    g. Capacity – flow, head

    h. Normal Operating Range

    i. NPSH Required (max, design flow)

3. Pump Construction

    a. Major pump components shall be of gray cast iron, ASTM A-48, Class 35 (minimum) with smooth surfaces devoid of blow holes and other irregularities. All exposed nuts and bolts shall be of 316 stainless steel construction. All surfaces coming into contact with sewage, other than stainless steel, shall be protected by an approved sewage resistant coating.

    b. The pump/motor shaft shall be solid one-piece stainless steel, minimum 100,000 PSI tensile strength and 75,000 PSI yield strength. The shaft from the top of the impeller to the lower bearing supporting the impeller shall have a minimum diameter of 2-1/4 inches not inclusive of the shaft sleeve diameter if provided. Shaft design shall be such that the amplitude of shaft deflection shall not exceed 0.002" at the lower shaft seal under the worst operating conditions imposed by the design points on this project. When provided, shaft sleeves shall be hardened 400 Series stainless steel. The shaft shall rotate clockwise when the pump is installed and viewed from above.

    c. Each pump shall be provided with a double carbon-ceramic mechanical shaft seal and housing with registered fit. For special applications, other seal materials shall be available. The mechanical seal housing shall be constructed of bronze or stainless steel with a registered fit. Seal springs and hardware shall be stainless steel with Buna-N or EPR elastomers. The housing shall be recessed into the pump backhead and securely fastened with stainless steel cap screws or stainless-steel studs with bronze nuts. The seal shall be pressurized and lubricated by filtered water taken from the pump backhead or volute discharge nozzle. The seal system shall incorporate a filter of corrosion resistant materials to screen out all solids larger than 50 microns. Filter shall be as manufactured by Schrade, or equal. The filter water line shall be 3/8” using stainless steel nipples and isolation ball valve between the pump and filter and 3/8” polyethylene tubing with compression fittings between the filter and mechanical seal housing. The

mechanical seal housing shall also be provided with a mechanical seal vent with manually operated brass valve.

d. The pump volute case shall be of gray cast iron, ASTM A-48, Class 35(minimum) with smooth surfaces devoid of blow holes and other irregularities. The pump volute casing shall also contain a replaceable front head/ suction plate with field- replaceable non-galling heat-treated 400 series stainless steel wear ring to maintain accurate suction end clearances between the impeller wear ring and pump case wear ring. The casing ring hardness shall exceed the impeller ring hardness by at least 100 BHN. The volute casing shall be provided with a minimum 3/8" tap for pump venting and priming unless otherwise indicated. Provide volute casing handhole cleanout where available. The volute shall be coated with an erosion resistant, ceramic coating where available.

e. The impeller shall be of gray cast iron, ASTM A-48, Class 35 (minimum), and shall be statically and dynamically balanced in to ISO 1940/1-1986E Grade 2.5 or better. The impeller shall be double-shrouded non-clogging design having a long thru-let without acute turns. The impeller shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in normal sewage applications. The impeller shall be a two or three vane design and shall rotate clockwise when the pumps are installed and viewed from above. The impeller shall be capable of passing a minimum 3-inch solid sphere. The impeller shall have a tapered fit to the shaft, be keyed and secured to the shaft by a stainless-steel cap bolt equipped with a self-locking device. The impeller shall not be screwed or pinned to the motor/pump shaft and shall be readily removable without the use of special tools. Impeller trimming to meet design conditions shall be applied to the vanes alone. Final impeller diameter shall be stamped on nameplate. Impeller shrouds shall not be trimmed and shall remain full diameter. The impeller shall be fitted with a replaceable 400 series non- galling heat-treated stainless steel wear ring with a Brinell Hardness of no less than 300. Impellers shall be provided with an erosion resistant ceramic epoxy coating where available.

f. Each pump shall have a one-piece cast iron ASTM A48, Class 30 or 35 backhead and motor adaptor with impeller adjustment cap screws and to adjust clearances between the impeller and the volute suction cover. The pumps shall be arranged so that the rotating assembly (motor, shaft, backhead and impeller) can be easily removed from the pump volute without disassembly. Multiple motor fits shall be provided to accommodate the largest motor required by the pump at the specified RPM.

g. The bearing nearest the impeller shall be designed to carry the maximum hydraulic radial loads encountered under the service conditions. The thrust bearing shall be designed to carry the maximum pump hydraulic axial thrust and dead-load thrust. All bearings shall be grease lubricated and shall be rated in accordance with AFBMA L-10 life of not less than 100,000 hours at the most severe loads imposed by the specified continuous duty conditions.

h. Pump base construction shall be of the rigid, heavy-duty cast iron pedestal or ring base design with ribs or bracing to prevent distortion of machine surfaces when the pumps are mounted against a soleplate as shown on the drawings. The mounting feet on the pedestal bases shall be machined flat with tolerances of no more than +/-0.002 inches difference between mounting pads.

i. Provide a pump suction elbow of gray cast iron, ASTM A-48, Class 35 (minimum) of long swept reducing design to help insure smooth flow into the impeller. Provide a minimum ½" NPT tap for pump draining (unless otherwise shown) and handhole cleanout where available.

4. Pump Motor

a. The pump motors shall be NEMA P-base, vertical, solid shaft, squirrel-cage induction type, suitable for 3-phase, 60 cycle, 460-volt power supply. They shall be continuous duty rated, have Class F insulation, suitable for temperatures up to 115 degrees C with temperature rise limited to 40 degrees C above ambient without exceeding an insulation temperature limit of 90 degrees C. The motors shall have normal starting torque and low starting current as specified for NEMA Design B characteristics. Motors shall be cast iron construction, open drip- proof, premium efficiency design with forced air ventilation by integral fan. Leads shall be terminated in a cast connection box and clearly identified. The motors shall have a 1.15 service factor and shall not be overloaded at any head with the operating range as specified in the design conditions. The motor shaft diameter at the mechanical seal shall be a minimum diameter of 2-1/4 inches not inclusive of the shaft sleeve diameter if provided The motor shall be fitted with at least two lifting eyes, each capable of supporting the entire weight of the pump and motor.

b. Pump motors applied to Variable Frequency Drives (VFD) shall be "Inverter Duty" rated and shall meet the power quality levels of NEMA MG-1, 1993, Part 31. Motors applied in VFD service need not be premium efficiency. On VFD applications motors 100 hp or greater shall be provided with isolated bearings to prevent shaft currents and electrical discharge pitting of bearings.

c. The motor rotor shall be statically and dynamically balanced to a Special Balance tolerance to give a vibration amplitude of no more than 0.8 mils measured on the bearing housings at operating RPM and no load when tested at the factory. If the motor manufacturer's standard tolerances are more stringent, then they shall apply.

5. Manufacturer

Sewage pumps shall be Model_____with impeller_____as manufactured by Smith and Loveless, Cornell, or Flygt.

6. Nameplate Data

Each pump shall be supplied with a stainless steel nameplate listing the following pump data:

a. Manufacturer and model number

b. Pump Size

c. Design Capacity & Head

d. Serial number

e. Date of manufacture

f. Horsepower rating

g. Nominal speed, RPM

h. Impeller diameter

Each motor shall be supplied with a stainless steel nameplate listing the following motor data:

i. Manufacturer

j. Model number

k. Serial number

l. Horsepower rating

m. Frame Number

n. NEMA Code Letter

o. Insulation Class

p. Operating voltage and amperage

q. Full load speed

r. Enclosure Type

s. Bearing information

7. Spare Parts

a. The following spare parts shall be supplied for the wastewater pumps:

i. (1) Impeller (dynamically balanced) with wear ring, Impeller Key and Impeller Retaining Cap Bolt

ii. (2) Seal Filter Elements

iii. (2) Volute Gaskets

iv. Set Double Mechanical Seals

v. Shaft sleeve

vi. Set of Wear Rings

b. Spare parts shall be packaged for long-term storage in heavy-duty cardboard or wooden

boxes. Boxes shall be clearly labeled with typed or printed labels identifying the name of the plant, project description, equipment name, part manufacturer, part number, part description and part quantity contained in the packaging.

C. Miscellaneous

1. All bearings, except those specifically requiring oil lubrication, shall be pressure grease lubricated. All lubrication points shall be readily accessible, away from locations dangerous to workmen. Pressure grease lubrication fittings shall be the "Hydraulic" type. The pattern of the fitting shall be selected for accessibility in lubrication and shall be acceptable to the Engineer. The Contractor shall furnish two hydraulic guns compatible with the fittings used.

2. If the top motor bearing grease fitting located behind or under the motor cooling fan hood, the grease lines and fittings shall be extended outside the hood. Removal of cooling fan hoods to lubricate bearings is not acceptable.

3. Special tools shall include any type of tool that has been specially made for use on an item of equipment for assembly, disassembly, repair or maintenance. All special tools that are required to assemble, disassemble, repair or maintain any mechanical equipment shall be furnished with the equipment.

## 11310.03 EXECUTION

A. General

1. Pump foundation shall be installed as designed with the baseplates flat and level in both directions.

2. Installed pump shall be free of piping strain. To check for piping strain, piping flanges shall be loosened up separately with flange movement observed continuously. Should movement exceed 1/8 inch, piping strain is considered excessive and shall be corrected by adding or adjusting pipe supports, hangers, expansion joints, etc. Installation of piping at pump casing connections shall be in accordance with Section 15210, Subsection .03 A, with particular attention to sub-item 12.

3. Pump support stand shall be resting firmly on the mounting bases and soleplates with equal loading on each support.

4. Pump support stand, base plate pads and soleplates shall be free of burrs, rust and obstructions.

5. When required stainless steel pre-cut shims shall be used to provide a firm, solid, adjustable link between pump and base plate.

6. Pump mounting feet and surfaces must be free of soft foot. To check for soft foot, the pump must be firmly bolted to the base plate. Each support foot is checked with the dial indicator or feeler gauges, loosening hold down bolts one at a time. If movement exceeds 0.003 inches, soft foot is indicated. Shim and torque uniformly to minimize soft foot.

7. After erection the Contractor shall demonstrate that all equipment is operating in a satisfactory manner. All adjustments shall be made to suit anticipated station operating conditions. Each piece of machinery shall be tested to show that it operates quietly without excessive vibrations, overheating, or signs of distress at specified capacity. The Engineer shall be notified in advance of all tests, and all tests shall be conducted to his entire satisfaction. Pump vibration testing and pump performance testing shall be done in the presence of a County Vibration Specialist and in accordance with Section 15990 and the Appendices of these specifications.
   a. The flowrate (GPM) shall be obtained from a calibrated sewage pumping station flow meter or by a volume over time calculation. The flowrate obtained from a flow meter shall be the average flow rate observed during the complete pump on and pump off cycle. The flowrate derived from a volume over time calculation shall include the complete pump cycle volume (pump on to pump off) plus the inflow over the observed time period.

8. Any drywell-mounted motor or pump that becomes submerged or damaged before final acceptance shall be replaced at no cost to the Owner.

9. Provide stainless steel pump casing vents and drains as indicated in Contract Drawings.

B. Coatings

1. All exposed ferrous materials, except stainless steel, shall be painted in accordance with Section 09900 PAINTING.

2. Coat all bolt threads prior to assembly with a compound to prevent seizing.

END OF SECTION

# SECTION 11320

# WET-WELL MOUNTED SEWER PUMPING STATION

## 11320.01 DESCRIPTION

A. Work performed under this section includes furnishing and installing one factory-built, automatic vacuum prime pump station as manufactured by Smith-Loveless, Inc. The station shall be complete with all needed equipment, factory- installed on a welded steel base with fiberglass cover. The packaged pumping station must adhere to the same regulatory agency standards as those listed under Section 16010 including UL listing for the wet well mounted pumping station supplied on this contract will comply with the above requirements.

1. The principal items of equipment shall include two vertical, close-coupled, motor driven, vacuum primed, non-clog pumps; valves; internal piping; central control panel with circuit breakers; motor starters; heater; ventilating blower; priming pumps with "Sonic Start" pump prime detection system and appurtenances all wiring and terminal strip for interfacing PLC/Bubbler wet well level control system with the Smith & Loveless central control panel.

2. PLC/Bubbler level control system for pump station operation shall be in accordance with Division 16, and as indicated on the Contract Drawings.

3. The package station and all components shall comply with NFPA 820 requirements.

B. Submittals

1. Shop Drawings

a. Submit shop drawings for the sewage pumps in accordance with the County Standard Specifications Section 5.04 of the General Provisions. Shop drawings for the sewage pumps shall include pump performance curves certified by the pump manufacturer, showing head, horsepower and efficiency versus capacity. Design point shall be marked on the curves. Shop drawings for the sewage pump motors shall include motor performance data, certified by the manufacturer, including efficiency and power factor 50, 75, 100, and 115 percent of rated full load for each motor. Shop drawings for sewage pump and motor shall also include shaft dimensions, shaft deflection, bearing manufacturers part number and size and bearing life calculations for the specified operating conditions. Shop drawings must clearly show that pump impeller supplied is capable of passing a minimum 3 – inch solid sphere. Shop drawings shall also include complete parts lists and Bill of Materials for the supplied equipment and components.

2. Operating and Maintenance Data

a. Operating and maintenance data shall be submitted for the sewage pumps in accordance with County General Provisions and as identified in the Contract Documents. The Final O & M shall also include the results of the field pump performance testing.

3. Manufacturer's Industry/Field Services

    a. Manufacturer's Instructions shall be provided for the sewage pumps as follows:

        i. Provide the services of a manufacturer's representative experienced in the installation, maintenance, and operation of the equipment supplied under this specification for this installation inspection, start-up, the specified testing, and or instructing the Owner's personnel in the operation and maintenance of the equipment.

        ii. The number of man days of these services and trips to the project site shall be as required to successfully complete all of the installation, start-up, and testing requirements specified herein.

    b. Instruction of the Owner's personnel in the operation and maintenance of the equipment shall be performed over two (2) 4-hour sessions.

4. Certificates of Compliance

    a. Submit certificates of compliance that materials comply with the requirements stipulated herein.

    b. Prior to the shipment, the manufacturer shall provide the pump rotor and motor balance certifications for the pump and motor. The certification shall state that the pump and motor meet the balance requirements as specified in Section 15990.

5. Manufacturers special requirement regarding vibration considerations/data or instructions shall be submitted as part of the shop drawing review.

C. Spare Parts

A complete replacement mechanical shaft seal assembly shall be furnished with the pump station. The spare seal shall include complete Installation Instructions. A spare casing gasket and seal shall be provided. One (1) Sonic Start prime level sensor shall be furnished. All spare parts shall come packaged for long time storage. Containers shall be labeled with the pumping station name, part number(s), quantities and description of parts contained herein.

## 11320.02 MATERIALS

A. General

1. Pump and major components specified herein shall be the product of a single manufacturer. The pump shall not overload the motors at any point on the pump performance curve within the operating limits recommended by the pump manufacturer. To obtain operation with the lowest vibration possible, major rotating components of each pump shall be dynamically balanced in accordance with Section 15990.

B. Design and Performance Requirement

1. Fluid pumped – raw unscreened sewage
2. Number of Units – 2
3. Discharge Size – (to be completed during Design)
4. Suction Nozzle Size – (to be completed during Design)
5. Solids size pumps will pass (inches) –3 inches (minimum)
6. Motor Horsepower – (to be completed during Design)
7. Pump Speed (1800 Max) – (to be completed during Design)
8. Shut-off Head at full speed – (to be completed during Design)

C. Design Conditions with Force Main:

1. Design Capacity at (DESIGN) rpm = (DESIGN)
2. TDH (feet) at Design Capacity = (DESIGN)
3. Min. Pump Efficiency @ Design Capacity = (DESIGN)
4. Max. Static Suction Lift (feet) = (DESIGN)

D. Pump Station Construction

1. The station shall be constructed in one complete, factory-built assembly. It shall be sized to rest on the top of the wet-well as well as detailed in the construction drawings. The supporting floor plate shall be minimum 3/8" thick steel with reinforcing, as required, to prevent deflection and ensure an absolutely rigid support. Steel plate shall meet or exceed ASTM A-36 specifications.

2. The pump station shall be enclosed by a hinged fiberglass cover made of molded reinforced orthophthalic polyester resins with a maximum of 30 % glass fibers with a minimum average length of 1 – ¼". The outside of the closure shall be coated with a polyester protective in-mold coating for superior resistance to weathering, ultra-violet radiation, yellowing and chalking. The completed fiberglass enclosure shall by resistant to mold, mildew, fungus, and corrosive liquids and gasses normally found in pump station environments. The dimensions of the enclosure shown on the drawings shall be considered a minimum, for internal component clearances and accessibility, and nothing smaller will be acceptable. The cover shall have a suitable drip-lip around the edge and shall be provided with a stainless hasp and staple connection to the floor plate to allow the pump chamber to be locked with a padlock.

3. The cover shall be attached with a multi segment stainless steel hinge, constructed of 7 gauge (minimum) type 304 stainless steel with 3/8" diameter stainless steel pin and supporting at least 75 % of the width of one end. Stainless steel bolts with tamperproof heads and a full 3/8" thick anodized aluminum backing plate shall anchor the hinge to the fiberglass cover. The cover shall be gasketed to minimize sewer gas leakage into the enclosure to meet NFPA 820 requirements.

4. Dual high pressure gas struts shall be provided to counteract the dead weight of the cover assembly and limit the maximum lifting force required for the opening to less than 20 pounds. The cover shall be self-latching upon opening, with a manually operated release for closing. Duplex heavy gauge stainless steel safety chains shall be provided to prevent over-extension. All hardware and components of the cover assembly which are exposed to the weather shall be constructed of aluminum or stainless steel, adjustable ventilating louvers shall be provided on each end of the fiberglass cover, which are capable of being closed during cold weather operation.

5. A gasketed, domed, gas-tight, aluminum or stainless-steel wet well access cover located exterior to the fiberglass pump chamber shall be provided. The cover shall be complete with stainless steel hinges, and "dogged handwheel" with strong back mechanism and hardware padlocking provisions. The 24" diameter manway shall be an integral part of the station floorplate and provide access to the wet well.

6. The manway cover shall have a three color 7" X 10" (minimum) corrosionresistant sign permanently affixed to it, reading "Danger – Before Entering, Test for Explosive Gasses. Test for Oxygen Deficiency. Supply Fresh Air to Work Area".

7. Enclosures utilized to house the valve train and / or controls, which are defined under OSHA Article 29CFR Part 1910 as a Confined Space shall not be acceptable.

8. The pump casings and discharge piping shall be mounted in relation to the floor plate as detailed in the construction drawings. The suction and discharge connections, where they pass through the floor shall be sealed by gaskets, rather than being welded, to allow adjustment and replacement.

9. All steel structural members shall be joined by electric arc welding with welds of adequate section for the joint involved. Structural welding shall be performed in accordance with AWS standards and procedures.

E. Protection Against Corrosion

1. All structural steel surfaces shall be factory blasted with steel grit, in an environmentally controlled booth, to remove rust, mill scale, weld slag, etc. Sandblasting is specifically prohibited. All weld spatter and surface roughness shall be removed by grinding. Surface preparation shall comply with SSPC-SP6 specifications. Immediately following cleaning, a single 6-mil dry film thickness of VERSAPOX, a self-priming Cycloaliphatic Amine Epoxy, shall be factory applied. This coating is formulated by Smith & Loveless for abrasion and corrosion resistance.

2. Stainless steel, aluminum and other corrosion-resistant surfaces shall not be coated. Carbon steel surfaces not otherwise protected shall be coated with a suitable non-hardening rust preventative compound. Auxiliary components such as the electrical enclosure, ventilating blower and vacuum pumps shall be furnished with the original manufactures coating.

3. Finish coating shall be accomplished prior to shipment of the station from the factory and shall comply fully with the intent of thesespecifications.

    a. A touch-up kit shall be provided by the pump station manufacturer for repair of and mars or scratches occurring during shipping and installation. This kit shall contain detailed instructions for use and shall be the same material as the original coating.

F. Main Pumps

1. The pumps shall be 4" vertical centrifugal non-clog type of heavy cast iron construction, especially designed for the use of mechanical seals and vacuum priming. Pumps shall be (DESIGN) with (DESIGN)inch impeller as manufactured by Smith & Loveless, Inc. In order to minimize seal wear resulting from shaft deflection caused by the radial thrust of the pump, the shaft from the top of the impeller to the lower bearing supporting the impeller shall have a minimum diameter of 1-7/8" for motor frame sizes 213 through 286; The dimension from the lowest bearing to the top of the impeller should not exceed 6". The motor shaft shall be directly connected to the impeller without use of the drive belts or couplings.

2. The bearing nearest the impeller shall be designed for the combined thrust and radial load. The upper bearing shall be free to move in a linear direction with the thermal expansion of the shaft and shall carry only radial loads.

3. The shaft shall be solid stainless steel though the mechanical seal to eliminate corrosion and rust particles. Removable shaft sleeves will not be acceptable if the shaft under the sleeve does not meet the specified minimum diameter.

4. The pump shall have an integral adapter providing a large water reservoir above the impeller to provide for positive exclusion of air from the impeller. The seal shall be inside this area to assure lubrication. Pumps which do not use hollow priming adapters for positive lubrication of the seal will not be acceptable. Self-priming pumps are specifically unacceptable due to the need for suction check valves, air vent piping and the possibility of overheating and damaging the pump or producing steam or high temperatures in the pump, which may be a hazard to the operator when the pump is run dry. The pump controls must be set so that the main pumps cannot be turned on unless they are filled with liquid, and the pump is completely primed.

5. The pump shall be constructed so as to permit priming from the lower pressure area behind the impeller. Priming from high pressure connections which tends to cause solids to enter and clog the priming system, will not be acceptable. The priming bowl shall be transparent, enabling the operator to monitor the priming level.

6. The pump shaft shall be arranged so that the rotating element can easily be removed from the casing without disconnecting the electrical wiring or disassembling the motor, impeller, backhead or seal, so that any foreign object may be removed from the pump or suction line. Enclosed impellers must be used to avoid the necessity of wear plates and the associated costs of replacement and maintenance of wear plate clearances with semi-open impellers.

    a. The pump shaft shall be sealed against leakage by a single mechanical seal constructed as to be automatically drained and primed each time the pump is drained and primed. Water, which lubricates the mechanical seal, shall be automatically drained from around the seal if the pump loses prime in order to allow the pump and the seal to be drained, thereby preventing freezing and breakage of the seal during power outages in sub-freezing temperatures.

7. The seal shall be of carbon and ceramic materials with the mating surfaces lapped to a flatness tolerance on one light band. The rotating ceramic shall be held in mating position with the stationary carbon by using a bronze seal housing to prevent excessive heat buildup. Use of cast iron or other ferrous material for the seal housing which will rust and damage the seal, shortening the life, will not be acceptable.

8. The pump vault shall be furnished with mounting lugs and bolted to the station floor plate, forming a gas tight seal.

9. The pump impeller shall be of the enclosed mono-port type made of close-grained cast iron and shall be in dynamic balance when pumping wastewater. Two port impellers are specifically disallowed. The dynamic balance shall be obtained without the use of balance weights or liquid filled chambers. The impellers shall be designed to allow for the trimming of the impeller to meet design condition changes without altering the balance. The eye of the impeller as well as the port shall be large enough to permit the passage of a sphere 3" in diameter in accordance with the nationally recognized codes. To further prevent clogging, the impeller port shall have a minimum area of 10.6 $in^2$. The impeller shall be keyed with a stainless-steel key and secured to the motor shaft by a stainless cap screw equipped with a Nylock or other suitable self-locking device. The impeller shall not be screwed or pinned to the motor pump shaft and shall be readily removable without the use of special tools. To prevent the buildup of stringy materials, grit and other foreign particles around the pump shaft, all impellers less than full diameter should be trimmed so that close minimum clearance from shrouds to volute is maintained. Both the end of the shaft and the bore of the impeller shall be tapered to permit easy removal of the impeller from the shaft.

G. Motors

1. The pump motors shall be vertical, solid shaft, NEMA P-base, squirrel- cage induction type, suitable for 3 phase, 60 cycle, and 460 volt electric current. They shall have Class F insulation. Insulation temperature shall, however, be limited to Class B. The motors shall have normal starting torque and low starting current, as specified by NEMA Design B characteristics. They shall be open drip-proof design with forced air circulation by integral

fan. Openings for ventilation shall be uniformly spaced around the motor frame. Leads shall be determined in a cast connection box and shall be clearly identified.

2. The motors shall have 1.15 service factor. The service factor shall be reserved for the owner's protection. The motors shall not be overloaded beyond their nameplate rating, at the design conditions, nor at any head in the operating range as specified under Operating Conditions.

3. The motor pump shaft shall be centered, in relation to the motor base, within 0.005". The shaft runout shall not exceed 0.003".

4. The motor shaft shall equal or exceed the diameter specified under Main Pumps at all points from immediately below the top bearing to the top of the impeller hub.

5. A bearing cap shall be provided to hold the bottom bearing in a fixed position. Bearing housings shall be provided with fittings for lubrication as well as purging old lubricant.

6. The motor shall be fitted with heavy lifting eyes or lugs, each capable of supporting the entire weight of the pump motor.

H. Vacuum Priming System

1. A vacuum priming system shall be furnished to prime the pumps. The system shall be as shown on the vacuum priming schematic and shall include two vacuum pumps, providing 100 % standby. Vacuum pumps shall have corrosion resistant internal components. The vacuum priming system shall be complete with large port vacuum control solenoid valves, vapor filters to protect the solenoid valves, SONIC START prime level sensor, float-operated check valves to protect the vacuum pumps, and all necessary shut off valves as shown on the piping schematic. The float-operated check valves shall have a transparent body for visual inspection. All hoses and tubing used in the priming system shall be at least 3/8" nominal diameter.

2. The solenoid valves used in the vacuum priming system shall be of the high flow, direct acting brass body type, with threaded ports, NBR seals and 300 series stainless steel plunger, rod, plate and springs. The minimum orifice diameter shall be 5/16". The solenoid valves shall be UL listed, with class F coil rating and of suitable voltage and thermal capacity for the application.

3. Each solenoid valve shall be protected by a vapor filter, installed in the vacuum line between the valve and the priming dome. The vapor filter shall be constructed of corrosion resistant materials and shall have a minimum filtration area of 2.74 square inches and be suitable for operation from 25" Hg to 100 PSI. They shall be readily replaceable without the use of special tools.

4. Liquid level in the pump priming chamber shall be monitored by a SONIC START resonant frequency liquid level probe. The probe shall be equipped with piezoelectric drive and sensitive circuits to detect frequency shifts when probe is covered by liquid. The probe shall be completely sealed and have a 316L stainless steel housing for corrosion resistance.

It shall be provided with a wiring connector molded of Poly Phenyl Sulfone, an amorphous high performance thermoplastic for impact and chemical resistance. The probe shall have a plug-in connector to facilitate easy removal.

a. The SONIC START probe shall be provided with light emitting diodes.

b. This diagnostic tool shall indicate connectivity, prime status or a fault condition. Systems utilizing an electrode, mechanical means such as a float, or that require any type of electrical or moving parts inside the priming chamber, which may accumulate debris, short out, bind or fail will not be acceptable.

5. The priming system shall automatically provide positive lubrication of the Mechanical seal each time a main pump is primed. To prevent excessive stoppage due to grease accumulation, no passageway in the priming system through which the pumped liquid must pass shall be smaller than the equivalent of a 2 – ½" opening.

6. The vacuum priming system shall have two field selectable modes of operation. In the "On Demand" mode, the priming system will operate only after a pump is called on to the run, and if it is not primed. Once primed, the pump will be allowed to run. In the "Constant Prime" mode, both pumps are kept primed continuously, and ready to start immediately when called for.

I. Environmental Equipment

1. A Supply and exhaust ventilating blower system capable of maintaining 6 air changes per hour minimum and 0.1-inch static water pressure in the enclosure shall be provided in order to remove the heat generated by continuous motor operation and prevent entry of wet well gases. The ventilating blowers shall be turned on and off by an on-off switch. A heavy extruded aluminum louvered grille with adjustable openings shall cover the discharge of the blower. A similar grille shall be provided in the other end of the station enclosure for air intake. A 500watt electric heater controlled by a preset thermostat shall be furnished. The heater shall be rigidly mounted in the station to prevent removal.

J. Piping

1. The pump suction shall be drilled and tapped for a 125 pound American Standard flange for easy connection of the suction riser. The discharge line from each pump shall be fitted with a clapper- type check valve and DeZurik eccentric plug valve. Size, location and quantity of check valves shall be shown on the construction drawing. The check valve shall be of the spring-loaded type with external lever arm and an easily replaced resilient seat for added assurance against vacuum leaks. Check valve shall have stainless steel shaft with replaceable Teflon seal. Ball-type check valves are specifically unacceptable for this application. An operating wrench shall be provided for the plug valves.

2. Protrusions through the floor plate shall be gas- tight where necessary to effect sealing between the equipment chamber and the wet- well to meet NFPA 820 requirements. Bolted and sealed joints shall be provided at the pump casings or suction pipes in order to prevent corrosive, noxious or explosive fumes from entering station. Welded joints that do not

allow adjustment or replacement will not be considered in this application. The pump station manufacturer shall extend the suction and discharge connection below the floor plate at the factory so that filed connections can be made without disturbing the gas-tight seals. The manufacturer of the pump stations shall provide a compression-type sleeve coupling for installation in the common discharge type.

## 11320.03 EXECUTION

A. Machinery shall be free of piping strain. To check for piping strain, piping flanges shall be loosened up separately with flange movement observed continuously. Should movement exceed 1/8", piping strain is considered excessive and shall be corrected by adding or adjusting pipe supports, hangers, expansion joints, etc. Installation of piping at pump casing connections shall be in accordance with Section 15210.

B. After erection the Contractor shall demonstrate that all equipment is operating in a satisfactory manner. All adjustments shall be made to suit anticipated station operating conditions. Each piece of machinery shall be tested to show that it operates quietly without excessive vibrations, overheating, or signs of distress at specified capacity. The Engineer shall be notified in advance of all tests, and all tests shall be conducted to his entire satisfaction. Pump performance testing shall be done in accordance with Appendices of these specifications.
    a. The flowrate (GPM) shall be obtained from a calibrated sewage pumping station flow meter or by a volume over time calculation. The flowrate obtained from a flow meter shall be the average flow rate observed during the complete pump on and pump off cycle. The flowrate derived from a volume over time calculation shall include the complete pump cycle volume (pump on to pump off) plus the inflow over the observed time period.

C. Manufacturer's Certificates that the installation of the equipment is in accordance the manufacturer's recommendations shall be secured by the contractor and submitted to the engineer,

END OF SECTION

# SECTION 11331

# SEWAGE GRINDERS

## 11331.01 GENERAL

A. Description

When indicated on the Drawings, the Contractor shall furnish and install a new submersible, explosion-proof electric motor driven sewage grinder that will continuously screen and grind, on a demand basis, solids in the raw sewage flow. The grinder shall be removable from above via a guide rail/frame system and pipe mounted to the influent pipe in the wet well as indicated on the Drawings. Grinder control and operation shall be as shown on the Drawings and as specified in this section.

B. Submittals

1. Shop Drawings shall be submitted for items specified herein, such as but not limited to:

   a. Grinder assembly and outline drawing

   b. Frame assembly and outline drawings

   c. Grinder controller schematic, wiring diagrams and outline drawings

   d. Epoxy anchor catalog information

   e. Grinder drive motor characteristics cross sectional drawing and maintenance information.

   f. Grinder drive gearbox characteristics cross sectional drawing and maintenance and shop overhaul information.

   g. Complete Parts List and Bill of Materials

2. Operation and Maintenance manuals shall be submitted for the grinder supplied. Manuals shall include grinder controller logic and reprogramming instruction in accordance with the County General Requirements and this Contract Document.

3. Structural computations, performed by a Maryland Registered Professional Engineer, shall be submitted for the grinder guiderail frame showing the frame will adequately support the weight of the grinder assembly.

C. General Notes

The Contractor shall verify all dimensions of the influent pipe, wet well depth and aluminum grating so that the grinder provided will fit together properly and will conform to the arrangement shown in the Drawings.

## 11331.02 MATERIALS

A. Manufacturer

The grinder shall be a twin shaft continuous operating type, wet or dry, capable of passing design flow rate of gpm at a free discharge condition. The grinder shall be twin shaft grinder complete with stainless steel guide rail system, overflow chute and frame, submersible TEFC motor and an automatic jam sensing and reversing controller, all as manufactured by JWC Environmental Muffin Monster, or equal.

B. Mechanical

1. Shafts: The shafts shall be minimum 2-inch hexagonal stainless steel.

2. Cutters: Constructed of appropriate number of teeth for materials/debris normally found in raw unscreened sewage. Alloy steel cutter and spacer materials shall be of the proper balance of carbon for strength and chromium for corrosion resistance and hardened to a minimum Rockwell HRC 60 or better.

3. Particle Deflector: A particle deflector shall be attached to the side rails to prevent large particles by bypassing the cutter action. Particles are returned for cutting while water is allowed to pass through, thereby reducing pressure drop.

4. Housing: The housing shall be cast from grade 65-45-12 ductile iron.

5. Seals and Bearings:

   a. Primary Seals – The primary seals shall feature elastomeric members which operate as opposing disk springs when compressed and at the same time keeping the faces of the two metallic rings together ensuring positive sealing. No metal springs shall be used.

   b. Labyrinth Rings – The contact-less labyrinth rings shall be supplied to further protect from coarse and fine granular contaminants.

   c. Bearings – The bearings shall be oversized deep groove double seal Conrad Type. The basic Dynamic Load is 7500 pounds.

6. Painting

   a. Description – Tnemic series 69 Hi-Build Epoxyoline (Epoxy Polyamide)

   b. Color – Manufacturers Standard

   c. Finish – Satin

d. Two coats will be applied: Prime and top.

7. Wet Well Frame and Guide Rail System

   The unit will be supported by a channel box and frame integral overflow bar screen in 316stainless steel. Channel frame and Guide Rail System will be mounted to the wall and shall allow the unit to be easily installed and removed without entering the wet well. It will be designed for direct flow from the influent pipe into the grinder. After frame installation, the grinder may be lowered into operation position by engaging the rails and lowering with a hoist. The hoist cable shall be left attached to the grinder for easy removal for inspection or maintenance.

8. Drive and Motor

   a. The grinder shall be driven by a direct coupled speed reducer. A flexible coupling shall be used to segregate the reducer from the machine. The reducer shall be rated for 24 hours a day high shock service. The motor shall be a 230/460 volts, 3 phase, 60 Hertz with a Submersible Explosion Proof Enclosure. Motors shall have 1.15 service factor; also shall be minimum Class F insulation.

   b. Two counter rotating shafts shall be driven by two heavy duty spur gears hardened to a Rockwell C of 40-45.

9. Electrical Controls

   a. An Automatic Reversing Controller shall be supplied with 30.5mm heavy duty oil tight controls and overload heater protector. The contents of the controller shall be housed in a NEMA 4X enclosure.

   b. A three-position Hand-Off-Auto switch shall control the mode of operation. The controller shall sense overload currents indicating a jam condition. The grinder shall stop, momentarily reverse and resume forward position. The controller shall reset itself back to zero count if no overloads occur after 30 seconds. The controller cabinet shall incorporate a main disconnect switch.

   c. Indicator lights shall be provided as follows:

      i. A red “Run Light” shall indicate the grinder is running.

      ii. An amber “Trip Light” shall indicate an alarm condition.

      iii. A White “Power On” light indicating power available to panel.

d. Two sets of contacts shall be provided as follows:

i. One set for RUN signal output.

ii. One set for FAIL signal output.

e. In the event of the loss of electrical power to the pumping station, the controller shall be capable of immediately restarting the grinder on restoration of power.

f. The PLC shall be manufactured by Siemens.

g. The grinder panel and controls shall meet the requirements of Section 16155 and 16946.

10. Spare Parts

A complete spare set of stationary and rotary cutters shall be supplied for the grinder installed. Parts shall be crated or boxed for long-term storage and clearly marked with Model number, Part number, parts description, quantity of parts contained and name of project.

## 11331.03 EXECUTION

A. General

1. Contractor shall provide all stainless steel grinder mounting hardware. Contractor shall provide all conduit and wiring between the grinder control enclosure main circuit breaker and grinder motor, and grinder control enclosure and emergency stop switch in accordance with Section 16010 and as indicated on the drawings.

2. After erection the Contractor shall demonstrate that all equipment is operating in a satisfactory manner. All adjustments shall be made to suit anticipated station operating conditions.

3. Contractor shall provide conduit, wiring and terminations for a normally closed single contact remote alarm circuit between the grinder controller and the station control panel to the station telemetry system.

4. As part of Conditional Acceptance, the Contractor shall demonstrate to the Owner the proper installation of guide rail frame, power cable and seating of the grinder by removing the unit from the wet well and then reinstalling and reseating the grinder in the wet well.

B. Services and Training

1. The grinder manufacturer shall provide to the County two copies of the PLC programming documentation and the controller software package for reprogramming, including all source codes required for reprogramming access. Upon Acceptance, software registration shall be transferred to the Owner. Contractor shall provide two 2-hour training sessions for

County operations personnel and two 4-hour training sessions for County maintenance personnel.

2. Sessions shall be scheduled prior to conditional acceptance. Training sessions shall include hands-on training with manufacturer supplied demonstration equipment to consist of an actual grinder of the type supplied.

END OF SECTION

# SECTION 11400

# TEMPORARY BYPASS PUMPING SYSTEM

## 11400.01 GENERAL

A. Summary

The Contractor is required to furnish all materials, labor, equipment, power, maintenance, etc. to implement a temporary pumping system for the purpose of diverting the existing flow around the work area for the duration of the existing sewage pump replacement work. Contractor shall not have two ongoing bypass pumping operations at different locations without DPW approval.

B. Quality Assurance

The design, installation and operation of the temporary pumping system shall be the Contractor's responsibility. The Contractor shall employ the services of a vendor who can demonstrate experience in the design and operation of temporary bypass pumping systems. The vendor shall provide at least five (5) references of projects of a similar size and complexity as this project performed within the past three years. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.

C. Submittals

1. The Contractor shall submit detailed plans and descriptions outlining provisions precautions to be taken by the Contractor regarding the handling of existing wastewater flows during the replacement and startup of the sewage pumps. This plan must be specific and complete, including such items as schedules, locations, elevations, capacities of equipment, materials and all other incidental items necessary and/or required to ensure proper protection of the facilities, including protection of the access and bypass pumping locations from damage due to the discharge flows, and compliance with the requirements and permit conditions specified in these Contract Documents. The plan shall include a “HIGH WATER ALARM” in the manhole or structure used for bypass pumping. The alarm shall be tied to the County’s existing SCADA system. The submittals shall include electrical schematics and control panel information for the pumps including start/stop and alarming configurations. No construction shall begin until all provisions and requirements have been reviewed by the Engineer/Owner. The Contractor shall allow 30 days for review and comment of this plan.

2. The plan shall include but not limited to details of the following:

    a. Staging areas for pumps;

b. Plan showing proposed equipment and piping layouts including details of tie-ins to existing sewer lines and force mains;

c. List of pump sizes, valves, piping, fittings and other appurtenances;

d. Method of noise control for each pump and/or generator (Use of portable generator can be allowed to feed more than 1 pump if approved by DPW);

e. Method for controlling and monitoring the pumps.

f. Method for providing 120V power to send signals to RTU for off-site alarming.

## 11400.02 MATERIALS

A. Equipment

1. All pumps used shall be automatic self-priming units that do not require the use of foot valves in the priming system. The pumps must be diesel powered or an electrical primary pump must be provided with full diesel back up. All pumps used must be constructed to allow dry running for long periods of time to accommodate the cyclical nature of pumping station sewage flows.

2. Pumps shall be Godwin Dri-Prime→ Automatic self-priming pumps with sound attenuation enclosures as manufactured by Godwin Pumps of America, Inc., or equal. Sound attenuation enclosures shall reduce operating noise to 66 dB at 30 feet. Sizing of pumps is per this Specification.

3. The by-pass pumping system shall include the necessary stop/start controls for the pumps.

4. A back-up pump of size equal to the largest by-pass pump shall be included.

5. The back-up pump shall be on-line, isolated from the primary system by a valve.

6. Temporary discharge piping shall be constructed of rigid pipe with positive, restrained joints. Aluminum“irrigation” type piping or glued PVC pipe will not be allowed. Discharge hose will only be allowed in short sections and as accepted by the Engineer.

7. Allowable piping materials will be Godwin “QD” Steel Pipe (Godwin Pumps of America, Inc.) or fused, high-density polyethylene pipe.

B. System Description

1. Design Requirements:
   a. The bypass pumping system shall have sufficient capacity to pump a peak flow of

gpm at TDH, not including the back-up pump capacity. The Contractor shall provide all pipeline plugs, pumps of adequate size to handle the peak flow, and temporary discharge piping to ensure that the total flow influent flow can be safely diverted around the section to be repaired. Bypass pumping system will be required to be operated and manned 24 hours per day from the time when one or both existing sewage pumps are taken off line and replaced, and until the new pump and control installation has been determined to have Substantial Completion as defined in the Special Provisions.

b. Temporary bypass pumping during construction may be accomplished by utilizing an existing sanitary sewer manhole and the Emergency Bypass Connection Vault or line stop structure as shown on the Contract Drawings. The Contractor shall verify location of all utilities, size of fittings, couplings and all other bypass requirements as previously noted. The bypass connection and piping shall be installed and tested prior to bypassing.

c. The Contractor shall verify that the existing plug valve in the existing vault in the existing bypass line, and all other existing valves necessary for the bypassing operation, are in good working condition. The County shall be responsible for operating these valves during construction/upgrades at existing facilities. The Contractor shall coordinate with Anne Arundel County personnel regarding the operation of these valves and provide a minimum of five (5) days notice to the County prior to any verification or construction operation.

2. Performance Requirements:

a. The design, installation and operation of the temporary pumping system shall be the Contractor's responsibility. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.

b. The Contractor shall provide all necessary means to safely convey the incoming sewage past the work area. The Contractor will not be permitted to stop or impede the flows in existing force mains.

c. The Contractor shall maintain sewer flow around the work area in a manner that will not cause surcharging of sewers, damage to sewers and that will protect public and private property from damage and flooding. Any sanitary sewer overflow that occurs due to a failure in the bypass system will be the responsibility of the Contractor. Any penalties issued to the County by Maryland Department of the Environment (MDE) will be reimbursed to the County Utility fund by the Contractor.

d. Prior to initiating any by-pass pumping, the Contractor shall submit a contingency

e. The Contractor shall protect water resources wetlands and other natural resources.

f. The Contractor shall be responsible to coordinate with the County at least one week in advance for the bypass pumping system monitoring tie-ins to the County SCADA system.

g. Bypass supplier shall conduct a training class to instruct Contractor designated pump watchman to operate the bypass system. Items covered during the training will be pump

monitoring, basic pump operation, basic repair, and emergency reaction sequence. Pump Watch personnel will be instructed how to monitor the suction well level and react if the level rises beyond the high level alarms. In addition, how to inspect the system for leaks, recognizing clogs and recording flow meter information. This includes instruction on pump operation in manual mode to bypass the auto start controls and manually operate a pump as needed.

## 11400.03 EXECUTION

A. Field Quality Control and Maintenance

1. Test:

   a. The Contractor shall perform leakage and pressure tests of the new bypass pumping discharge piping using clean water prior to actual operation. The Engineer shall be given 24 hours notice prior to testing.

   b. The bypass pumping system shall be tested and operated successfully for 24 continuous hours, and the wet well shall be emptied, prior to start of work.

2. Inspection:

   Contractor shall inspect the bypass pumping system every two hours to ensure that the system is working correctly.

3. Maintenance Service:

   The Contractor shall ensure that the temporary pumping system is properly maintained and a responsible operator shall be physically on-site 24-hours a day, when a bypass system is being implemented and pumps are operating.

4. Extra Materials:

   a. Spare parts for pumps and piping shall be kept on site as required.

B. Adequate hoisting equipment for each pump and accessories shall be maintained on the site.

1. Precautions

   a. Contractor is responsible for locating any existing utilities in the area the Contractor selects to locate the bypass pipelines. The Contractor shall locate his bypass pipelines to minimize any disturbance to existing utilities and shall obtain approval of the pipeline locations from the County and the Engineer. All costs associated with relocating utilities and obtaining all approvals shall be paid by the Contractor.

   b. During all bypass pumping operations, the Contractor shall protect the Pumping Station and main and all local sewer lines from damage inflicted by any equipment.

C. Installation and Removal

1. The Contractor shall remove manhole sections or make connections to the existing sewer and construct temporary bypass pumping structures only at the access location indicated on the Drawings and as may be required to provide adequate suction conduit.

2. Plugging or blocking of sewage flows shall incorporate primary and secondary plugging devices. When plugging or blocking is no longer needed for performance and acceptance or work, it is to be removed in a manner that permits the sewage flow to slowly return to normal without surge, to prevent surcharging or causing other major disturbances downstream.

3. When working inside manholes or sewer lines, the Contractor shall comply with OSHA requirements when working in the presence of sewer gases, combustible oxygen-deficient atmospheres, and confined spaces.

4. The installation of temporary bypass pipelines is prohibited in all saltmarsh/wetland areas. The pipeline must be located off streets and sidewalks and on shoulders of the roads. When the bypass pipeline crosses local streets and private driveways, the contractor must place the bypass pipelines in trenches and cover with temporary pavement. Upon completion of the bypass pumping operations, and after the receipt of written permission from the Engineer, the Contractor shall remove all the piping, restore all property to pre-construction condition and restore all pavement. The Contractor is responsible for obtaining any approvals for placement of the temporary pipeline within public ways from the County.

END OF SECTION

# SECTION 11745 – STEP & GRAVITY SEPTIC TANK SYSTEM

## 11745.01 GENERAL

A. Description

1. Work performed under this section shall include, but is not limited to, furnishing and installing STEP & gravity septic tank system in addition to the requirements in County's Reference Drawings for Concrete and ROMAR STEP and Gravity Septic Tank Installations, Specification for Construction and Standard Details. Concrete tanks are for commercial use only.

2. No modifications or alterations are to be made to the septic tank systems without the written approval of the County.

3. Private systems shall comply with the requirements in this section and County design standards.

B. Related Work Included Elsewhere

1. Trench excavation, backfill, and compaction; Section 02550.

2. Sanitary sewer and sanitary house connection installation; Section 02561.

3. Sanitary Sewer Force Mains; Section 02563

4. Low-Pressure Sewer Systems; Section 02566

5. Directional Drilling; Section 02930

6. Cast-in-place concrete; Section 03310.

7. Tracer wire and metallic detection tape; Section 02570

C. Quality Assurance

1. All equipment and material specified in this Section of the Specifications shall be furnished and coordinated by the Septic Tank Manufacturer.

2. All equipment furnished under this Specification shall be new and unused and shall be the standard product of manufacturers having a successful record of operation, manufacturing, and servicing similar equipment and systems.

D. Submittals

1. Copies of all materials required establishing compliance with the specifications shall be submitted to the Engineer. Submittals shall include at least the following:

a. Complete layout drawings.

b. Product drawings and cut sheets on all furnished equipment.

E. Product Handling

1. All equipment items shall be properly protected (refer to manufacturer's installation, storage and handling requirements) so that no damage or deterioration will occur from the time of shipment until installation is completed and the units and equipment are ready for operation.

## 11745.02 MATERIALS

A. Septic Tank

1. The tank shall be located so that the following minimum conditions are met:

a. All public tanks – Contractor/ Homeowner shall provide a 20'x20' public utility easement prepared by a licensed surveyor showing the precise routing of the pipeline from the tank to the in-street collection line.

b. Gravity tanks- locate the tank such that pipe slope be 2% (two percent) minimum between the house and the tank and 1% (one percent) minimum between the tank and the street. Fall through the tank is 3 inches. Minimum cover shall be 2'.

c. Pressure tanks- Provide 3'-6' minimum cover over the discharge pipe between the tank and the street.

d. Pressure tank shutoff valve shall be 18" to 24" below the tank lid.

2. Excavate for new septic tank to undisturbed earth. Provide dewatering system so that excavations remain dry.

3. Install 6" minimum levelling bed of AASHTO #57 aggregate.

4. Tank shall be installed level, and at an elevation such that the lid shall be 4 to 8 inches above surrounding grade. A working tolerance of 3/16 inches per foot out of level will be allowed.

5. Backfill shall be placed around the tank so as to provide uniform support. Backfill shall be compacted in 8-inch layers to 95 percent compaction of the standard proctor of the backfill material utilized.

6. Install concrete masonry units (CMUs) such that the top of the CMUs are below the centerline (springline) of the tank. Pretension the polypropylene ropes as indicated on the Reference Drawings for Concrete and ROMAR STEP and Gravity Septic Tank Installations. Polypropylene ropes shall have a 4 foot long protector sleeve where they pass through CMUs. Do not wrap ropes around riser.

7. Install backfill to the invert of the inlet and outlet pipes.

8. Install pipe couplings from the tank stubs to the inlet and outlet sewer lines. The couplings shall be rigid, PVC couplings with shear strength equal to the attached pipe.

9. Complete backfill operations and fill excavation to grade. Adjust septic tank risers and inlet tee extensions to grade and cap as shown on the Reference Drawings for Concrete and ROMAR STEP and Gravity Septic Tank Installations. Setting of electrical J-box, conduit elbows and concrete support pad to take place at this time on pump tanks.
10. Finished grade elevation in the vicinity of the riser and tank extension shall be 4 to 8 inches above surrounding grade. No extending tank riser shall be provided.
11. Install all pump equipment for pump tank installations.
12. Run pump through two complete operations to verify proper operation of floats and controls in the presence of the Engineer/ Inspector. Demonstrate removal of pump from the tank without the need to disconnect cables at J-box. Once a pump is removed, demonstrate complete removal of pump basket from the tank without obstruction.
13. Metallic detection tape shall be installed in all pipe trenches at a depth of 1 foot below grade.
14. Final curb valve locations shall be clearly marked on record drawings and referenced by distance (in feet) from the tank riser to valve box location.

B. Precast Pressure Concrete Septic Tank Components (Commercial Use Only)

| Item No. | Item Description | Quantity |
|---|---|---|
| 1 | Precast Concrete, 2 Compartments, 1500 gallon minimum, one piece Monolithic Septic Tank, No mid-seam tank. | 1 |
| 2 | 6” Diameter Inlet Structure | 1 |
| 3 | 4” Diameter Baffle Structure | 1 |
| 4 | Kor-N-Seal Boots<br>Inlet<br>Outlet<br>Baffle<br>Items No. 1 through 4 supplied by Baystar Precast Corp., 925 Skinners Turn Rd, Owings, MD, (310) 855-6777. | <br>1<br>1<br>1 |
| 5 | Green Polyethylene Domed Lid<br>Romar Model #HA – Lindnins – Mod<br>Item 5 is manufactured by: Ames/ Messco, 9020 Mendenhall Court, Suite J, Columbia, MD 21046, (410) 995-6971 | 2 |
| 6 | Stainless Steel ¼” – 20 x 1” Pan Head Drilled Spanner Tamper Proof Bolts<br>Item No. 6 is manufactured by: A.K. Industries, Inc. 2055 Fidco Drive, Plymouth, Indiana 46563, (219) 936-6022.<br>Disributed by: Ames/ Messco, Inc. 9020 Mendenhall Ct., Suite J, Columbia, MD 21046 | 6 |

C. Electrical Components – Pressure Tanks Only

| Item No. | Item Description | Quantity |
|---|---|---|
| 7 | Submersible Effluent Pumps 1/2 hp. Goulds Model 3885, WE0511HH (1/2). | 1 |
| 8 | 6-foot Electrical Service loop<br>Items No. 7 and 8 are manufactured by: Goulds Pump, Inc. and disturbed by Ames/Messco, 9020 Mendenhall Court, Suite J, Columbia, MD 21046 | 1 |
| 9 | Polypropylene Mini-Floats<br>High Water<br>Pump On<br>Pump Off<br>Item No. 9 is manufactured by: Anchor Scientific, Inc,<br>Box 378, Long Lake, MN 55256, (612) 473-7115. | 3 |
| 10 | Simplex Pump Control Panel- Fiberglass, NEMA 4X Enclosure, with lockable hasp. All metal parts to be stainless steel.<br>Enclosure shall have a submersible rating and be U.V. stabilized.<br>All components shall be "UL" or "CSA". approved.<br>Internal components shall be industrial rated and include the following:<br>a) Magnetic controller- Model No. CA3-12-12V with one auxiliary contact by Sprecher and Schuh.<br>b) Circuit Breakers- Model No. QC 1020 and QC 1015, single pole by Westinghouse.<br>c) Hand/Off/Auto Toggle Switch-"Maintained" in both the hand and auto position<br>d) High water Alarm Buzzer - Model No. MC-09201-Q with manual volume control by Floyd Bell.<br>e) High water Alarm Light- Model No. DTV3P-R-101-01 by Sprecher and Schuh<br>f) Terminal Strip shall be 6 point minimum and rated to 15 AMP.<br>g) Each control panel shall be supplied with a Dead Front Interior Shield.<br>h) Control Panel sign shall be adhesive backed, non-fading. Sign shall be 3"X5" and shall read:<br>"Anne Arundel County Department of Public Works<br>Septic Tank effluent Pump Controls<br>In Case of Alarm Telephone 410-222-8400<br>Do not open Panel"<br>The County shall add a sticker to the exterior of the control panel after the warranty period. | 1 |

| | | |
|---|---|---|
| | Item No. 10 shall be as manufactured and distributed by: Ames/Messco, 9020 Mendenhall Court, Suite J, Columbia, MD 21046 (410)995-6971. | |
| 11 | Main Circuit Breaker and Enclosure NEMA Type 3R, lockable, rainproof, safety switches with 30 AMP circuit breaker<br>Item No. 11 is manufacturer by: Square D Manufacturing Company, Towson, MD (301)-337-8448 | 1 |
| 12 | 6" X 8" Quazite Composite Enclosure, PC Style w/no base (part # PC0608BA06) | 1 |
| 13 | 6" X 8" PC style Quazite Composite Lid w/ no Gasket and (2) Stainless Steel Pentahead Lid Bolts (part #PC0608CA00) "Electric" logo on lid.<br>Items 12 and 13 are distributed by: Graybar Electric, 3701 E. Monument Street, Baltimore, MD 21205 (410)342-5500 | 1 |
| 14 | King #40-563 and #40-564 "One Step" Watertight/Raintight Safety Wire Connectors or Ideal DB Twister Plus #30-260 Watertight Wire Connectors. | As required |
| 15 | 1 ½" Sch. 40 Rigid PVC Conduit Elbows | 2 |
| 16 | 1 1/2 " Sch. 40 Rigid PVC Conduit as needed to suit setting of J-Box | As required |
| 17 | 1 1/2" Carlon Bell Ends (PVC) #E997H or equal<br>Item numbers 14 through 17 are distributed by: Lee Electric Company, 600 West Hamburg Street, Baltimore, MD 21203 (410)752-4080 | 4 |
| 18 | Spec Seal Firestop Putty by STI Products (product #SSP 100) 36 cu.in. tube<br>Item 18 is distributed by: Tristate Electric Supply Company, 2032 Industrial Drive, Annapolis, MD 21401, (410)-224-4245 | As required. |
| 19 | 14" X 14" X 3" Precast Concrete Pad with 6" Diameter Round void in center for supporting/ stabilizing electric enclosure.<br>Item 19 is manufactured by: Hoyle Stone Products, Central Ave. and Queen Anne Rd, Mitcheville, MD, (301)249-5171<br>The following Items 20-24 Apply to Multiple Dwellings/Commercial Installations Only. | 1 |
| 20 | 8" X 8" X 6", NEMA 7, Class I, Group D Junction Box Crouse-Hinds EJB886SA or equal. Provide tamper resistant stainless steel cover bolts. | 1 |
| 21 | 1 ½" rigid PVC coated steel conduit | As required. |

| | | |
|---|---|---|
| 22 | 1” rigid PVC coated steel conduit | As required. |
| 23 | 1 ½” insulating conduit bushings | 2 |
| 24 | 1” insulating conduit buildings | 2 |

D. Piping and Valve Components

| Item No. | Item Description | Quantity |
|---|---|---|
| 25 | 4-inch Diameter SDR 35 PVC pipe | Length as required |
| 26 | 1 1 / 2” Diameter Schedule 40 PVC pipe | Length as required |
| 27 | Morrison Bleeder Valve-Part #S20182, or equal Pressure Tank Only<br>Items no 25 through 27 are distributed by: Tate Engineering Inc, 601 West Street, Baltimore, MD 21230 (410)-539-0787 | 1 |
| 28 | 1 1 / 2” Diameter PVC True Union Ball valve Hayward, Pressure Tank only | 1 |
| 29 | 1 1 / 2” Diameter PVC True Union Ball Check Valve Hayward, Pressure Tank only | 1 |
| 30 | Weld on Primer<br>P-70 or equal, All Tanks | As required |
| 31 | Weld on Pipe Cement<br>711 or equal, All Tanks | As required |
| 32 | Pipe Joint Lubricant (Sub Aqueous)<br>Items No. 28 through 32 are distributed by: PPS (Plastic Piping Systems) McGraw Court, Columbia, MD 21046 (410)995-6758 | As required |
| 33 | 316 Stainless Steel Split Ring Pipe support brackets<br>Gravity<br>Pressure<br>Item No.33 is manufactured by Penn Pipe Hangers, 4501 Aramingo Ave, Philadelphia, PA 19124 1(800)742-6437 | <br>3<br>2 |
| 34 | Metallic Plastic Marker Tape<br>Item No. 34 is manufactured by: Allon Co.,Inc, 1803 McGowen St. Houston, Texas 77004(713)659-5468 | As required |
| 35 | 1 1 / 2” Bronze Ball Curb Valve Per Section 02566.03.E. | 1 |

| | | |
|---|---|---|
| 36 | Valve Stem Extension with Teehead for Valves 5-ft and deeper<br>Item No 35 and 36 are manufactured by: Ford Co.distributed by Municipal and Contractor Sales, 2930 Industrial Park Drive, Infrastructure, Finksburg, MD 21048 (410)833-4300 | Length as required |
| 37 | Plastic Valve Box with Cast Iron Cover<br>Cast iron cover shall be labeled "SEWER".<br>Model Fig. No. 8000 for shallow and Fig. No. 8750 for deep<br>Item No. 37 is manufactured by: Bingham and Taylor , P.O. Box 939, Culpepper, VA 22701 (703)825-8334 | 1 |
| 38 | 6" Diameter Cleanout<br>Gravity Tank<br>Pressure Tank<br>Item No. 38 is distributed by: PPS (Plastic Piping Systems), McGraw Court, Columbia, MD 21046 (410)995-6758 | <br>2<br>1 |

E. Piping and Valve Components (Concrete Tanks Only)

| Item No. | Item Description | Quantity |
|---|---|---|
| 39 | Rubber Butyl Compression Seal<br>Item No. 39 is manufactured and distributed by: Press Seal Gasket Corp, Concrete Products Supply Co, P.O Box 10482, Fort Wayne, Indiana 46852 1(800)348-7325. | As required |
| 40 | Non-Shrink Grout<br>Item No.40 is manufactured and distributed by National Permacrete Co, Inc, P.O Box 866, Devon, PA 19333 | As required |
| 41 | Coal Tar Epoxy<br>Item No.41 is manufactured by Tnemec Co, Inc, and distributed by: C. Distler Co, Inc 302 W. Cary St. Richmond, VA 23220 Baltimore Metro (301)467-2435 | As required |
| 42 | Caution Label for Riser Cover<br>"Caution: Hazardous Atmosphere Do not Enter"<br>All Tanks | 1 |
| 43 | 1 / 2" Polypropylene Rope with stainless Steel Lifting Hoops at each end for pump, Pressure Tank Only | 1 |
| 44 | 4"X18"X18" Masonry Pump Stand<br>Items No. 43 and 44 are distributed by: Bowen Farm Supply, 2550 Riva Road, Annapolis, MD (410)-224-3340 | 1 |

| | | |
|---|---|---|
| 45 | AASHTO #57 aggregate or equal<br>All Tanks | As required |

## 11745.03 EXECUTION

A. Installation

Installation by the Contractor of each equipment item shall be in strict accordance with the manufacturer's requirements. No lifting by the riser shall be allowed. All cost for the installation shall be provided by the Contractor.

B. Start-up

The Contractor shall inform the County and the Engineer 48 hours prior to scheduled start- up. The County may require to re-schedule.

C. Testing

After all equipment has been completely installed according to the direction of the Manufacturer, conducted in the presence of the Owner, tests shall be performed to indicate that the System operates satisfactorily and will meet the design criteria set forth in this Specifications Section.

The HDPE septic tanks shall be vacuum tested for leaks following assembly and the connections of all pipes and conduits. Following the plugging of all pipes and the sealing of all other entrances as specified, the structures shall be tested by drawing a vacuum of four inches of mercury. Suitable plugs and equipment shall be supplied by the Contractor for the purposes of the test. An acceptable test shall be one in which the vacuum loss following evacuation is zero over a five minutes period.

Manufacturer shall provide visual inspection at this time for any discrepancies, which the Contractor shall correct. The field test shall demonstrate correct mechanical operation after system start-up. Field tests shall include all equipment included under this section.

**END OF SECTION**

# SECTION 15100

# GENERAL MECHANICAL REQUIREMENTS

## 15100.01 SCOPE

A. All work under Division 15 is subject to the General Provisions and Special Requirements for the entire Contract.

B. Provide all labor, materials, equipment, and services necessary for and incidental to the complete installation and operation of all mechanical work.

C. Unless otherwise specified, all submissions shall be made to, and acceptances and approvals made by the Engineer.

D. Contract Drawings are generally diagrammatic, and all offsets, fittings, transitions and accessories are not necessarily shown. Furnish and install all such items as may be required to fit the work to the conditions encountered. Arrange equipment and other work generally as shown on the contract drawings, providing proper clearance and access. Where departures are proposed because of field conditions or other causes, prepare and submit detailed shop drawings for approval in accordance with this Section and Section 01010. The Engineer reserves the right to make reasonable changes in location of equipment, piping, and ductwork, prior to the time of rough-in or fabrication.

E. Conform to the requirements of all rules, regulations and codes of local, state and federal authorities having jurisdiction.

F. Coordinate the work under this section with the work of all other construction trades.

G. Be responsible for all construction means, methods, techniques, procedures and sequences used in the work. Furnish all tools, equipment and materials necessary to properly perform the work in a first class, substantial, and workmanlike manner, in accordance with the full intent of the contract documents.

H. Permits and Fees

Obtain all permits and pay taxes, fees and other costs in connection with the work except as excluded in the General Conditions. File necessary plans, prepare documents, give proper notices and obtain necessary approvals. Deliver inspection and approval certificates to the Owner prior to final acceptance of the work.

I. Fire Safe Materials

Unless otherwise indicated, materials shall conform to UL. NFPA or ASTM standards for fire safety with smoke and fire hazard ratings not exceeding flame spread of 25 and smoke developed of 50. The materials, containers or shipping cartons shall bear certification with these requirements.

J. REFERENCED STANDARDS, CODES AND SPECIFICATIONS

Specifications, Codes and Standards listed below are included as part of this specification, latest edition:

| | |
|---|---|
| AABC | - Associated Air Balance Council |
| AMCA | - Air Moving and Conditioning Association |
| ASTM | - American Society for Testing and Materials |
| IEEE | - Institute of Electrical and Electronics Engineers |
| IMC | - International Mechanical Codes |
| MOSHA | - Maryland Occupations Safety and Health Administration |
| NEC | - National Electrical Code |
| NEMA | - National Electrical Manufacturers Association |
| NFPA | - National Fire Protection Association |
| OSHA | - Occupational Safety and Health Administration |
| UL | - Underwriters Laboratories |

K. Color Selection

Color of finishes shall be as selected by the Owner. Submit colors of factory-finished equipment for acceptance prior to ordering.

L. Guarantee

1. Guarantee obligation shall be as hereinbefore specified in the General Conditions of these specifications, with the following supplementary requirements.

2. Guarantee shall apply to all materials, equipment, and services and shall include readjustment and rebalancing of systems and equipment where required.

3. During the guarantee period, make appropriate revisions or corrections to operating instructions, equipment manuals, and other as-built data.

## 15100.02 MATERIALS

A. Materials and Equipment

1. Materials and equipment installed as a permanent part of the project shall be new, unless otherwise indicated or specified, and of the indicated type and quality.

2. Where proprietary name, model number and/or manufacturer identity material or equipment, furnish named item, or its equal, subject to approval by the Engineer. Substituted items shall be equal or better in quality and performance and must be suitable for available space, required arrangement, and application. Submit all data necessary to determine suitability of substituted items, for approval.

3. The suitability of the named item only has been verified. Where more than one item is named, only the first named item has been verified as suitable. Substituted items including items other than first named shall be equal or better in quality and performance to that of the specified items, and must be suitable for available space, required arrangement and application.

B. Supports, Hangers and Foundations

1. Provide supports, hangers, braces, attachments, and foundations required for the work. Support and set the work in a thoroughly workmanlike manner without placing strains on materials, equipment, or building structure, submit shop drawings for approval.

2. Supports, hangers, braces, and attachments shall be standard manufactured items or fabricated structural steel shapes.

3. Concrete pads and foundations shall not be less than 4 inches high and in general shall extend 2 inches beyond equipment bases. Provide wire-mesh reinforcement or as required by design; chamfer exposed edges and corners; finish exposed surfaces smooth, connect as specified above.

C. Drive Guards

1. Provide safety guards on all exposed belt drives, motor couplings, and other rotating machinery. Provide fully enclosed guards where machinery is exposed from more than one direction.

2. Fabricate guards of heavy gauge metal; rigidly braced, removable and finished to match equipment. Provide openings for tachometers. Guards shall meet OSHA and MOSH requirements.

D. Vibration Isolation

Furnish and install vibration isolators, flexible connections, supports, anchors and/or foundations required to prevent transmission of vibration from equipment or ductwork to building structure.

E. Provisions for Access

Furnish and install adequate access to all equipment, dampers, controls, and other devices requiring maintenance or manual operation.

F. Identification

1. Mark and permanently identify all systems and equipment in accordance with project nomenclature, including controls. Use plaques, stencils, nameplates, tags, markers, or other acceptable means. Securely mount or attach all signs, nameplates and tags.

2. The method of identification shall suit the particular item to be identified and all similar items shall be identified in a like manner. Lettering shall be uniform, neat, legible, and professional in quality. Characters shall be readable at a normal distance of operation.

3. Identification methods shall be:

    a. Plaques: For direct mounting on walls or large equipment; metal or laminated plastic; printed, engraved, or stenciled characters up to 2 –inch minimum size.

    b. Stencils: For direct application on equipment; characters ½-inch minimum size.

    c. Tags: For attachment to controls and concealed equipment; stainless steel; engraved and filled characters ¼-inch minimum size.

    d. Identification system shall be as manufactured by W.H. Brady Co., or equal.

    e. Embossed Plastic Tape: Prohibited, except where specifically approved in writing.

    f. Identification by means of marking pens or other temporary methods will not be acceptable.

## 15100.03 EXECUTION

A. Supervision and Coordination

1. Provide complete supervision, direction, scheduling and coordination of all work under the Contract, including that of subcontractors.

2. Coordinate rough-in of all work and installation of sleeves, anchors, and supports for work performed under Division 15.

3. Coordinate electrical work required under Division 15 with that Division 16.

4. Coordinate all work under Division 15 with work under all other Divisions.

B. Cutting and Patching

1. Accomplish all cutting and patching necessary for the installation of work under Division 15. Damage resulting from this work to other work already in place shall be repaired at Contractor’s expense. Where cutting is required, perform work in a neat and workmanlike manner. Restore disturbed work to match and blend with existing, using materials compatible with the original. Use mechanics skilled in the particular trades required.

2. Do not cut structural members without approval.

C. Penetration of Waterproof Construction

Coordinate the work to minimize penetration of waterproof construction, including roofs, exterior walls, and interior waterproof construction. Where such penetrations are necessary, furnish and install all necessary curbs, sleeves, flashings, fittings and caulking to make penetrations absolutely watertight.

D. Cleaning, Painting and Finishes

1. Provide protective finishes on all materials and equipment. Use coated or corrosion-resistant materials; hardware and fittings throughout the work. Paint bare, untreated ferrous surfaces with rust-inhibiting paint.

2. Clean surfaces prior to application of insulation, adhesives, coatings, paint or other finishes.

3. Provide factory-applied finishes where specified. Unless otherwise indicated factory-applied paints shall be baked enamel with proper pretreatment.

4. Protect all finishes and restore any finishes damaged as a result of work to their original condition.

5. These requirements apply to all work whether exposed or concealed.

6. Remove all construction markings and writing from exposed equipment, ductwork, and building surfaces. Do not paint manufacturer’s labels or tags.

E. Protection of Work

Protect work, material and equipment from weather and construction operations before and after installation. Properly store and handle all materials and equipment. Cover temporary openings in equipment to prevent the entrance of water, dirt, debris, or other foreign matter. Cover or otherwise protect all finishes.

F. Operation of Equipment

1. Clean all systems and equipment prior to initial operation for testing, balancing, or other purposes. Lubricate, adjust, and test all equipment in accordance with manufacturer's instructions. Do not operate equipment unless all proper safety devices or controls are operational. Provide all maintenance and service for equipment that is authorized for operation during construction.

2. Where specified, or otherwise required, provide the services of the manufacturer’s factory-trained servicemen or technicians to start up the equipment.

3. Do not use mechanical systems for temporary services during construction unless authorized in writing by the Engineer. Where such authorization is granted, temporary use of equipment shall not limit or affect warranties or guarantee period of the work.

4. Upon completion of work, clean and restore all equipment to new conditions; replace expendable items such as filters.

G. Testing, Balancing and Adjustment

1. Perform all specified or required tests to demonstrate that the work is installed and operating properly. Where formal tests are required, give adequate notice and perform preliminary tests to assure that work is complete and ready for the final test.

2. Balance and adjust all systems, equipment, and controls to operate at the proper capacities in a safe, efficient and stable manner.

H. As-Built Drawings

1. During construction, the contractor shall maintain an accurate, up-to-date record of the installed locations of all work on a set of contract drawings.

2. Upon completion of the work, deliver to the Engineer, one complete set of contract drawings with all “as-built” information neatly recorded thereon in red ink.

I. Equipment by Others

1. The Contractor shall make all system connections required to equipment furnished and installed under other divisions, and by the Owner. Connections shall be complete in all respects to render the equipment functional to its fullest intent.

2. It shall be the responsibility of the supplier of the equipment to furnish complete instructions for connections. Failure to do so will not relieve the Contractor of any responsibility for improper equipment operation.

J. Lubrication

1. All bearings, motors, and all equipment requiring lubrication shall be provided with accessible fittings for the same. Before turning over the equipment to the Owner, the Contractor shall fully lubricate each item of equipment, shall provide one year’s supply of lubricant for each, and shall provide the County with complete written lubricating instructions, together with a diagram locating the points requiring lubrication.

2. In general, all motors and equipment shall be provided with grease lubricated roller or ball bearings with Zerk or equal accessible or extended grease fittings and drain plugs.

END OF SECTION

# SECTION 15140

# PIPE SUPPORTS

## 15140.01 GENERAL

A. Description

This section includes provisions for pipe hangers, brackets, supports, and spacing of expansion joints in piping systems. Pipe supports shall be furnished, complete with all necessary inserts, bolts, nuts, rods, washers, and other accessories.

B. Submittals

1. Submit Contractor's drawings in accordance with Section 01010 including the following:

2. Catalog cuts on all pipe support components to be used including detailed specifications.

3. Submit layout drawings in conjunction with Sections 15210 and 15400 showing the location of all pipe supports.

## 15140.02 MATERIALS

A. Materials

1. Pipe supports are identified by manufacturer's name and catalog number. Pipe supports shall be manufactured for the size and type of pipe to which they are applied. Strap hangers will not be acceptable. Threaded rods shall have threading to permit the maximum adjustment available in the support item.

2. In certain locations, pipe supports and anchors have been shown on the drawings, but no attempt has been made to indicate every pipe support and anchor. It shall be the Contractor's responsibility to provide a complete system of pipe supports and to anchor all piping, in accordance with this section.

B. Description

1. Pipe support types and applications shall comply with the following:

    a. Description or Size:

        i. Hangers:

            a. 2-1/2" and smaller pipe:

                i. Split ring: Elcen Flg 90. Fee & Mason Fig 210.

                ii. Unistrut J-Style. Grinnell Fig. 104Clevis Grinnell Fig 65, Fee & Mason Fig 104

b. 3” through 12” pipe:

i. Clevis Grinnell Fig 260, Fee & Mason Fig 239

ii. Concrete Inserts, steel:

| | |
|---|---|
| 12” and small pipe | Channel 12 ga; galv. 1-5/8” X 1-5/8” Min 8 inches long. Anchor lugs on 4” centers, at least three lugs and caps, and filler strip. Grinnell Fig. 285. Fee & Mason Fig 186 |

iii. Non-Adjustable Floor Supports, cast iron:

a. 6” and smaller pipe Grinnell Fig. 259, Fee & Mason Fig 295.

b. 8” through 24” pipe Grinnell Fig. 258, 264 Fee & Mason.

iv. Adjustable Pipe supports:

a. Use Standon Model S89, 316 stainless steel or equal.

## 15140.03 EXECUTION

A. Location

1. Unless otherwise indicated on the drawings, or directed by the Engineer, piping shall be supported approximately 1-1/2 inches out from the face of walls.

2. Unless closer spacing is indicated on the drawings, the maximum spacing for pipe supports and expansion joints shall be

| Type of Pipe | Pipe Support Max Spacing, Ft. | Max Run without Expansion Expansion Joint, Loop, ft. Bend, ft. | Max Run without Expansion Joint Max Spacing, | Type of Expansion Joints |
|---|---|---|---|---|
| Ductile Iron | 15 | 80 | 80 | Mechanical Couplings |
| Steel | | | | |
| 1-1/4" and | 7 | 30 | 100 | None required |
| Smaller | 10 | 30 | 100 | Mechanical |
| 1-1/2 to 4" | 15 | 80 | 80 | Couplings |
| Over 4" | | | | |
| Copper | 5 | -- | -- | None required |
| 1" and smaller | | | | |
| Over | 7 | 50 | 100 | None required |
| PVC Continuous | (Note 1) | | | |
| 1/8 and ¼" | | 20 | 80 | None required |
| Support | | | | |
| ½ to 2" | 4 | 20 | 60 | None required |
| Over 2" | 6 | 20 | 60 | None required |
| Cast iron Soil pipe | 10 | -- | -- | None required |

Note 1. Hanger and bracket spacing may be increased to 10 feet where PVC pipe is provided by continuous support.

B. Application

1. Concrete inserts or L-shaped anchor bolts shall be used to support piping from new cast-in- place concrete. Expansion anchors shall be used to fasten supports to existing concrete and masonry.

2. Design loads for inserts, brackets, clamps, and other support items shall not exceed the manufacturer's recommended loads.

3. Anchorage shall be provided to resist thrust due to temperature changes, changes in diameter or direction, or dead ending. Anchors shall be located as required to force expansion and contraction movement to occur at expansion joints, loops or elbows, and as required to prevent excessive bending stresses and opening of mechanical couplings.

Anchorage for temperature changes shall be centered between elbows used as expansion joints.

4. Contact between dissimilar metals shall be prevented in supporting copper tubing. Those portions of pipe supports that contact the tubing shall be copper plated, rubber or vinyl coated, or stainless steel.

5. All piping shall be supported and anchored so that there is no movement or visible sagging between supports.

END OF SECTION

# SECTION 15210

# PIPES, VALVES, FITTINGS AND SPECIALTIES

## 15210.01 GENERAL

A. Description

This section includes requirements for interior piping and fittings, buried and interior valves and specialty items used in conjunction with piping systems.

B. Related Work Specified Elsewhere:

1. Section 02200: Earthwork
2. Section 02400: Excavation support
3. Section 02512: Dewatering
4. Section 02563: Sanitary Sewer Force Mains, HDPE Piping and ARV's
5. Section 15400: Plumbing

C. Submittals

The Contractor shall submit certificates of compliance for all materials furnished under this section in accordance with Section GP-6.05 of the General Provisions.

D. Quality Assurance

All materials shall be new and of the highest grade. The Contractor shall carefully inspect all materials for defects prior to installation, report deficiencies to the Engineer, and replace deficient materials as directed by the Engineer.

## 15210.02 MATERIALS

A. General

1. Pipe and Fittings

All pipe fittings shall be of the types indicated on the Contract Drawings unless otherwise specified. Ferrous piping shall be provided with ferrous fittings; copper piping shall be provided with bronze, wrought copper, or brass fittings.

B. Ductile Iron Piping

1. Ductile iron piping shall conform to the requirements of AWWA C 151. All fittings for ductile iron pipe shall be ductile iron, conforming to AWWA C110. Exposed ductile iron

pipe and fittings shall have flanged ends. Ductile iron pipe for exposed flanged piping shall be Class 53 minimum and shall conform to the requirements of AWWA C 115. All flanged ductile iron pipe and fittings shall be bituminous seal coated on the inside and outside in accordance with AWWA C 115.

2. All ductile iron pipe fittings shall be supported, anchored and/or buttressed as indicated in the specifications or stipulated on the Drawings.

3. Ductile iron wall castings shall have integral water stops and shall have ends as indicated on the Drawings.

C. PVC Pipe

1. PVC pipe and fittings shall be Schedule 80 with screwed or solvent welded joints. Fittings for threaded pipe shall be Schedule 80 with threads recessed and cut in accordance with ANSI B2. 1. Fittings for solvent-welded pipe shall be Schedule 80- recessed type.

2. Flanged fittings or valves where shown or required, shall have companion flanges of the threaded type on the pipe side of these connections.

3. All pipe shall be threaded where required for installation of valves and connections to equipment. PVC unions shall be installed in the pipeline adjacent to all valves and equipment connections, and at reasonable intervals along the run of the pipe, to permit disassembly.

D. CPVC Pipe

1. Chlorinated Polyvinyl Chloride (CPVC) pipe and fittings shall be schedule 80 with screwed or solvent welded joints. The pipe shall be manufactured from a Type IV, Grade 1, CPVC compound with a minimum cell classification of 23447 per ASTM D1784. The pipe shall be manufactured in strict compliance to ASTM F441, consistently meeting the Quality Assurance Test requirements of the standard with regard to material, workmanship, burst pressure, flattening and extrusion quality.

2. The pipe shall have a flame spread rating less than 25 and a smoke development rating less than 50 when tested. The pipe shall also be listed for surface burning characteristics in accordance with CAN/ULC-S 102-2-M 88.

3. Pipe and fittings shall be manufactured by Harvel Plastics, Inc., or equal.

E. Stainless Steel Pipe

1. Stainless steel pipe and fittings shall not have a lining and the outside shall not be painted.

2. Pipes 2-1/2 inch and smaller shall be ASTM A312, Type 316, schedule 40 seamless, unless otherwise noted. Joints shall be screwed type unless otherwise noted. Fittings shall be screwed, stainless steel, conforming to ASTM A182, Grade TP304 or barstock to ASTM A276 Type 316 with dimensions conforming to ANSI B16.3 for 150 lb SWP malleable iron screwed fittings.

F. Copper Tubing

1. Copper tubing shall be Type K, annealed, and shall meet the material, chemical, and mechanical requirements of ASTM B 88.

G. Unions

1. Unions for use in galvanized steel pipe systems shall be galvanized malleable iron, screwed end, ground joint, brass seat unions, suitable for 150 psi service.

2. Unions for use in polyvinyl chloride (PVC) piping systems shall be Schedule 80, manufactured from polyvinyl material conforming to the requirements of ASTM D1784, with Buna-N or Viton O-rings.

3. Unions shall be furnished adjacent to valves and equipment connections, and at appropriate intervals along the run of pipe to permit disassembly.

4. Copper tube couplings shall be Mueller Catalog Number H-15405 two-part union or equal.

H. Joints

1. Unless otherwise specified or indicated on the Drawings, joints for exposed ductile iron pipe and fittings shall be flanged. Pipe shall have screwed-on flanges conforming to AWWA C1 15. Fittings shall have integrally cast flanges in accordance with AWWA C1 10.

2. PVC solvent-welded piping joints shall conform to ASTM D2564 and ASTM F402.

3. Joints for galvanized steel pipe and fittings shall be threaded joints except where otherwise indicated on the Contract Drawings.

I. Wall Castings and Sleeves

1. Provide wall castings and sleeves in walls and floors for the passage through concrete and other materials of all pipes.

2. Wall and floor sleeves for pipe smaller than 4-inch shall be ductile iron or HDPE. Sleeves in concrete shall have integral waterstops. Sleeves passing through floors shall extend approximately 1/2-inch above the finished floor. The space between pipes and sleeves shall be sealed with modular rubber mechanical seals or other methods as approved by the Engineer. Low melting point asphaltic materials will not be permitted for caulking.

3. Generally, except where otherwise noted on the Drawings, all wall castings in concrete walls or floors for pipes 4-inch and larger shall be minimum ductile iron ANSI Class 125 of the shapes and sizes indicated and shall be complete with water-stop flanges. The ductile iron wall coatings shall conform to ANSI A2 1.10.

4. Modular rubber mechanical seals shall consist of interlocking rubber links shaped to continuously fill the angular space between the pipe and the pipe sleeve. All metal modular

rubber seal parts shall be stainless steel. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe. When the seal is in place, the bolts are tightened and a watertight seal is made. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe O.D. and sleeve I.D. involved. Seals shall be "Link Seal" as manufactured by Thunderline Corporation or equal.

J. Mechanical Couplings

1. Mechanical couplings shall be sleeve type with steel coupling body, rubber gaskets and steel follower glands secured to the coupling body with steel bolts. Couplings shall be designed specifically for use with ductile iron pipe. Couplings shall be designed for a working pressure of 150 psi.

2. Mechanical couplings shall be Style 38 as manufactured by Dresser Industries or equal.

3. Pipe ends at each side of mechanical couplings shall be tied together with at least 2 threaded rods extending to the nearest flanges or by utilizing two (2) piece pipe clamps. Piping restraint at mechanical couplings shall be as acceptable to the Engineer.

K. Plug Valves

1. Plug valves shall be the eccentric plug, non-lubricated type, with ductile iron body, welded nickel plug seat, resilient-type neoprene coated plug, stainless steel, sleeve- type bearings, and multiple stem packing. Valves shall have 100 percent port opening. All 4-inch and 6-inch exposed plug valves shall have lever operators unless otherwise shown on the contract drawings, quarter turn to full open position with extension pipe. Exposed plug valves of 8-inch and larger shall have geared operators and handwheels or operating nuts with extension stems couplings, bearing plate and wall brackets as shown on the contract drawings. Geared operators shall be sized and designed for the full differential pressure rating of the valve. External fasteners shall be 316 stainless steel whether the valve is exposed or buried.

2. Buried plug valves shall have mechanical joint ends, and operating nut. Exposed plug valves shall conform to ANSI B16.1, 125 PSI flanged ends. Plug valve bolt threads shall be coated prior to assembly with a compound to prevent seizing.

3. Plug valves shall be rated for 175 PSI operating pressure. The valve shall be rated "bubble tight" with the rated operating pressure applied on either side of the plug. For valves greater than 12 inches shall be rated for 150 PSI operating pressure.

4. Plug valves shall be installed so that so the plug seats when closed against the normal direction of flow, or as directed by the Engineer. Where plug valves are installed horizontally the plugs shall open towards the top of the body.

5. All buried plug valves shall be furnished with a buried service-type gear operators. Buried valve shall be furnished with a roadway box and operating stem extension to bring the operating nut within 12 inches of finished grade. Extension stems shall be securely attached to the valve operating nut (no shear pin will be allowed as bolt) and a two-inch square operating nut shall be welded to the top of the extension stem. If shear pin protection is required, a separate device shall be placed at ground level area to facilitate

quick replacement during emergency situations. Spacer discs or rods shall be installed in the valve box as required to center the extension stem. Extension stems shall be as recommended by the manufacturer of the valve with which it will be installed. Orientation of buried plug valves shall be below:

a) In plug valve shut position, flow of sewage is in face of plug

b) In plug valve open position, plug rotates 90 degrees to open

6. As part of the shop drawing submittals, the manufacturer shall provide the number of turns to fully open the valve from the closed position.

7. Plug valves shall be manufactured by DeZurik, Val-Matic, or equal.

8. Extension stems shall be provided for operation of valves where required or shown in the Contract Drawings. Extension stems shall be made from extra heavy duty galvanized steel, sized so as to transmit full torque from the operating mechanism to the valve without binding, twisting or bending. Extension stems shall be complete with coupling for attachment to the valve stem for non-rising stems and a 2-inch operating nut.

9. Stem guide shall be high-strength cast iron and installed as necessary but at a minimum so that extension stems do not go unsupported for lengths more than eight feet.

L. Resilient Seated Gate Valves

1. Gate valves 4-inches and larger shall conform to the applicable requirements of AWWA C509 for resilient seated gate valves.

2. Gate valves shall be cast iron body, with a ductile iron wedge encapsulated by a bonded-in-place elastomer. Resilient seated gate valves shall provide full pipe opening when opened fully. Valves shall be constructed with bolted bonnets and provided with cast iron stuffing boxes having bolted followers. Bonnet and packing gland bolts shall be 316 stainless steel. Exposed gate valves shall have non-rising stem, handwheel operator, and integral ANSI B 16.1 Class 125 flanged ends. Buried gate valves shall have non-rising stem, nut operator and mechanical joint ends.

3. All buried gate valves shall be furnished with a roadway box and operating stem extension to bring the operating nut within 12 inches of finished grade. Extension stems shall be securely attached to the valve-operating nut. A two-inch square operating nut shall be welded to the top of the extension stem. Spacer discs or rods shall be installed in the valve box as required to center the extension stem. Extension stems shall be as recommended by the manufacturer of the valve with which it will be installed.

4. Exposed gate valves 4- inches and larger shall be by Clow, Mueller, or equal. Buried gate valves shall be Style 3067-01 manufactured by M&H Valve Co., Mueller, or equal.

5. Gate valves 3 inches and smaller shall be bronze, non-rising stem, solid wedge, screwed bonnet, screwed ends, 125 psi rating. Valves shall be Figure 107 as manufactured by Stockham, Lukenheimer Figure 2127 or equal.

M. Check Valves

1. Check valves 3-inch and larger shall be the heavy-duty clapper swing check type. It shall open smoothly at pump start and close quickly and quietly on pump shut down. When closed, the valve shall seat drop tight. Check valves shall meet or exceed the requirements of AWWA C508. Check valves shall be suitable for use in the horizontal or vertical position.

2. The body shall be heavy-duty, high strength cast iron and shall have a removable cover for inspection and removal of the clapper assembly. Check valves shall have integral ANSI B16.1 Class 125 flanged ends and a stainless steel or bronze replaceable body seat. The valve body shall be designed to provide full flow with the valve swung open 30%.

3. The disc shall be cast iron and faced with a renewable disc seat ring of BUNA-N rubber, held in place by a bronze or stainless steel follower ring and stainless steel screws. The disc nut shall be bronze or stainless steel with stainless steel cotter pin to prevent loosening.

4. The disc arm shall be ductile iron suspended from and keyed to a stainless steel shaft and supported on each end by heavy bronze bushings with o-ring seals or adjustable graphite packing.

5. The check valve shall be supplied with a steel external lever and adjustable weight to assist in valve closing Check valves 3-inches and larger shall be manufactured by GA Industries, Clow, M&H, or equal.

6. Check valves smaller than 3 inches shall be bronze, swing type, with screwed cap suitable for seat regrinding, Figure B-364 as manufactured by Stockham, or equal.

7. The check valve shall be supplied with a hold open device for backflushing.

N. Rubber Flapper Check Valve (When indicated on the drawings)

1. The rubber flapper check valve shall have a cast iron body and cover with stainless steel bolts. The body shall be long pattern design with integrally cast-on end flanges. The flapper shall be Buna-N having an “O” ring seating edge and be internally reinforced with steel. Flapper shall be removable without the need to remove the valve from the line.

2. Check valves shall have a full pipe size flow area and the seating surface shall be on a 45° angle requiring the flapper to travel only 35° from the closed to the full open position. The check valve shall be rated for an operating pressure of psi.

3. Where indicated on the drawing the check valve shall be provided with an external backflow device meeting OSHA requirements. The backflow device shall be constructed of bronze meeting the requirements of ASTM B-584 and shall be capable of being removed from the valve without removing the check valve from the line or taking the pump off service. The valve shall be APCO, as manufactured by Valve & Primer Corp., Schaumburg, Illinois.

O. Pressure Gauge Taps and Shutoffs

1. Pressure gauge taps shall be provided on the suction and discharge line of each pump.

2. Fittings

a. Quick Connect Stems: Shall be Type 316 stainless steel, full flow type, Y2-inch female NPT stem with protector cap, Swagelok "QF" series or equal. Quick connect stems shall be fully compatible with the quick connect body furnished with the pressure gauges. Both stem and body shall be of the same manufacturer.

b. Ball Valves: Shall be Type 316 stainless steel body, stem and ball with Teflon seat and packing, spring return handle to the fully closed position, Marpac, PBM, Flow- Tek or equal.

c. Service Saddles: Shall be bronze or nylon-coated iron with double stainless steel straps for use on pump discharge installations, Smith Blair or equal. Furnish bronze bushings as required for Y2-inch NPT connections.

d. Nipple: Shall be Schedule 80, seamless, Type 316 stainless steel conforming to ASTM A312-89 with threaded ends.

P. Pressure Gauges

1. Pressure gauges, unless otherwise specified shall be bourdon-tube type with measuring element of phosphor-bronze. Gauges shall be 4-1/2-inch diameter, glycerin filled, white dial with black numbers, and Y2-inch NPT connection on the underside. All gauges shall have an accuracy of plus or minus one percent of full-scale range. Gauges shall include a stainless steel diaphragm seal (glycerin filled) with bleed pet cock on lower half (wastewater side), and 316 SS. quick connect fitting to match the quick connect stems in subsection 15210.02-M.2.a. of this Section.

2. Note: The gauge assembly should not be installed directly into the pump, but into a straight length of pipe. The nipple must not be installed in a tapped hole in the piping. Use either a welded-on "Thread-o-Let" connection (3000 psi rating standard) or a service saddle. The service saddle should have either a bronze or coated iron saddle with a double stainless strap.

3. Pump discharge pressure gauges, where shown on the Contract Drawings, shall have a dual scale reading in psi and feet of water with full scale not greater than 2 times or less than 1.25 times the pump design TDH.

4. Pump suction piping (except wet pit submersible pumps), where shown on the Contract Drawings shall have a compound pressure and vacuum gauge with scale indicating psi and feet of water from -7.5 psi to +7.5 psi.

Q. Surge Relief Valve

1. The surge relief valve shall be of the spring relief type with hydraulically-damped cylinder. The valve body shall be angle design and constructed with a cast iron body and

cover/yoke assembly to withstand severe shock conditions. The body shall be a 90 degree, long radius angle pattern to permit side or downward discharge. The valve exterior shall be coated with red phenolic primer paint.

2. A cover/yoke assembly shall provide an air gap between the surge valve and hydraulic cylinder. The valve stem shall be connected to the hydraulic cylinder by means of a self-aligning, universal connector to ensure a smooth and positive opening, without binding, during shock opening of the valve.

3. The hydraulic cylinder shall be removable from the valve without dismantling or removing the valve from the line.

4. Closing speed shall be externally adjustable by means of a color-coded, micrometer control valve.

5. The valve disc shall be normally closed against system operating pressure by means of a spring plus hydro-pneumatic accumulator. When the system pressure exceeds the factory valve setting, the surge relief valve shall open immediately to relieve the pressure surge and close slowly at a controlled rate as the system pressure returns to normal by means of the hydraulic cylinder.

6. The valve disc shall be cast iron or steel and have a renewable, resilient seat secured in place by an alloy bronze or stainless steel retaining ring and stainless steel screws. The body seat shall be alloy bronze or stainless steel.

7. The pressure relief valve shall quickly open when the system pressure exceeds the spring setting, remain open as long as the pressure exceeds this setting, and slowly close drop tight when the pressure subsides below the spring setting.

8. The valve shall be APCO Series 3000 Angle surge relief as manufactured by the Valve & Primer Corporation.

R. Mud Valves

1. Non-rising stem; to be cast stainless steel as manufactured by Trumbull or equal.

2. Refer to Section 15400.02.H in Supplement to the Design Manual.

S. Quick Connect Couplers (Valve Vault)

1. Quick connect couplers need to be female type with dust plug. Quick connect couplers 4-inches and larger shall be 316 stainless steel, cam-and groove type male couplers, ANSI B16.1 Class 125, flange type (FLA) adapter with cam lock type locking handles. Provide dust caps with stainless steel security chain with each coupler. Bodies and locking handles shall be type 316 stainless steel. Gasket shall be Buna-N. Couplings shall be Ever-Tite, Dixon or equal.

2. Quick connect coupler shall be used when the riser sections are 4-inches. Over 4-inch risers require a blind flange.

3. Bypass riser shall be the same size as the forcemain.

S. Rubber Expansion Joints

1. When shown the drawings, rubber expansion joints shall be installed between rotating/vibrating equipment and piping as indicated. Expansion joints shall be designed and selected to withstand the test pressures specified for the pipeline in which they are to be installed.

2. Straight-run rubber expansion joints shall be of the single, filled-arch, spool type with split retainer rings and have a minimum lateral movement of 0.3 inches. Straight-run rubber expansion joints shall be Proco Products, Mercer Rubber Company, Metraflex Company or equal.

3. Reducing rubber expansion joints shall be of the single, filled-arch, eccentric type with split retainer rings and have a minimum lateral movement of 0.3 inches. Straight- run rubber expansion joints shall be Proco Products, Mercer Rubber Company, Metraflex Company or equal.

4. The tube shall be of single piece construction and extend to the outside edge of the flanges. The flanges shall be full-face with fabric reinforced rubber. The exterior surface shall be oil resistant. Split retainer rings shall be galvanized steel.

5. Provide control rods of sufficient number and size for the peak operating pressures expected and a surge pressure of 220 psig. Control rods, nuts and washers shall be of matched grade, heat treated steel. Rubber washers shall be placed between the control rod/nut washers and the control rod plates to further isolate vibration. Provide galvanized steel control rod flange plates supplied by the joint manufacturer.

T. Pump Vents and Drains

1. Provide stainless steel pump vents and drains in accordance with Drawings

## 15210.03 EXECUTION

A. Piping system Installation

1. The Contractor shall verify all dimensions of pipes, valves, fittings, and equipment so that pipe work will fit properly and conform to general arrangement shown on the Drawings. Pipe, valves, fittings and related accessories shall be carefully examined for defects before installing and no defective pieces shall be installed. Pieces shall be thoroughly cleaned before installation and shall be kept clean and dry.

2. Threads shall be standard, clean-cut and tapered. All pipe shall be reamed free from burrs and kept free of scale or dirt. Threaded joints shall be made up with lubricating oil and graphite or graphite pipe joint compound applied to male thread only. The use of red or white lead will not be permitted. Complete threaded joints shall not have more than two

threads exposed when made tight. Threads shall comply with ANSI Specifications No. B-2.1.

3. All gaskets between flanged connections and fittings shall be rubber meeting the requirements of AWWA C 115.

4. Flange bolts, nuts and washers shall be 316 stainless steel for metal pipe, with good sound well fitting threads; the nuts shall be cold punched, hexagonal, trimmed and chamfered. Heads, nuts and threads shall be United States Standard sizes. Bolts shall be of such length as to project one-quarter inch beyond the nut when the flanged joint gasket is assembled. Bolt threads shall be coated prior to assembly with a compound to prevent seizing. Compound shall be specifically designed for stainless steel applications.

5. Solvent-welded polyvinyl chloride (PVC) pipe joints shall be made with a solvent cement supplied or recommended by pipe manufacturer. Socket and plain ends shall be clean and dry; a thin application of solvent shall be applied to both socket and plain end, the plain end inserted to the socket shoulder and given one-half turn to ensure proper distribution of solvent. Following jointing operation, the joint shall be immobilized for not less than four hours, or as recommended by the manufacturer. Solvent welding operations shall be conducted in well-ventilated areas, remote from open flames, sparks, or other combustion hazards. Solvent welding operations shall be conducted in strict conformance with manufacturer's temperature recommendations.

6. During construction, the Contractor shall keep ends of pipes or conduits, and equipment connections, closed with caps, plugs, or wooden flange covers, so as to prevent entrance of dirt, building materials or other foreign matter.

7. Prior to drilling holes for anchors, supports, hangers, etc., in structural or building work, the Contractor shall secure permission from the Engineer.

8. Specialties shall be installed in strict accordance with the manufacturer's recommendations.

9. Provide an insulating union, coupling or flange connector for corrosion control wherever pipes of dissimilar metals join. Connectors shall include an approved type dielectric separator.

10. Wall castings and sleeves shall be provided in walls and floors for the passage of all pipes as specified and as shown on the Drawings. The boxing out of concrete for installation of any wall castings or sleeves will not be permitted. Pipe sleeves shall be provided where pipes and tubing pass through walls, floors, and partitions. Sleeves shall be placed during construction and at no time shall drilling or jackhammers be used. Space between pipe, tubing, or insulation and the sleeve shall be not less than 1/2-inch. Securely hold sleeves in proper position and location before and during construction. All sleeves shall be of sufficient length to pass through entire thickness of walls, partitions or slabs. Sleeves in floor slabs shall extend Y2-inch above the finished floor. Modular rubber seal-wall sleeve systems shall be in accordance with the seal manufacturer's printed instructions and as specified.

11. Polyvinyl Chloride (PVC) piping shall be installed in conformance with the requirements of ASTM D2855, ASTM F402, and the piping manufacturer's recommendations, subject to the approval of the Engineer.

12. Piping/flange alignments at pump casing connections shall meet the following standards in order to minimize piping/casing strain:
    a. Mating flanges shall be concentric to within 1/16-inch tolerance unbolted
    b. Mating flange faces shall be parallel to within a tolerance of no greater than Y2 the gasket thickness unbolted.
    c. Flange face separation shall be no more than 1/8-inch beyond the normal gasket thickness unbolted.

13. Pipe supports must be adjustable, unless noted otherwise by Engineer.

B. Piping Modifications

Piping shall be modified or relocated where necessary to accommodate the work only with the approval of the Engineer.

C. Piping Tests

1. All tests shall be performed in the presence of the Engineer. All necessary labor, tools, equipment and materials, including gauges shall be supplied by the contractor. No additional compensation will be allowed for these tests and any defective items discovered during the performance of such tests shall be satisfactorily repaired or replaced at the discretion of and to the complete satisfaction of the Engineer.

2. Piping shall be adequately braced and supported during tests to prevent movement, displacement or damage upon application of test pressure. Equipment used in the testing shall be subject to the approval of the Engineer.

3. The Contractor shall not apply test pressures to existing piping systems. New piping systems shall be isolated and capped or plugged before tests are carried out. Where any section of new piping cannot be isolated for testing, the test shall be conducted in actual use conditions.

4. Some or all of the instruments and equipment connected to the piping systems may not be designed for the test pressures specified herein. All such instruments and equipment shall be disconnected, and open ends of pipelines shall be capped or plugged before tests are carried out.

5. All pressure gauges used in testing shall be calibrated, within six months prior to use, by an independent testing agency. A copy of the calibration report shall be submitted to the Engineer.

6. Interior Piping

    a. Maintain the test pressures for at least two hours with no pressure drop. Test piping systems in accordance with the following schedule:

| System | Testing Medium | Testing Pressure |
|---|---|---|
| Exposed Pressure, Piping 3 inches & Larger | Water | 150 psi |
| Exposed Pressure, Piping 3 inches & Smaller | Water | 150 psi |
| High Pressure or Gas Piping | Air | 150 psi |
| Low Pressure or Gas Piping | Air | 25 psi |

b. Piping not passing pressure tests shall be repaired or replaced and retested as specified to the satisfaction of the Engineer.

END OF SECTION

# SECTION 15400

# PLUMBING

## 15400.01 GENERAL

A. Description

1. This division of the Specifications covers water and drain system plumbing and includes all piping, meters, valves, appurtenances, permits, permit costs, connection fees and includes the coordination of the plumbing with all other trades. All piping, valves, and equipment shall be new, and shall be installed completely in every detail.

2. In general, Drawings for the work are diagrammatic and show the location, type and size of piping, plumbing fixtures and accessory equipment. The Contractor shall furnish all fittings necessary for the proper installation of the work. The Contractor shall verify all necessary dimensions before installing any of the work, and shall check his layouts to allow clearance required for other work as shown on the Drawings.

B. Submittals

1. Submit shop drawings for the yard hydrants, service valves, hose bibs and backflow preventers in accordance with Section 5.04 of the "General Provisions".

2. Submit operating and maintenance data for the backflow preventer and box hydrant.

3. Submit certificate of compliance for copper pipe, soil pipe and hose.

4. Submit certification that backflow prevention (BFP) device is inspected, tested and certified by a person certified to test BFP; device to be tagged and dated.

C. Permits, Licenses and Inspections

1. The Contractor shall obtain and pay for all permits required by Anne Arundel County.

2. All work shall conform to all applicable local codes.

3. Upon completion of the entire system covered by these Specifications, a certificate of approval from the different departments having jurisdiction shall be obtained and then delivered to the Engineer. This certificate will in no way relieve the contractor from the terms of his warranty.

## 15400.02 MATERIALS

A. General

All materials shall conform, as applicable, to the following designated standards with latest addenda and errata. Materials not designated herein shall comply with the Standard Specifications and Details.

Cast iron soil pipe and fittings A40.1(ANSI)

Cast iron screwed fittings B 16.4 (ANSI)

Cast iron drainage fittings B 16.12 (ANSI)

Copper tubing types K, L, M H23.1 (ANSI)

Solder-type copper fittings B16.22 (ANSI)

B. Piping

1. Water piping below grade shall be type K copper tube. Water piping above grade shall be type K copper tube. Water pipe shall comply with ASTM B88.

2. Soil pipe below grade shall be standard weight cast iron bell and spigot type. Soil waste and vent pipe above grade shall be standard weight cast iron, or Schedule 40 galvanized steel with black drainage pattern cast iron fittings or drainage weight copper, or plastic drainage pipe and fittings.

C. Joints

1. Joints for above grade copper piping shall be solder-type or compression pattern. Joints for buried copper piping shall be a compression pattern.

2. Soil pipe joints shall be rubber gaskets.

D. Valves and Specialties

1. Gate valves shall be bronze, non-rising stem, solid wedge, figure B-1 15 as manufactured by Stockham, or equal.

2. Backflow preventer shall be reduced pressure principle type, Series 909 as manufactured by Watts, or equal, installed with double check valves on water supply line. Backflow preventer shall meet ASSE 1013 standard.

E. Hose

Hose shall be fifty-foot length, industrial quality with single-ply braided reinforcement rated for working pressure of 100 psi, minimum. Hose shall be nominal 3/4-inch inside diameter and shall be fitted with standard 3/4-inch brass threaded hose couplings. An adjustable spray

pattern brass nozzle with standard 3/4-inch threads for connection to the hose shall also be furnished.

F. Yard Hydrant

Yard hydrant shall be non-freeze post type with ¾- inch IPS pipe connection and 3/4-inch threaded hose connection. Yard hydrant shall have cast bronze casing, neoprene plunger, removable bronze operating parts, aluminum protective shield, and shall be 30 inches in height above finished grade. The yard hydrant shall be in compliance with ASSE 1057.

G. Wall Hydrant

Wall hydrants shall be a quarter turn non-freeze wall hydrant, cast bronze with stain finish Nikalloy face with ¾-inch H.P.T. outlet, The wall hydrant shall be Josam HYDRASAN II 71200 or equal.

H. Mud Valve

1. Mud valves shall be of the iron body, bronze-mounted type with non-rising stems, flanged ends. Provide an extension stem with 2-inch square operating nut and extension stem support as required. Provide stainless steel supports and external stems.

2. The frame, yoke and disc shall be of cast iron conforming to ASTM A 126 Class B.

3. The stem, stem nut and seats shall be bronze. The stem shall be machined with accurately cut, modified ACME threads.

4. The gate seat shall be rolled into a dove-tailed groove under pressure to make one inseparable unit. The body seat ring shall be threaded and screwed into place in the frame. Both gate and body seat ring surfaces shall be machined to a smooth finish.

5. Mud valves shall be manufactured by M&H, Trumbull or equal.

I. Sump Pump

1. Furnish and install submersible sump pumps where shown on the contract drawings.

2. The sump pump shall be driven by a continuous duty, single-phase, 120-volt, 60 Hz motor with Class F insulation and thermal overload protection. The motor shall be provided with thrust and radial bearings to carry all loads which may be imposed upon it under all operating conditions. Furnish with a carbon/ ceramic mechanical seal. The motor shall be UL approved for sump pump application and shall be provided with sufficient cord length to plug into the adjacent 120VAC receptacle. Pump shall pass 3/4-inch solids, deliver 50 gallons per minute against 15 feet head and shall be driven by a 1/2 horsepower motor suitable for the service and available current characteristics and designed for submersible operation.

3. Provide an adjustable, piggy-back mounted, float switch for automatically controlling the pump.

4. Provide sump pumps consisting of gray Class 30, ASTM A-48 cast iron casing and motor housing, heavy duty stainless steel shaft, and cast iron or bronze, non-clog impeller capable of passing up to ½ inch diameter solids. Impeller shall be threaded or keyed and bolted to the shaft.

5. The capacity of the pump shall be_____GPM at_____feet of head.

6. The discharge shall be 1-1/2 inch N.P.T. unless otherwise indicated on the drawings. Each sump pump shall have a 1-1/2 inch diameter discharge line with double check valves and isolation ball valve.

7. Sump pumps shall be Goulds, Hydromatic, or equal.

**15400.03 EXECUTION**

A. Workmanship

1. Copper pipe at solder joints shall be cut squarely and mechanically cleaned. Tube ends shall be reamed. Joint shall be made with a non-corrosive flux and 50-50 solder. No ferrous metal pipe will be permitted.

2. Threaded pipe shall be reamed and pipe compound shall be applied to male thread only.

3. Pipe below ground shall be laid on undisturbed earth and bell holes shall be excavated for piping. Bolts, nuts, etc. on pipe below grade shall be given two coats of non- corrosive bituminous compound.

4. Where pipe passes through walls or floors, provide sleeves and seals as specified in Section 15210. All piping shall be properly supported with compatible non-corrosive hangers.

5. Pipe shall be kept closed and free of dirt during construction.

6. Unions shall be installed at all equipment and valves.

7. Contractor shall determine the exact location of utilities and shall check elevations before installing pipe.

8. All cutting of walls, floors, etc., for the passage and accommodation of pipes and all closing up of superfluous openings that may be caused by any work under this Contract, and the removal of all debris caused by said work, shall be performed by the Contractor. No cutting of any walls or floors shall be done until the condition of cutting has been approved by the Engineer.

END OF SECTION

# SECTION 15550

# FUEL TANK

## 15550.01 GENERAL

A. Description

This Section shall include a complete fuel storage system for the emergency generator including fuel piping and accessories, vent piping, connections and level monitoring required for a complete installation.

B. Quality Assurance

1. All equipment furnished under this Section shall be furnished by manufacturers who meet the quality, workmanship, and experience requirements as specified in the General Provisions section of this Contract.

2. The generator set fuel tank system, including all accessories described herein, shall meet all standards established by:

   a. Underwriters Laboratories.

   b. National Electrical Manufacturers Association.

   c. National Electrical Code.

   d. National Fire Protection Association Pamphlets 30, 31, 37, 76A and 110.

   e. MIL-STD-705B.

C. Related Work Specified Elsewhere

1. Power Generation: 16200

D. Submittals

1. Submittals and samples shall be submitted in accordance with the provisions set forth in the General Provisions.

2. Prior to obtaining any material in connection with this Section, detailed shop drawings on all material shall be submitted.

3. Submittals shall contain a material list with manufacturer data describing the material and showing its compliance with specifications, associated standards and test requirements.

4. Submittals shall include mounting details, field specific piping diagrams indicating connections to the tank and emergency generator. Submittals shall include catalog cuts and

installation diagrams for the tank and level gauge.

5. Submit a copy of manufacturer's warranty for the fuel storage tank.

6. Submit a copy of the factory and field pressure tests.

7. Submit Operations and Maintenance Manual in accordance with the General Provisions.

## 15550.02 MATERIALS

A. General

1. The Contractor shall furnish and install a fuel storage tank as specified herein. The Contractor shall field verify pipe fittings, connections and accessories required to connect the fuel storage tank to the emergency generator.

2. The tank shall be sized to hold #2 diesel fuel for 24-hours of operation at the running load of the facility.

B. Fuel Storage Tank - General Requirements

1. An above grade fuel storage tank with secondary containment shall be provided with a capacity of____ gallons. The fuel storage tank shall carry a minimum of a 30 year written warranty and shall include the following:

   a. Fuel tank shall be UL Listed and shall comply with the requirements set forth in UL 142, "Steel Above Ground Tanks for Flammable and Combustible Liquids" or UL 2085 “Protected Aboveground Tanks for Flammable and Combustible Liquids”.

   b. The tank shall be constructed of a minimum of 7- gauge (3/16") carbon steel of all welded construction with factory applied , coating for all exposed metal surface.

   c. Tank shall include readily accessible grounding lugs located on the tank saddle. Ground lugs shall be factory connected to the tank with a #4, solid copper grounding conductor.

   d. Fuel storage tank shall be suitable for storage of No. 2 diesel fuel oil.

   e. Threaded pipe connections, bushings, end caps, and couplings for tank fill, generator pump suction, fuel return, overflow, vent and drain shall be provided as required to perform connections as indicated herein and on the Contract Drawings. Tank fill pipe shall be capped and shall be readily accessible for filling the tank. Tank fill cap shall include provisions for locking the cap in the closed position.

   f. Black iron vent piping shall be provided for venting the tank.

   g. An emergency vent shall be provided in accordance with the requirements of applicable local codes.

   h. Level gauge shall be a mechanical float type device suitable for outdoor installations.

Level gauge shall be provided with required couplings and connections. In addition to the level gauge, a dipstick shall be provided for manual level inspection of the tank. The level gauge and dipstick shall be clearly marked and shall be coordinated with the tank size to monitor the entire capacity of the tank. Fuel level gauge shall be manufacturer's standard product for the tank.

2. Fuel Oil Piping

   a. Piping between the fuel tank and the generator shall be minimum 1/2" diameter or of sufficient size as required by the generator manufacturer. Piping material shall be ASTM A53, schedule 40, black iron. Pipe shall be provided with couplings and fittings as required to connect the fuel tank to the generator engine. Pipe shall be provided with necessary hangers and supports between the fuel tank and the generator to support the piping.

   b. Flexible connections shall be provided for the supply and return line connections at the generator engine. Valves that are required to be installed by applicable NFPA or local codes shall be provided.

   c. Where shown on the drawings, provide a bronze, fuel shut-off ball valve on the fuel supply line where it passes up thru the generator channel frame.

   d. Tank shall be provided with a foot valve on the fuel suction line.

   e. Fill and vent piping shall be ASTM A120, schedule 40, black iron sized as indicated on the drawings. Vent piping shall be provided with a whistle signal as indicated on the drawings, Scully Ventalarm® Signal or equal. Fittings shall be 150 lb., black malleable iron screw fittings, ANSI B16.3. All tank openings shall be provided with suitable caps. Provide a bronze, drain ball valve w/plug at lowest point of tank for removal of any accumulation of water in the tank. The fill pipes shall be extended minimum 4-foot above finished grade. The fill pipes shall be solid-piped from fill cap to tank with no flexible joints in between.

   f. Piping between the fuel tank and the generator flexible fuel connectors as well as fill and vent piping shall be primed and painted black.

   g. Provide threaded weld-o-let fittings for all tank penetrations.

   h. For free standing fuel tanks provide an anti-siphon valve per NFPA 30. Valve shall be a solenoid valve with a manual override feature. Valve shall be located on top of the fuel tank, be normally closed, have Viton seals and operate on the same voltage as the generator battery. Valve shall be preceded in the fuel line by a 100 mesh strainer and have stainless steel, quarter-turn ball valves on both sides. Provide Morrison Brothers 710MO or equal.

3. Signs and Labels

   a. Warning signs and labels shall be provided on the exterior of the fuel storage tank to indicate fuel content, tank filling procedures and any applicable information as required to meet applicable code requirements. Signs and labels shall be suitable for installation in outdoor locations.

b. Fuel piping shall be appropriately labeled as follows:

FUEL SUPPLY LINE
FUEL RETURN LINE
FUEL FILL LINE
FUEL VENT LINE

4. Free Standing Fuel Tanks (Located inside buildings)-Additional Requirements

a. Where indicated, interior fuel tank shall be free-standing, of dual-wall construction of carbon steel. The tank shall meet the 25-psi hydrostatic test and have four times the maximum recommended set weight load testing as required by UL and ULC. The tank shall include manual overfill protection, internal baffles, lockable 2" fill cap, and fuel level gauge. The tank shall be finish painted black.

b. The vent pipe shall extend a minimum of 12 feet above grade. Stainless steel anchors and supports shall be provided to support the vent pipe. Provisions shall be provided to ground the vent pipe to the underground grounding grid.

c. The fill pipe shall be extended through the building and placed at an accessible height to permit filling from outside of the building. All penetrations through the building wall shall be made watertight.

5. Sub-Base Fuel Tanks (Located on exterior generators)- Additional requirements.

a. When indicated, the fuel tank shall be a double-wall sub-base system mounted beneath the engine generator set. The tank shall mount directly to the generator set skid and include manual overfill protection, internal baffles, lockable 2" fill cap, 4" vents and fuel level gauges.

b. The tank shall be provided by the generator set manufacturer and installed prior to shipment to the site.

c. The fill pipe shall be extended thru the enclosure accessible enough to permit filling from outside of the enclosure. All penetrations through the enclosure shall be made wate1iight. Fill connection shall be a minimum of 4-ft above finished grade.

d. The primary tank normal and emergency vents and secondary emergency vents shall extend outside the generator enclosure. Vents shall extend a minimum of 1-ft above the fill pipe or as required by State and local codes.

e. Furnish and install a tank level gauge on the primary tank. Level gauge shall be the self-acting, continuous direct reading type. Furnish and install an inspection port and level indicator for the secondary containment tank.

f. The vent pipe shall be extended minimum 1-foot above fill pipe.

g. If the tank height exceeds 18-inches above grade, a platform that conforms to applicable OSHA regulations will be provided to allow access to all panels and equipment associated with the generator.

h. Provide factory-applied coating on entire sub-base fuel tank exterior surface (bottom, top and sides) with Line-X™ or Rhino™ coating.

i. Provide spill box that includes a stainless-steel hasp

j. Walkways shall be inspected, regularly and as necessary, and maintained in a safe condition.

1. Provide five (5) gallon spill box.

## 15550.03 EXECUTION

A. Installation

1. The fuel storage tank and accessories shall be installed in the location indicated on the Contract Drawings. The fuel storage tank shall be installed according to applicable codes and the manufacturer's instructions.

2. Piping shall be installed above and below grade were shown on the Contract Drawings. Piping shall be supported as required to make connections between the fuel storage tank and the emergency generator.

3. Tank shall be grounded to the facility ground loop.

4. Warning signs and labels shall be installed in such a manner as to meet local code requirements. Warning signs and labels for fuel piping shall be installed after heat tracing, insulation and metal jacket have been installed and tested for operation.

5. Contractor shall provide all fuel to run the generator for startup and testing procedures of the emergency generator system. Upon completion of all testing the Contractor shall fill the tank to maximum capacity with winter mix No. 2 diesel fuel oil.

B. Tank shall be pressure tested at the factory and in the field at 5 psig for a minimum of one hour. Test reports shall be submitted with the Operations and Maintenance Manuals.

C. Properly prepare and touch-up all painted surfaces, which have been nicked, scratched, chipped or c01Toded during construction including piping.

END OF SECTION

# SECTION 15600

# HEATING, VENTILATION AND AIR CONDITIONING

## 15600.01 GENERAL

A. General Requirements

1. Provide all labor, materials, equipment, and services necessary for and incidental to the complete installation and operation of all mechanical systems.

2. All work under Section 15600 is subject to the General Conditions and Special Provisions for the entire Contract.

3. Unless otherwise specified, all submissions shall be made to, and acceptances and approvals made by the Engineer.

4. Conform to the requirements of all rules, regulations and codes of local, state and federal authorities having jurisdiction.

5. Perform the work in first class, substantial and workmanlike manner.

6. Coordinate the work of all trades.

7. Be responsible for all construction means, methods, techniques, procedures, and sequences used in the work. Furnish and use all tools, equipment, and materials necessary to properly perform the work.

B. Arrange piping, ductwork, equipment, and other work generally as shown on Contract Drawings, providing proper clearances and access. Carefully examine all contract drawings and properly fit work in each location without substantial alteration. Where departures are proposed because of field conditions or other causes, prepare and submit detailed drawing for acceptance. The right is reserved for the Engineer to make reasonable changes in location of equipment, piping, or ductwork up to time of rough-in or fabrication.

C. Contract Drawings are generally diagrammatic and all offsets, fittings, transitions and accessories are not necessarily shown. Provide all such items as may be required to fit the work to the conditions.

D. Permits and Fees

The contractor shall be solely responsible for acquisition and payment for all required permits and compliance with applicable codes.

E. Examination of Site

The contractor shall examine the site, determine all conditions and circumstances under which the work must be done, and make all necessary allowances.

F. Materials and Equipment

1. Materials and equipment installed as a permanent part of the project shall be new, unless otherwise indicated or specified, and of the indicated type and quality.

2. Where material or equipment is identified by proprietary name, model number and/or manufacturer, furnish named item, or its equivalent, subject to its acceptance.

3. The suitability of the named item only has been verified. Where more than one item is named, only the first named item has been verified as suitable. Substituted items, including items other than the first named, shall be equal or better in quality and performance to that of the specified items, and must be suitable for available space, required arrangement, and proposed application. Submit any and all data necessary to determine suitability of proposed items.

4. Substitutions will not be permitted for specific items of material or equipment where noted.

G. Fire-Safe Materials

Unless otherwise indicated, materials shall conform to UL, NFPA, or ASTM Standards for fire safety with fire and smoke hazard ratings not exceeding flame spread of 25 and smoke developed of 50. The materials, containers, or shipping cartons shall bear certification that the product complies with these requirements.

H. Referenced Standards, Codes and Specifications

Material, equipment, installation and procedure shall conform to applicable requirements of current referenced standards, codes and specifications.

| Abbreviations | |
|---|---|
| AMCA | Air Moving and Conditioning Association |
| ANSI | American National Standards Institute |
| ASHRAE | American Society of Hearing, Refrigerating and Air Conditioning Engineers |
| NEC | National Electrical Code |
| NEMA | National Electrical Manufacturer Association |
| NFPA | National Fire Protection Association |
| SMACNA | Sheet Metal and Air Conditioning Contractors National Association |
| UL | Underwriters' Laboratories |
| COMAR Title 26.02.03 | Code of Maryland Regulations (COMAR), Title 26.02.03 Control of Noise Pollution |

I. Submittals, Review and Acceptance

The contractor shall make submittals to the Engineer for review in accordance with Section 5.04 of the "General Provisions".

J. Shop Drawings

The contractor shall make submittals to the Engineer for review in accordance with Section 5.04 of the "General Provisions".

K. Supervision and Coordination

1. Provide complete supervision, direction, scheduling, and coordination of all work under the Contract, including that of subcontractors, using full attention and the best skill. Be responsible for all work and make all subcontractors, suppliers, and manufacturers fully aware of all requirements of the Contract.

2. Coordinate rough-in of all work and installation of sleeves, anchors, and supports for piping, ductwork, and all other work specified.

3. Coordinate required electrical work.

L. Cutting and Patching

1. Accomplish all cutting and patching necessary for the installation of work specified. Damage resulting from this work to other work already in place, shall be repaired at Contractor's expense. Where cutting is required, perform work in a neat and workmanlike manner. Restore disturbed work to match and blend with existing, using materials compatible with the original. Use mechanics skilled in the particular trades required.

2. Do not cut structural members without approval.

M. Penetration of Waterproof Construction

1. Coordinate the work to minimize penetration of waterproof construction, including roofs, exterior walls, and interior waterproof construction. Where such penetrations are necessary, provide all necessary curbs, sleeves, flashings, fittings and caulking to make penetrations absolutely watertight.

2. Where sleeves are installed in waterproof membrane construction, provide clamping collars and flash membrane to fitting.

N. Electrical Requirements

1. The available electrical service shall be 277/480 volt, 3 phase, 60 Hertz, 4 wire, unless otherwise indicated on the drawings.

2. Control and interlock wiring for the equipment furnished will be provided under Section 16100, unless otherwise indicated in Section 15600 of these specifications.

O. Electric Motors

1. Motors shall be quiet operating, continuous duty high efficiency type suitable for the specific application. Select motors in accordance with nameplate ratings for voltage, horsepower, and ambient temperature. Size motors so that operating loads do not exceed nominal horsepower ratings, exclusive of any service factors.

2. Motors shall conform to applicable NEMA and IEEE Standards.

3. Unless otherwise indicated motors 3/4 horsepower and larger shall be suitable for operation on 480 volt, 3 phase power supply.

4. Unless otherwise indicated motors smaller than 3/4 horsepower shall be suitable for operation on 120 volt, single-phase power supply.

5. Motor enclosures shall be open-drip proof, unless otherwise indicated.

6. Motors shall be constant-speed, 1800 rpm maximum.

P. Drive Guards

1. Provide safety guards on all exposed motor couplings, and other rotating machinery. Provide fully enclosed guards where machinery is exposed from more than one direction.

2. Fabricate guards of heavy gauge steel, rigidly braced, removable, and finished to match equipment. Provide openings for tachometers.

Q. Supports, Hangers and Foundations

1. Provide supports, hangers, braces, attachments and foundations required for the work. Support and set the work in a thoroughly substantial and workmanlike manner without placing strains on materials, equipment, or building structure.

2. Supports, hangers, braces, and attachments shall be standard stainless steel, aluminum or FRP manufactured items or fabricated structural shapes.

3. Provide vibration isolators, flexible connections, supports, anchors, and foundations to prevent the transmission of vibration from equipment to the building structure.

R. Provisions for Access

1. Provide adequate access to all equipment, valves, dampers, controls, and other devices requiring maintenance or manual operation.

S. Cleaning, Painting and Finishes

1. Provide protective finishes on all materials and equipment. Use coated or corrosion-resistant materials, hardware and fittings throughout the work to the maximum extent feasible. Paint bare, untreated ferrous surfaces with rust- inhibiting paint. See "Painting", Section 09900.

2. Clean surfaces prior to application of insulation, adhesives, coatings, paint, or other finishes. See "Painting", Section 09900.

3. Provide factory-applied finishes where specified. Unless otherwise indicated, factory-applied paints shall be baked enamel with proper pretreatment.

4. Protect all finishes and restore damaged finishes to their original conditions. See "Painting", Section 09900.

5. The preceding requirements apply to all work whether exposed or concealed.

6. Remove all construction marking and writing from exposed equipment, ductwork, piping and building surfaces.

T. Protection of Work

1. Protect work, material and equipment from weather and construction operations before and after installation. Properly store and handle all materials and equipment.

2. Cover temporary openings in piping, ductwork, and equipment to prevent the entrance of water, dirt, debris, or other foreign matter.

3. Cover or otherwise protect all finishes.

U. Operation of Equipment

1. Clean all systems and equipment prior to initial operation for testing, balancing, or other purposes. Lubricate, adjust, and test all equipment in accordance with manufacturer's instructions. Do not operate equipment unless all proper safety devices or controls are operational. Provide all maintenance and service for equipment that is operated during construction and protect the equipment.

2. Where specified, or otherwise required, provide the services of the manufacturer's factory-trained servicemen or technicians to start up the equipment.

3. Do not use mechanical systems for temporary services during construction unless authorized in writing by the Engineer. Where such authorization is granted, temporary use of equipment shall in no way limit or otherwise affect warranties or guarantees on the work.
4. Upon completion of work, clean and restore all equipment to new condition.

V. Testing, Balancing and Adjustment

1. Perform all required tests to demonstrate that the work is installed and operating properly. Where formal tests are required, give adequate notices and perform preliminary tests to assure that work is complete and ready for final test.

2. Balance and adjust all systems, equipment, and controls to operate at the proper capacities in a safe, efficient and stable manner.

W. Guarantee

1. In addition to and in conjunction with the guarantee requirements specified herein before, provide complete periodic service and maintenance of all work during the guarantee period, without additional cost to the Owner.

2. Service and preventative maintenance shall be performed as scheduled in the equipment manufacturer's manual and agreed upon in advance by the County. The work shall include necessary cleaning, lubrication, adjustment, repair, replacement, renewal, and preventive maintenance as recommended by the equipment manufacturers or otherwise required by the equipment. Include labor, materials, and services, complete, including belts, air filters, packings, lubricants, and other materials.

X. Provide complete and prompt emergency service on a 24 hour basis with a minimum four hour response time.

## 15600.02 MATERIALS

A. Ductwork

Duct systems shall be as follows:

1. Emergency Generator:

   General exhaust and ventilation: low-pressure aluminum.

2. Wet Well:

   a. General exhaust and ventilation: Schedule 80 FRP, PVC pipe or stainless steel or aluminum duct sheet.

   b. The fabrication and installation of all duct systems together with related equipment shall comply with the standards of the National Fire Protection Association, as set forth in NFPA Standard No. 90A, as well as with the requirements of the Sheet Metal and Air Conditioning Contractors' National Association, Inc., and the latest edition of the ASHRAE Guide.

   c. Low pressure aluminum ductwork shall be sheet aluminum conforming to Commercial Designation 3003 Temper H14 and Duct Sheet. Duct gauges, jointing and reinforcement shall conform to Section 1 of the Duct Manual and Sheet Metal Construction for Ventilation and Air Conditioning Contractors' Association.

   d. All sheet aluminum ductwork shall be erected in a first-class and workmanlike manner, rigidly and permanently secured in place. Suitable hangers shall be provided, securely attached to building construction by means of bolts, clips or inserts. Hangers shall be aluminum structural shapes, flat bars, formed straphangers; the use of wire will not be permitted. Hangers shall not pass through or be inside duct. Where ducts pass through walls, all space around the ducts at such locations shall be gasketed and watertight.

   e. Flexible connections of neoprene NFPA approved non-flammable sheet material shall

be provided in the duct system at all fan inlet and outlet connections and where indicated on the Drawings.

f. Duct turning vanes shall be provided in all rectangular duct turns where the centerline radius is less than 1 1/2 times the width of the duct. Turning vanes shall be the air-foil type with extended trailing edges.

B. Motor Operated Dampers

1. Provide all dampers except motor operated dampers provided with exhaust fans.

2. Dampers shall be tight shut-off, low-leakage substantially built in galvanized steel frames and provided with 6063T5 heavy gauge, extruded aluminum blades. Frames and blades shall be constructed of .125" thick(minimum) materials. Maximum spacing of blade axis to be 6-inches. Provide friction-free nylon bearings and steel linkages and pivot pins with suitable locking retainers. All dampers shall be provided with blade edge seals of neoprene, and blade end seals of neoprene to ensure tight closure, opposed blade type. Dampers shall be Johnson Service Co. D-1300, Pacific Air Products Co., Ruskin CD50 or equal, and shall meet named manufacturer's leakage criteria.

3. Provide electric motor operators for all dampers. Electric motor operated dampers, including linkage, motors, interconnection wiring and all accessories shall be provided. All electrical work shall meet all provisions of Section 16100 - ELECTRICAL. Motor operators shall be Johnson M-80 Motors with spring return, Honeywell, or equal with auxiliary switches for control of motor position, 120 volt 1 phase, 60 Hertz, motor operator with mounting bracket for two position operation and linkage.

C. Backdraft Dampers

1. Furnish and install where indicated Model CBD-6 heavy-duty backdraft dampers as manufactured by Airstream Products Company, Inc., Air Balance, Inc., or equal. Dampers mounted in vertical position shall have damper counterbalance adjustment arranged for horizontal damper operation.

2. All frame members shall be of 16 gauge cold roll formed galvanized steel with 3/4- inch stops forming an integral part of the head and sill members to ensure positive stop and closure at these points.

3. Blades shall be roll formed of aluminum alloy 1 100-H-14, 0.05 1 minimum gauge and have three integral stiffening ribs running the full length of each blade. Provide felt blade edge seals.

4. Pivot axle and blade grab shall be one piece-molded nylon reinforced with fiberglass for added strength and positive power transfer between blades and blade linkage. No mechanical fasteners or spot welds shall be used to attach blade axle brackets to blades.

5. Bearings shall be stainless steel balls riding in cadmium-plated steel raceways; bearing assembly shall be seated on extruded shoulder holes pierced in hat channel frames.

6. Counter-balance shall be provided to the assembly by means of an adjustable weight.

7. All blades shall be linked together to enable uniform movement with all linkage concealed in the jambs.

D. Ventilation Blowers

1. Blowers for ventilation of wet wells and dry wells shall be general-purpose nonmetallic fans of the capacities scheduled on the Contract Drawings. Fans shall be tested and rated in accordance with the AMCA Standard Test Code and shall bear the AMCA Certified Rating Seal.

2. Blowers shall be direct drive, arrangement 4 where if available for the blower sizes listed in the schedules on the contract drawings. When belt drives must be provided, bearings shall be constructed of the heavy-duty, self-aligning ball bearing type. A complete weather cover shall protect the shaft, bearings, sheaves, belts and motors and shall be FRP, aluminum or stainless steel attached with stainless steel fasteners.

3. Fan housings shall be FRP construction and UV stabilized. Fan shall be of corrosion resistant polyester resin with flame retardant additives to reduce the flame spread rate below 25 for a Class I flame spread rating. Fan wheels shall be backwards curved design and shall be of fiberglass material. Fan housings shall be provided with a ½" (min) NPT bottom drain with plug at the lowest point of each housing. Fan wheels shall be dynamically balanced.

4. The support pedestal base shall be constructed of heavy gauge steel and shall have (1) coat primer and (2) coats epoxy. All fasteners and anchors shall be stainless steel.

5. Provide grease-lubricated ball bearings with a minimum L-10 life of 50,000 hours.

6. Provide TEFC motors which will supply the required torque at any point on the blower operating curve without overloading. The motors shall have a 1.15 Service Factor, Class F insulation if blowers require motors of 1 HP or more. Mill and Chemical Duty rating. Motors shall conform to NEMA MG1.

7. Furnish factory supplied rubber vibration mounting and rails. Provide the fans with suitable flexible connections for connecting to ductwork.

8. Fan inlets shall be equipped with a removable stainless steel bird screen.

9. Fans shall be controlled as indicated diagrammatical on the contract electrical drawings.

10. PVC or aluminum rain hoods shall be provided on the inlet for the wet well blower.

11. Blower/Fan assemblies specified herein shall be as manufactured by M. K. Plastics of Mooers, New York, Hartzell Fan, Inc. of Piqua, Ohio, Ceilcote Air Pollution Control, or equal.
12. Blower fans shall provide a minimum of 30 air changes per hour for intermittent operation and 12 air changes per hour for continuous operation.

E. Wall-Mounted Propeller Exhaust Fans

1. The propeller exhaust fan shall be of the direct drive type as scheduled and shall be provided with a single speed motor, motor operated dampers, wall box, and motor side guard screen.

2. The fan frame and venturi shall be constructed of heavy gauge, powder-coated steel with the fan assembly bolted to the venturi for ease of removal and service. All fasteners shall be corrosion resistant.

3. Wall box and guard screen shall be fabricated from 14 gauge or heavier aluminum with a ½" expanded metal grid screen cover.

4. Propeller shall consist of stamped aluminum blades securely attached to a heavy gauge aluminum spider by means of stainless steel rivets.

5. The fan shall bear the AMCA Certified Rating label.

6. The fan motor voltage, phase and horsepower shall be as shown on the schedules. Motor shall be sized for 150% of rated fan horsepower capabilities.

7. Propeller fans shall be manufactured by PennBarry Type P Breezeway, Loren Cook SWD, Greenheck, or equal.
8. Exhaust fans shall provide a minimum of 10 air changes per hour.

F. Unit Heaters – Electric

1. Propeller type unit heaters equal, with heating and air delivery capacities and electrical characteristics as indicated on the drawings. The heating coil shall consist of metal sheath fin tube electric heating elements. The rust resistant fin tube elements shall be attached to the junction box with leak-proof threaded fittings for maximum corrosion resistance.
2. Automatic reset thermal overheat protection shall be wired for instantaneous pilot operation of control contactor.
3. Unit heater motor shall be totally enclosed continuous duty with permanently lubricated ball bearings for long life. Motor shall be resistant to moisture and corrosion, and shall be provided with integral overloads. Each unit shall be equipped with a combination fan guard/motor support resiliently mounted at four points to absorb motor vibration.

4. Unit fans shall be aluminum directly connected to the fan motor, dynamically balanced and designed specifically for unit heater application. All metal surfaces of casing shall be phosphate coated to resist corrosion and finished in baked enamel.

5. Heaters shall be controlled by a remote wall-mounted thermostat and as indicated diagrammatically on the Drawings.

6. Heaters shall be capable of operation on voltages indicated on the Drawings, with capacities as scheduled on the Drawings.

7. Unit heaters shall be provided with a NEMA 4X molded fiberglass junction box. Junction box shall house built-in controls which shall include two power contactors (primary and backup), motor contactor and fused transformer for 120V control circuit.

8. Unit shall be provided with a stainless steel swivel-mounting bracket.

9. Unit shall be provided with a built-in overload protection provided by an epoxy sealed automatic and manual (back up) reset thermal cutout.

10. Unit shall be provided with an epoxy sealed thermal fan delay allowing the fan motor to continue to operate after the heating thermostat has been satisfied to maximize transfer of generated heat to space being heated and extend operating life of the heating element.

11. All hardware shall be stainless steel.

12. Unit shall be provided with an adjustable louvered outlet grille to direct air flow up or down. Grille shall be painted with one coat of zinc chromate primer and two coats of corrosion resistant paint.

13. Unit shall be provided with a heavy-gauge rear wire grille to protect against accidental contact with the fan. Finish shall be the same as the grille.

14. Unit shall be provided with a pilot light to indicate power on.

15. Unit shall be suitable for water contact associated with periodic water wash downs.

16. Heater shall be controlled with an integral thermostat.

17. Electric Unit Heaters shall be as manufactured by Chromalox Model HDH, Indeeco TRIAD or Ruffneck CR1 Triton Series washdown and corrosion resistant heaters.

G. Thermostats (Electric)

1. Thermostats shall have fully field adjustable temperature range with mounting box, and standard cover. Unit shall contain no moving parts except integral set point adjustment and shall have a thermistor-sensing element. Units shall have "Marine Finish" suitable for use in corrosive and wet areas. Thermostats shall have key adjustment and limit stops and NEMA 4 enclosures.

2. All thermostats shall be protected by a heavy-duty cast and die formed guard. Guards shall be securely fastened to the building construction independent of the thermostat. Guards fastened directly to the thermostat are not acceptable. Plastic guards are not acceptable. All room thermostats shall be mounted 5 feet 3 inches from the finished floor except where directed otherwise.

3. Where identified on plans, provide a dial timer with preset thermostat such that the thermostat is bypasses for a specified period of time and then resumes standard thermostat setting.

4. Heating thermostats shall have a temperature range of 40 degrees F. to 90 degrees F., Penn TY26, Honeywell, or equal.

5. Ventilating thermostats shall have a temperature range of 60 degrees F. to 90 degrees F., Penn TY26, Honeywell, or equal.

H. Dehumidifier

1. The Contractor shall provide and install an industrial rated dehumidifier in location shown on the Contract Drawings. Dehumidifier unit shall be mounted and supported on a painted steel wall shelf approximately 3 feet above the finished floor. Shelf shall be reinforced to support weight of the dehumidifier unit.
2. The dehumidifier unit shall have a rated dehumidification capacity of a minimum of 60 pints per day at 70 °F. Unit shall have a minimum operating temperature range of 40 °F with automatic coil ice detection and thawing function. The unit shall be controlled by an integrated adjustable humidistat to automatically start and stop operation at the desired set point. Unit shall be provided with required drain tube attachment and condensate pump.
3. The unit shall be provided with 16-gauge steel galvanized or painted cabinet and a removable and cleanable foam air filter. Contractor shall provide one spare air filter.
4. The industrial dehumidifier unit shall be rated for continuo\ls operation on 120 Volt, 60 Hertz AC power. Unit shall be powered with plug and cord to a dedicated wall receptacle or hardwired to circuit as indicated on the drawings.
5. The Contractor shall provide and install a PVC drain tube from the dehumidifier unit to the floor drain. Contractor shall coordinate the PVC pipe size with the dehumidifier unit. Coordinate the actual routing of the drain line and floor drain with the Engineer during installation. .
6. Dehumidifier unit shall be manufactured by Oasis, Woods, or equal.

## 15600.03 EXECUTION

Install as shown on Contract Drawings, in accordance with these Specifications and Manufacturer’s recommendations.

END OF SECTION

# SECTION 15880

# AIR HANDLING

## 15880.01 GENERAL

A. Description

This Section includes the requirements for ductwork and accessories as indicated in accordance with the Contract Documents.

B. Quality Assurance

1. Materials and installation shall be in accordance with the latest revisions of the following codes, standards and specifications, except where more stringent requirements have been specified herein:

   a. American Society for Testing and Materials (ASTM).

      i. ASTM A525, Standard Specification for General Requirements for Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process.

      ii. ASTM B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

   b. Underwriters Laboratories (UL).

   c. National Fire Protection Association (NFPA).

   d. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA).

   e. HVAC Duct Construction Standards.

   f. Air Diffusion Council (ADC).

      i. ADC 1062 - Certification, Rating and Test Manual.

   g. American National Standards Institute/National Fire Protection Association (ANSI/NFPA).

      i. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilating Systems, 1985.

   h. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE).

      i. ASHRAE 70 - Method of Testing for Rating the Airflow Performance of Outlets and Inlets, 1972.

2. Submittals

    a. Submittals shall be developed and submitted in accordance with the General Provisions, and shall include, but not be limited to, the following:

        i. Submit catalog data for the following items:

            a. Ductwork.

            b. Ductwork hangers and supports.

            c. Turning vanes.

            d. Duct access doors.

            e. Flexible connections.

            f. Registers (Supply, Return, and Exhaust).

            g. Slot diffusers (Supply, Return, and Exhaust).

            h. Volume control dampers.

    b. Shop drawings shall be submitted for air distribution systems, and shall include scaled layouts of ductwork and accessories, including equipment connections, dampers, access doors, turning vanes, fittings, approximate locations of supports, flexible connections, approximate locations of duct drains and test ports, registers, diffusers, and wall and floor penetrations. Shop drawings shall be provided on scaled building layouts with a minimum scale resolution of 1/4" per foot. Duct elevations shall be noted on the shop drawings at each elevation change.

    c. Shop drawings shall be submitted for wall and floor penetrations (scaled drawings not required), and shall include framing details and duct support details. Details shall be submitted for fire/smoke damper installation at wall and floor penetrations.

    d. Submit details of intermediate structural steel members required to span main structural steel for the support of ductwork.

    e. Submit method of attachment of duct hangers to building construction.

## 15880.02 MATERIALS

A. General

1. Ductwork shall conform to the more stringent recommendations of the current editions of the ASHRAE handbook and of the Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) "HVAC Duct Construction Standards", and "Accepted Industry Practice for Industrial Duct Construction" published by SMACNA.

a. Elbows for rectangular duct shall be full radius with single thickness vanes or square with airfoil double vanes. Elbows shall be provided with turning vanes. Turning vanes shall be of the double thickness type and shall have non-adjustable air turn of 45 degrees. Turning vanes shall be roll-formed with surfaces and edges smooth and free from edge friction and blade turbulence.

b. Transitions shall be made with a maximum angle of 15 degrees. Where 15-degree transition is not available (only due to space restraints), optional transitions angles shall be provided upon approval from the Engineer.

c. Similar materials shall be used within a given unit of ductwork including joints and bracing angles, hangers, bolts, rivets, and other fabrication materials.

d. Welded construction shall be performed in accordance with SMACNA, "Guidelines for Welding Sheet metal."

e. Ductwork shall be provided with instrument test holes at appropriate locations for insertion of 3/4-inch pivot tubes and similar air measuring instruments. Such openings shall be equipped with removable, tight fitting caps or plugs.

f. Provide fiberglass reinforced polyester duct (FRP), including all fittings, for supply fans and associated exhaust ducts, and as shown on the drawings. Pressure classification of duct shall be as indicated on drawings.

g. The duct for Supply Fan located at Wet Well shall be wall supported to 3 feet above the max water level, and the duct for Supply Fan and Exhaust Fan located at Dry Well shall be wall supported to 1 foot below the well ceiling.

2. Connectors

Rectangular and round ductwork connectors shall consist of two mating connector flanges with an integral sealant gasket between the two mating flanges, and a roll formed closure ring that is drawn tight with a bolt and nut, and shall conform to Ductmate Industries, Inc. standard 25/35 connector system, or equal.

3. Duct Hangers

a. Sheet metal straps

i. Stainless steel straps shall conform to ASTM A 924 and ASTM A 653 for coating designation G-90.

ii. Ductwork straps shall be 1/8-inch thick by 1-inch wide bands or 1-inch by 1-inch channel or angle supports. Perforated bands shall not be acceptable.

b. Hangers shall be of the trapeze type with straps extending around the bottom of the duct. Straphangers shall be limited to duct hanging distances of 3 feet maximum. Above 3

feet in length, threaded rod and unistrut trapeze supports shall be used. Material of rod and unistrut shall match the requirements of the strap system.

c. Fabricate ductwork hangers in accordance with SMACNA "HVAC Duct Construction Standards".

d. Rod Type Hangers: 316 stainless steel, unless otherwise specified; fully threaded or threaded each end, with 2 removable nuts each end for positioning and locking rod in place.

4. Miscellaneous Fasteners and Upper Hanger Attachments

a. Sheet Metal Screws, Machine Bolts and Nuts: Stainless steel.

b. Concrete Inserts: Stainless steel; continuously slotted or individual inserts.

c. C Clamps: Stainless steel Fee & Mason Co.'s 255L, or equal; with locking nut, and 2555 with retaining strap.

d. Metal Deck Ceiling Bolts: Stainless steel 8-Line Systems, Inc.'s Fig. 83019, or equal.

e. Machine Bolt Expansion Anchors (Stainless Steel):

f. Non-caulking single unit type: FS FF-S-325, Group II, Type 2, Class 2, Style 1.

g. Non-caulking double unit type: FS FF-S-325, Group II, Type 2, Class 2, Style.

h. Self-drilling type: FS FF-S-325, Group III, Types 1 and 2.

B. Access Doors

1. Access doors shall be fabricated from aluminum or stainless steel, one gauge heavier than the ductwork.

2. Access door shall be the maximum size recommended by the duct manufacturer.

3. Access doors shall be of the removable, sandwich-type construction, consisting of three layers of precision stamped .030" stainless steel. The inside door will combine two layers of metal spot welded together at the rim.

4. Doors shall seal against the duct wall with a closed cell neoprene gasket (UL 94 HF 1 listed) with a service temperature range of -70 F to 220 F. The gasket shall be permanently bonded to the inside of the door to eliminate leakage. Doors shall be capable of withstanding a minimum of 5" WG pressure with no noticeable leakage.

5. Duct Access Doors shall be as manufactured by:

a. Ductmate Industries, Inc.

b. Vent fabrics.

C. Turning Vanes

1. Turning vanes shall be fabricated from stainless steel. Turning vanes shall be of the double thickness type and shall be provided at each elbow unless otherwise noted. Dual blades shall be roll-formed with surfaces and edges smooth and free from edge friction and blade turbulence. Blades and side pieces shall be cut to size and assembled in the field.

2. Turning Vanes shall be as manufactured by:

a. Barber Coleman “Airturns”.

b. Tuttle & Bailey “Ducturns”.

D. Flexible Connection

1. Flexible connections at fans shall be provided with a minimum space between flanged connections of six inches. Flexible connections shall have a minimum density of 30 ounces per square yard, and shall be constructed of neoprene coated woven glass fiber fabric conforming to the requirements of NFPA 90A. Flexible connections shall be UL listed, fire-retardant, waterproof, and shall be crimped into a stainless steel retaining strip at the ends.

2. Flexible Connectors shall be as manufactured by:

a. Vent fabrics.

b. Elgen Manufacturing Co.

E. Supply Air Register

1. Supply air register shall be of the rectangular supply register type and shall be provided with curved louver grille. Register shall be provided with two way positioning of grilles and an integral opposed blade control damper designed for cooling, heating and ventilating systems. Register shall include the following:

2. Register shall be designed for surface mounting.

3. Register shall be fabricated from aluminum.

4. Louvers shall be individually adjustable with spacing at 1-inch on center.

5. Register shall be provided with countersunk screw holes with recessed screws.

6. Opposed-blade volume damper shall be adjustable from the register face.

7. Registers shall be as manufactured by:

a. Anemostat model X1CV20.

b. Titus.

F. Duct Drains

Duct drains shall consist of a 6" length of 3/4" diameter pipe with isolation ball valve and a threaded end cap. Drainpipe shall be stainless steel. Ball valves shall be stainless steel for aluminum duct drains.

G. Volume Control Dampers

1. Rectangular duct damper

a. Rectangular dampers shall be of the opposed blade type with manual operator. Damper inside dimension shall match the dimension of the ductwork for installation.

b. Frame, blades, axles and linkage shall be fabricated from stainless steel, unless otherwise indicated.

c. Bearings shall be of the oil impregnated bronze ball type.

d. Pressure drop shall not exceed .80-inch wcg at the full open position with a face velocity of 3900 fpm.

e. Manual operated dampers shall be provided with an actuator capable of locking the blades at any set position between 0 and 100 percent open. Actuator shall be heavy-duty quadrant type with minimum 12-inch lever arm.

f. Blades shall have a maximum width of 9-1/2 inches and shall be a minimum 16-gauge stainless steel.

g. Blade stops shall be constructed of 16-gauge stainless steel.

h. Dampers shall be suitable for operation in minimum air stream temperature of 250 F.

i. Blade operator axles shall be a minimum size of ½-inch diameter for damper widths through 36-inches, and ¾-inch minimum size for damper widths 48-inches and larger.

j. Dampers shall be sleeve frame type and shall be provided with 0-100 percent scales on actuators indicating percent open.

k. Rectangular duct dampers shall be as manufactured by:

i. American Warming & Ventilating: Model VC-41.

ii. Louvers & Dampers: Model CD-400.

## 15880.03 EXECUTION

A. General

1. Where insulated or uninsulated ducts pass through walls, floors, or partitions, the opening in the construction shall not exceed 1/2-inch clearance on all sides. Where ducts pass through walls, floors, or partitions required to have a fire resistance rating and fire dampers are required, the opening in the construction shall not exceed 1/2-inch clearance on all sides and shall be filled solidly with an approved material capable of preventing the passage of flame and hot gases sufficient to ignite cotton waste when subject to the same NFPA 251 time-temperature fire conditions required for fire barrier penetration. Where smoke dampers are installed, proper clearance for expansions shall be maintained.

2. Duct sizes shown on drawings are in terms of width by depth. Duct sizes are inside clear dimensions.

3. Pitch horizontal ductwork not less than 1-inch in 10 feet with duct drain located at low point toward direction of airflow.

4. Flexible duct connections shall be provided at the inlet and outlet of fans, dehumidifiers, gas duct heaters, and air handling units where connected to ductwork. They shall be secured with 1/8-inch by 1-inch retaining strips, bolted or riveted on 6-inch centers. There shall be at least 1-1/2 inch slack at each joint.

B. Access Doors

1. Access doors shall be provided for all fans, inlet or outlet of volume and control dampers, and upstream and downstream of elbows where turning vanes are used.

2. Minimum size access door shall be 10"x10". Access doors shall be sized to enable inspection and maintenance of all items associated with equipment listed above.

3. Provide access doors on each side of the generator fan exhaust duct minimum 24" wide by 36" high.

C. Clean dust, dirt, debris, and scrap metal from inside ductwork prior to start-up.

D. Exhaust branch connections to main ducts shall be 45-degree lateral wye type installed with the direction of airflow.

E. Each run of flexible duct shall be a maximum of 6 feet in length.

F. Installation

1. Install interior ductwork as high as possible and parallel to walls.

2. Ductwork shall not be installed in front of doors or windows. Ductwork shall not block access to equipment

3. Install products in accordance with the manufacturer's instructions.

4. Check locations of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and light arrangement.

5. Install duct mounted diffusers and registers with airtight connection.

6. Provide bituminous coating to all aluminum ductwork and material, in contact with concrete surfaces.

G. Exterior Finish

Attach sponge rubber padding to exterior corners of horizontal ductwork installed less than 7'- 0" above finished floor.

H. Adjusting and Balancing

Test, adjust and balance ductwork in accordance with the requirements of Section 15990.

END OF SECTION

# SECTION 15885 – ODOR CONTROL SYSTEM

## 15885.01 GENERAL

A. Description

1. Description

These Specifications are intended to give a general description of what is required, but do not cover all details that will vary in accordance with the requirements of the equipment furnished. They are, however, intended to cover the furnishing, delivery and installation of all materials, equipment and appurtenances for the complete Odor Control System herein specified, whether specifically mentioned in these Specifications or not.

The Contractor shall furnish and install a pre-engineered Odor Control System as hereinafter specified.

B. Warranty

1. All equipment supplied under this Section of the Specifications shall be warranted for a period of two (2) years from date of conditional acceptance.

2. The equipment shall be warranted to be free from defects in workmanship, design, and materials. If any part of the equipment should fail during the warranty period, it shall be repaired or replaced and the system restored to service at no expense to the Owner.

C. Description of System

1. The Manufacturer shall furnish a complete, pre-engineered Odor Control System and shall be responsible for the design and fabrication of the complete system within the limits specified herein. Site preparation shall be the responsibility of the Contractor as described and as specified.

2. The following minimum design parameters shall be incorporated into the Manufacturer's design:

| | | |
|---|---|---|
| a. | Average Influent concentration: | Less than 15 ppm Hydrogen sulfide ($H_2S$) |
| b. | Airflow rate: | ___scfm @ __” wg |
| c. | Removal rate: | >99.0% $H_2S$ |
| d. | Design carbon life: | >1 year |

D. Quality Assurance

1. All equipment and material specified in this Section of the Specifications shall be furnished and coordinated by the Odor Control System Manufacturer.

2. All equipment furnished under this Specification shall be new and unused and shall be the standard product of manufacturers having a successful record of operation, manufacturing, and servicing similar equipment and systems.

E. Submittals

1. Copies of all materials required establishing compliance with the specifications shall be submitted to the Owner's Consulting Engineer in the form of a booklet or binder. Submittals shall include at least the following:

   a. Plan view drawing showing arrangement of the odor control unit.

   b. Product drawings and cut sheets on all furnished equipment.

   c. Detailed physical drawings of the odor control unit to include all external piping connections and associated sizes, and materials of construction.

   d. Product data sheets for the blower and drive motor including performance curve with operating point and data.

   e. Specification data for the activated media

F. Product Handling

1. All equipment items shall be properly protected (refer to manufacturer's installation, storage and handling guidelines) so that no damage or deterioration will occur from the time of shipment until installation is completed and the units and equipment are ready for operation.

2. All exposed blower and equipment openings shall be protected.

3. Proper care shall be taken to protect mechanical parts from the entrance of water during shipment, storage, and handling.

4. Each box or package shall be properly marked to show its contents.

## 15885.02 MATERIALS

A. General

1. All equipment furnished shall be new and suitable for the conditions of service to which they will be subject. Workmanship shall be of the highest quality and shall be carried out by competent and experienced workmen. All parts shall be protected so that no damage may occur during a long delay from time of shipment to time of completion of installation.

   a. Operating Conditions - The odor control system shall be suitable for long-

term operation under the following operating conditions.

1) Duty: Continuous
2) Ambient environment: Exterior
3) Ambient Temp. (°F): 25-105
4) Project site elevation (ft. MSL): __
5) Total air flow (SCFM): ___
6) Average influent H2S conc. (ppm): 15
7) Maximum influent H2S conc. (ppm): <50 ppm, intermittent
8) Removal required (%): >99.0% H2S

B. Carbon Adsorption Vessel

1. The adsorber canister shall be constructed entirely of 304L stainless steel. An air distribution plenum shall be located at the beginning throughpoint of the canister. Drilled or slotted pipe shall not be acceptable as an air distribution means. The canister shall have a centered bottom inlet and top outlet. The canister shall have an EPDM-gasketed, removable stainless steel full sized top lid secured with stainless steel 18-8 cap bolts and Nylock nuts for carbon replacement access. A 1/4" drain valve shall be located at the bottom of the piping header for the removal of condensate.

2. Design - The carbon adsorption vessel shall meet the following design criteria:

| | |
|---|---|
| a. Number of vessels (minimum): | 1 |
| b. Minimum diameter (in): | __ |
| c. Maximum height (in): | __ |
| d. Depth of carbon (in): | __ |
| e. Inlet size (in): | __ |
| f. Airstream Carbon Contact time (max) | 100 Lf/Mi |
| g. Media Life: | >1 year |
| h. Fan Noise Crieria: | <55 dB with acoustical enclosure |

B. Activated Carbon

1. The carbon vessel shall be filled with a total of 6 cubic feet of high H2S capacity catalytic type carbon. The carbon shall be designed for low pressure drop. Contractor to pout furnished media into canister and bold down the lid.

2. The catalytic carbon shall meet the following design criteria:

a. Odoroxidant Sp Media
   - Moisture content: 35% maximum

- Average crush strength: 35% minimum - 70% maximum
- Average abrasion: 4.5% maximum
- Bulk density: 50 lbs/ft$^3$ (800 kg/m$^3$)
- Nominal pellet diameter: 1/16" (1.587mm)
- Sodium permanganate content: 12% minimum

b. OdorCarb Ultra
- Moisture content: 5.0% maximum
- CTC: 55 minimum
- Base material: activated carbon
- Bulk density: 30-32 lbs/ft$^3$ (480-512 kg/m$^3$)
- Odormix SP Media shall be UL Class 1 listed.

C. Centrifugal Blower

1. The blower shall have a radial or backward inclined, non sparking wheel design with an aluminum housing, and be coated interior and exterior with two part powder coat epoxy. The blower shall be directly coupled to the drive and mounted in a common housing. Fan body model AF9-R10527.

2. Drive - The drive shall be a continuous duty, 208-230/460 Volt, 0.5 HP, 3 phase, 60 Hz, XP (Class 1, Div 1) electric motor. The motor shall be as manufactured by Leeson and shall be model 116190 XP or equal.

3. Design - The fan shall be designed to meet the following criteria:
   a. Number of fans: 1
   b. Capacity at design conditions (SCFM): __
   c. Discharge pressure (in. of water): __"
   d. Maximum inlet temperature (°F): 105
   e. Blower Speed,(base VFD) RPM: 1750
   f. Inlet size (in.): __
   g. Outlet size (in.): __

4. Weather Resistant Acoustical Enclosure

   a. All enclosure fasteners and hardware shall be stainless steel.
   b. The unit shall include an all weather sound panel specifically designed to withstand outdoor exposure in full sunlight, extreme weather conditions, and industrial environments.
   c. The all weather panels shall include an internal layer of U.L. classified Acoustiblok sound insulation material, plus a specifically engineered 2" thick weather proof sound absorbing material. Enclosure shall be suitably sized for motor and fan assembly provided and shall be mounted upon the odor control unit skid. Skid dimensions shall be __ft x __ft.
   d. NRC (Noise Reduction Coefficient) shall be 1.00.
   e. STC (Sound Transmission Class) shall be 29.
   f. UL std 7223 fire resistance shall be - Flame Spread 0; Smoke development 0.
   g. Assembly panels shall be UV tolerant, animal resistant, washable, and shall not support mold growth.

5. Panel construction
   a. Frame shall consist of 0.125" welded corrosion resistant 6063- T5 aluminum, mill finish
   b. Inward face of each panel shall consist of .040 corrosion resistant 5052-H23 aluminum alloy with 3/32" holes staggered on 5/32" centers
   c. The Outward face of each panel shall consist of .032 corrosion resistant 5052-H23 aluminum alloy, solid face, mill finish.
6. Vibration Isolators: Furnished by manufacturer.
   a. Quantity: 4.

D. PROCESS STREAM PIPING

1. Process stream piping contained within the odor control unit shall be schedule 10 stainless steel. The interior of all piping and canister(s) shall be coated with Heresite VR500. Sizes shall be as shown on the drawings.

E. SYSTEM WIRING

1. The blower shall be equipped with an explosion proof electrical motor connection junction box.

2. Field connection of a 460 volt, 3 phase, 60 Hz power supply to the controller shall be made in accordance with the National Electrical Code (NEC), and all other related local electrical and NFPA 820 fire code requirements.

F. ACCEPTABLE PRODUCTS

1. Odor Control System shall be Model _____ as manufactured by EZ Vent Mfg., Conowingo, MD, (410 658 2000) or equal. Items to be furnished by manufacturer shall also include one EZ Vent VFD controller, vibration isolators, and one full charge of media.

2. VFD Controller shall be Model _____ with UL508 listing.

G. OTHER MATERIALS

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

**15885.03 EXECUTION**

A. Installation

Installation by the Contractor of each equipment item shall be in strict accordance with the manufacturer's recommendations in the locations shown on the drawings. All cost for the installation shall be provided by the Contractor. The controller shall be located outside of both the pump station Class 1, Div 1 or Div 2 envelope and the odor skid class 1, Div 1 or Div 2 envelope.

B. Inspection, Start-up, and Operator training

A manufacturer's representative shall be present to perform the required inspection, start-up, and operator training services for the system. The Contractor is responsible to schedule this service with the manufacturer's representative. The Contractor shall inform the County and the Engineer 14 days prior to scheduled start- up, and operator training. The County may require to re-schedule.

C. Testing

After all equipment has been completely installed according to the direction of the Manufacturer, conducted in the presence of the Owner, tests shall be performed to indicate that the System operates satisfactorily and will meet the design criteria set forth in this Specifications Section. Manufacturer shall provide visual inspection at this time for any discrepancies, which Contractor shall correct. The field test shall demonstrate correct mechanical operation after system start-up. Field tests shall include all equipment included under this section.

**END OF SECTION**

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# SECTION 15990

# VIBRATION, TESTING, ADJUSTING AND BALANCING

## 15990.01 GENERAL

A. Section Includes

Vibration design and installation requirements for rotating equipment.

B. Related Sections

Section 11310 – Sewage Pumps.

C. System Description

Vibration requirements for rotating equipment furnished and installed in these specifications to assure that said rotating equipment will operate within vibration limits specified in Appendix D of these standards.

D. Design Vibration Requirements

1. Provide adequate pipe supports so that equipment will not carry the weight of the piping so as not to stress the machinery casing, put a strain on the shaft and bearings and set up a vibration which is difficult to correct.

2. The machine base of the rotating equipment shall be mounted on the sole plate and concrete sub-base in accordance with Standard Details PS-S2-6A/6B and in a manner that is level in both directions according to the machined surfaces on the base. If the sub- base is cast-in-place concrete, coordinate drawings to show details of steel reinforcement. The base is to be supported firmly by hold-down bolts all the way around the base and grouted when necessary.

E. Pump Requirements:

1. Provide proper sump pit design and suction line design per Hydraulic Institute Standards to avoid pre-rotation, vortexing and cavitation-related vibration problems. As part of this requirement, perform a net positive suction head available analysis (NPSHA) and include this information in the pump specification. The NPSHA shall be calculated for expected design flows and shall exceed the pump manufacturer's recommendations with an added margin of safety of not less than 2 feet.

2. Avoid applications where centrifugal pumps operate for extended periods of time in an adverse area of their performance curve. Example includes pumps operating at low flows and high head or near shutoff head. If such operation is necessary, pumps with heavy-duty shafts and bearings are to be specified. Excessive hydraulic radial loads developed in the volute casing and acting on the impeller from operation in

adverse hydraulic conditions cause excessive shaft deflection, vibration, rapid bearing and mechanical seal/packing wear and shaft fatigue.

## 15990.02 MATERIALS

A. Manufacturer's Vibration Requirements

1. Mounting feet or surfaces of rotating equipment shall be machined.

2. Base Structure: Cast iron or welded steel construction with ribs or bracing to prevent distortion and machine surfaces where equipment is to be mounted. Tolerance shall be +/- 0.002 inches between mounting pads. Base structure shall have mounting holes around the perimeter. Center distance between these holes shall not be more than 30 inches

3. Hollow Baseplates: Holes sufficiently large on top of baseplate for filling and venting grout, throughout the entire underside of the base. If cross-members are provided in the baseplate for added rigidity, provide grout vent holes for each base compartment.

B. Dynamic balancing and unbalance vibration of the rotating element (or rotor) shall be as follows:

1. Pump impellers shall be balanced in accordance with ISO 1940/1 – 1986E balance quality grade G2.5 or better. If the manufacturer's tolerance is more stringent, then that balance quality shall apply.

2. Motor rotors shall be balanced in accordance with NEMA MG-1, Part 7 standards to a Special Balance or Ultra Standard tolerance to give an amplitude of vibration of no more than 0.08 inches per second (peak) unfiltered vibration velocity on the bearing housings. If the motor manufacturer's tolerances are more stringent, then they shall apply.

C. Shaft Alignment Requirements: On coupled rotating equipment installation where driver and driven units are supplied as a factory mounted unit, shafts shall be aligned in angular and offset positions and within tolerances as specified in this section with all hold-down bolts/nuts tight.

## 15990.03 EXECUTION

A. Installer's Vibration Requirements

1. Sub-Base

a. Sub-base that supports the equipment base and made of concrete shall be reinforced with steel reinforcements of the proper design as indicated in Standard Details PS-S2-6A/6B.

b. The sub-base shall be level in both directions. Particular care shall be taken at hold-down bolt locations so that these areas are flat and level.

2. Machine Base

    a. Machine bases of rotation equipment shall be mounted on sub-bases in a manner that they are level in both directions according to machined surfaces on base.

    b. Leveling of machine bases on sub-bases and alignment of shafts between driver and driven unit shall be accomplished by use of stainless steel shim blocks and/or stainless steel precision cut shims.

    c. Provide shim blocks and shims at each anchor bolt. Blocks and shims shall be square shaped with "U" cut out to allow blocks and shims to be centered on anchor bolts. Shim blocks and shims shall be generously sized to provide solid support at each anchor bolt location.

3. Piping/flange alignment at machinery casing connections shall meet the following standards in order to minimize piping strain on the equipment:

    a. Mating flanges shall be concentric to within 1/16-inch tolerance unbolted.

    b. Mating flange faces shall be parallel to within the tolerance of no greater than one half the gasket thickness unbolted or 1/8", whichever is less.

    c. Flange face separation shall be no more than 1/8-inch beyond the normal gasket thickness unbolted, or relaxed expansion joint length unbolted; nor less than the relaxed expansion joint length by more than 1/16".

4. Machinery Shaft Alignment: All rotating motor-driven equipment shafts with couplings shall be aligned as installed on-site using a computer-aided optical laser shaft alignment system. As the shafts are rotated through 180 degrees, any parallel offset or angularity shall be measured by the laser position detectors. The position detector measurements shall automatically input to the computer, which calculates shaft misalignment from the beam deflection, and then converts shaft misalignment at the coupling to corrective measures/movements, to the nearest 0.0005 inches, at the machine feet in order to bring the motor and driven unit shafts into alignment within the tolerances specified in 15990.03B .

    a. Preliminary and final alignments shall be performed. Preliminary alignment shall occur before grouting of the base, connection the piping and cabling connections are performed. During preliminary alignment, soft foot function shall measure machine feet sitting unevenly on the foundation and determine the necessary corrections. Measurement of the amounts and directions of misalignment, calculations of corrective moves, and initial alignment shall be performed.

b. Following the completion of all connections and grouting, the final alignment shall be performed.

c. For machinery with couplings subjected to thermal growth during operation, the computer shall automatically calculate alignment specifications into the corrections such that when thermal growth is present, the machines will be positioned to grow into optimum alignment at operating temperatures. All data collected will be permanently recorded in a report and included in the final O&M manual for the equipment.

d. Shims used to adjust alignment shall be precision factory pre-cut stainless steel sized for the appropriate motor horsepower.

e. Accuracy of the optical laser alignment system shall be traceable to the National Institute of Standards and Technology. Allowable equipment tolerances are as set forth elsewhere in this Section.

f. Coupling manufacturer alignment tolerances shall not be used for shaft alignment tolerances. The tolerances specified in 15990.03B shall apply to both vertical and horizontal alignments measured at or calculated to the coupling centerline. In cases where the equipment manufacturer requires more stringent shaft alignment standards, the manufacturer's standards shall apply.

g. If the equipment comes as a factory mounted/aligned unit the shaft alignment shall be rechecked as installed on site and any misalignment corrected in accordance with these specifications and tolerance herein.

5. Prior to final shaft alignment, the following criteria must be met:

a. Machinery foundation must be installed as designed with the base parallel with respect to the machine's shaft on horizontally mounted machines.

b. Machinery must be free of piping strain. To check for piping strain, piping flanges should be loosened up separately with flange movement observed continuously. Should movement exceed 1/8- inch, piping strain is considered excessive and shall be corrected by adding or adjusting pipe supports, hangers, expansion joints, etc., per requirements of this Specification.

c. Machinery must be resting firmly on the mounting bases with equal loading on each support.

d. Horizontally mounted machinery (coupled) over 125 horsepower shall be provided with fine-thread jackbolts for horizontal alignment adjustments. Machine foothold down bolts shall be loosened before horizontal position adjustments are made with the jackbolts. All jackbolts shall be backed-off (1) turn after the alignment procedure is complete.

e. Machinery supports, , soleplates and baseplate pads shall be free of burrs, rust, scale and other obstructions

f. Stainless steel precision pre-cut shims shall be used to provide a firm, solid, adjustable link between machine and baseplate.

g. Machinery must be free of soft foot. To check for soft foot, the machinery must be firmly bolted to the baseplate. Each support foot is checked with the dial indicator and/or feeler gauges, loosening hold-down bolts one at a time. If movement exceeds 0.002 inches, soft foot is indicated. Shim and torque uniformly to minimize soft foot. (see Drawing #2 & #3 in Appendix A.)

B. Shaft Alignment Tolerances

Alignment Tolerances (in inches)

| RPM | Offset (inches) | Offset (Inches per Inch) |
|---|---|---|
| 900 | 0.006 | 0.0015 |
| 1200 | 0.004 | 0.0008 |
| 1800 | 0.003 | 0.0006 |
| 3600 | 0.002 | 0.0004 |

C. After installation the contractor shall demonstrate that all equipment is operating in a satisfactory manner. All adjustments shall be made to suit anticipated operating conditions. Each piece of machinery shall be tested to show that it operates quietly without excessive vibration, overheating, or signs of distress at specified capacity. The engineer shall be notified in advance of all tests, and all tests shall be conducted to his entire satisfaction. All tests shall be made by the manufacturers' representative and the results recorded and submitted to the County. Vibration testing and acceptance shall be done in accordance with the Performance Testing in Appendix B, D, and E of these design standards.

D. Manufacturer's certificates that the installation of the equipment is in accordance with the manufacturer's recommendations shall be secured by the contractor and submitted to the engineer.

E. Certification that the equipment shafts are aligned to the alignment tolerances specified.

F. Certification that equipment motors, impellers, rotors, etc. have been dynamically balanced within the tolerances specified.

END OF SECTION

# SECTION 15991

# HVAC SYSTEM ADJUSTING AND BALANCING

## 15991.01 GENERAL

A. Description

This Section includes requirements for adjusting and balancing of ventilation systems.

B. Quality Assurance

1. Equipment furnished under this Section shall be furnished by manufacturers who meet the quality, workmanship, and experience requirements as specified in the General Provisions Section of this Contract.

2. Adjusting and Balancing Agency's Qualifications: Firm certified by National Environmental Balancing Bureau (NEBB) in those disciplines similar to those required for this project. Firm shall not be the installer of the system being adjusted and balanced and shall otherwise be independent of the project. Firm shall be a member in good standing with NEBB for a minimum of five (5) years.

3. Comply with recommended procedures for examination, preparation, and performance of adjusting and balancing, as outlined in the referenced NEBB standard, for mechanical air and liquid distribution systems and their associated equipment.

4. Comply with ASHRAE recommendations pertaining to measurements, instruments, and adjusting and balancing; except as otherwise indicated.

C. Submittals

1. Submittals shall be developed and submitted in accordance with the requirements of the General Provisions and shall include, but not be limited to, the following:

   a. Submit name of the adjusting and balancing (AB) agency for approval within 30 days after award of Contract. Submittal shall also include certification by the adjusting and balancing agency-affirming membership in good standing with NEBB or Associated Air Balance Council (AABC) for the time frame specified herein.

   b. Adjusting and Balancing Reports

      i. Submit report(s) on NEBB or AABC forms. Submit draft copies of report for review prior to performance of adjusting and balancing Work. Include adjusting and balancing instrument calibration history with draft report.

      ii. Submit certified adjusting and balancing reports bearing the seal and signature of the Adjusting and Balancing Engineer. The reports shall be certified proof that the

systems have been adjusted and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the adjusting and balancing procedures; and are an accurate record of final quantities measured to establish the normal operating values of the system.

iii. Provide reports in soft cover, letter size, 3-ring binder, complete with index page and indexing tabs, with cover identification on front and spine. Include system schematic drawings and/or reduced drawings with air outlets and inlets, balancing dampers and fittings, and equipment identified to correspond with report forms. Include calibration histories of test instruments used.

iv. Report shall be divided by system type and subdivided within each type by individual systems (e.g., Exhaust Air System, Air Handling Unit Distribution System, etc.).

2. Submit detailed procedures, agenda, sample report forms indicating all adjusting, balancing and equipment data required, system schematics, and samples of patching plugs, stamped brass tags, and caulking sealant for approval prior to commencing system(s) balance.

3. Submit detailed drawings for non-ducted equipment balancing, including temporary ductwork size and details of temporary ductwork support, connection to equipment, as well as repair to equipment at the point of connection.

D. Sequencing and Scheduling

1. Sequence Work to commence after completion of system installation and before conditional acceptance of project.

2. Provide written notification to the Engineer a minimum of five (5) working days prior to the performance of adjusting and balancing Work. Perform adjusting and balancing work in the presence of the Owner's designated Representative.

E. Warranty

1. Adjusting and balancing results shall be warranted to maintain setting and adjustment and to perform as stated in the test report for 90 days from the date of final adjustments.

2. Balancing Contractor shall be subject to recall to the site to verify results before approval of the balancing test report.

## 15991.02 MATERIALS

A. Qualifications

Adjusting and balancing shall be performed by a company specializing in the adjusting and balancing of heating, ventilating and air conditioning systems specified in this Section having a minimum of five (5) years experience and shall be certified by AABC or NEBB. The adjusting

and the balancing contractor shall not be the installer of the system and shall otherwise be independent of the project. Individuals qualified for that work by the AABC or the NEBB shall perform system balancing. Proof of such qualifications, outlines of proposed balancing procedures, and data sheets for the specific instrument to be used, listing their most recent calibration dates shall be submitted for approval. The balancing procedures used shall meet the recommendations of the ASHRAE as published in the 1991 ASHRAE Systems and Applications Handbook under the chapter headed Testing, Adjusting and Balancing, and shall be witnessed by the Engineer.

B. Detailed Material Requirements

1. Adjusting and balancing instruments and equipment

a. Adjusting and balancing instruments and equipment used shall be selected to provide the precision stated in this specification and capacity requirement as indicated on the Contract Drawings for the system(s) being tested. Selection shall follow the guidelines on NEBB; preference shall be given to instruments, which are required for NEBB certification.

b. Adjusting and balancing instruments and equipment used shall be company owned and remain the property of the company. Use adjusting and balancing instruments that are in first class operating condition with individual calibration histories to guarantee accuracy. Include instrument calibration histories in the test report.

2. Patching Materials

a. Circular Plastic Plug: With retainer, size to fit tightly into drilled hole.

b. Sheet Metal: Material and gage shall match ductwork or housing, cut to allow a minimum of one inch lap all around.

c. Caulking Sealant: Silicone rubber; Dow Corning "732" or equal.

## 15991.03 EXECUTION

A. General

1. Adjusting and balancing Work shall follow recommended procedures for examination, preparation, and performance of adjusting and balancing, as outlined in the referenced NEBB standard.

2. Prior to commencing any final adjusting or balancing Work, the Contractor shall verify that ductwork and accessories for each system has been completely installed and is ready for operation. Contractor shall verify the following:

a. Electrical service has been installed to motors and controls.

b. Motor overloads have been installed.

c. Fans have been inspected for correct rotation.

d. Access doors, test holes and duct drains have been closed and plugged.

e. Mating flanges shall be within 1/16" tolerance unbolted.

f. Flange face separation shall be no greater than 1/16" beyond normal gasket thickness.

B. The Contractor shall notify the Engineer five (5) full working days prior to beginning adjusting and balancing.

C. After adjusting and balancing is complete the Contractor shall leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical boxes and panels, and restoring thermostats to specified settings.

D. Where HVAC equipment is non-ducted, the Contractor shall provide temporary ductwork as required in order to measure airflow and static pressure. Temporary ductwork shall be removed after airflow measurement and balancing is complete.

E. Examination

1. Examine installed Work and conditions under which adjusting and balancing is to be done to ensure that work has been completed, cleaned, and is operable.

2. Report any defects or deficiencies noted during examination to the Engineer. Promptly report abnormal conditions in mechanical systems or conditions which prevent system balance.

F. Installation Tolerances

1. Adjust air handling systems to plus or minus 5 percent for supply systems and plus or minus 10 percent for return and exhaust systems from scheduled values.

G. Air System Procedures

1. Adjust air handling and distribution system to provide required or design supply, return, and exhaust air quantities as identified herein.

2. Sound pressure level measurements shall be taken at each fan location. Measurements shall be taken at distances of five feet, ten feet, and twenty feet from the fan with the fan operating, and with the fan not operating. Measurements shall be taken at four separate points at each distance. Measurements shall be taken on each side of the wall of a wall-mounted fan, and on the interior and exterior of the roof for the up-blast fan. Measurements shall be taken in the presence of the Engineer.

H. Report Preparation

1. Prepare report of test results, including instrumentation calibration histories, in format recommended by referenced NEBB standard.

2. Submit draft of report for approval.

I. Final Compliance Procedures

1. The following items of the Work are to be carried out only after acceptance of the adjusting and balancing report.

   a. Final Inspection

      i. Recheck random selections of data recorded in report. Take measurements to verify balance has not been disrupted or that such disruption has been rectified.

      ii. Verify that systems are in proper working order, belt guards have been replaced, access doors have been closed, doors to electrical boxes and panels have been closed, and thermostats have been restored to specified settings.

   b. Marking of System Settings

      i. Mark equipment and control device settings to show final settings at completion of adjusting and balancing Work.

      ii. After final check of the systems has been performed, the Contractor shall provide stamped brass tags at each volume control damper and fan indicating the following information:

         a. Flow (CFM).

         b. Velocity (FPM).

         c. Date readings were taken.

   c. Patching

      i. Patch holes drilled in ductwork and equipment housings for adjusting and balancing purposes using plastic plugs with retainers.

      ii. Patch non-circular and larger holes using sheet metal of like material and gage. Secure patch to duct or housing using aluminum or stainless steel pop rivets. Seal patch using silicone rubber caulking. Degrease, prepare, and prime paint patch.

END OF SECTION

# SECTION 16010

# GENERAL ELECTRICAL REQUIREMENTS

## 16010.01 GENERAL

A. Description

1. This section includes materials, installation, and testing of the electrical system.

2. All work under this section is subject to the General Conditions and Special Provisions for the entire Contract.

3. Carefully examine all contract drawings and fit the work in each location without substantial alteration. Where departures are proposed because of field conditions or other causes, prepare and submit detailed drawings for acceptance.

B. Regulatory Agencies and Standards

1. Regulatory Agencies: Installations, materials, equipment, and workmanship shall conform to the provisions of the following agencies and codes:

   a. National Electrical Code (NEC).

   b. Occupational Safety and Health Act (OSHA).

   c. Local authorities having lawful jurisdiction pertaining to the work required.

   d. NFPA 79-2021 and NFPA 820-2024 or latest version thereof.

   e. Underwriters Laboratories, Inc. (UL): Materials, appliances, equipment, and devices shall conform to the applicable UL standards. The label of, or listing by, UL is required wherever applicable.

2. Standards: Where referenced in these specifications or on the drawings, the publications and standards of the following organizations apply:

   a. American Society of Testing and Materials (ASTM).

   b. National Electrical Manufacturers Association (NEMA).

   c. National Fire Protection Association (NFPA).

   d. American National Standards Institute (ANSI).

   e. Institute of Electrical and Electronics Engineers (IEEE).

   f. Insulated Cable Engineers Association (ICEA).

C. Utility Company Requirements and Fees

1. For Developer Projects: The Engineer shall make an application for electric and telephone service. The Contractor will pay utility company fees, cable charges, and added facilities charges. After transfer of service, at conditional acceptance, the DPW's Bureau of Utility Operations shall start to pay utility fees.

2. For Capital Construction Projects: During the construction period DPW's Bureau of Engineering shall pay for all utility fees. After transfer of service, at Conditional Acceptance, DPW's Bureau of Utility Operations shall resume paying utility fees.

3. The Contractor shall provide all coordination for service with the utility company.

4. The Contractor shall provide and install electric service entrance equipment, conduit, wire, and devices in accordance with the serving utility's requirements. Coordinate with the serving utility to ensure timely connection by the utility. Obtain utility company approval of service entrance and metering equipment shop drawings prior to starting fabrication.

D. Submittals

1. Submit shop drawings in accordance with the General Provisions.

2. Submit operation and maintenance data for all items in accordance with the General Provision 5.04.08.

3. As-built drawings shall be in accordance with Section 5.04.7 of the "General Provisions".

## 16010.02 MATERIALS

A. Materials

1. General

a. Similar materials and equipment shall be the product of a single manufacturer.

b. Provide only the products which are new, undamaged, and in the original cartons or containers.

c. Materials and equipment shall be the standard products of manufacturers regularly engaged in the production of such material and shall be the manufacturer's current design.

d. Where material or equipment is identified by proprietary name, model number and/or manufacturer, furnish the named item or equivalent thereof, subject to acceptance by the Engineer.

e. Substituted items or items other than those named shall be equal or better in quality and performance and must be suitable for the available space, required arrangement and application. Submit any and all data and samples necessary to determine the suitability of substituted items. Data and samples shall be as required by the engineer.

f. Substitution will not be permitted for specific items of material/equipment where specifically indicated.

g. Materials and equipment shall be suitable for storage, installation, and operation in an ambient of 0°C to 40°C except where more stringent conditions are stated in individual equipment specifications.

h. Electrical equipment and panels shall be factory finished with manufacturer's standard primer and enamel topcoats, unless stated otherwise in the individual equipment specifications.

i. Provide all supports, hangers, braces, attachments and foundations required for the work. Supports, hangers, braces and attachments shall be standard manufactured items of fiberglass-reinforced plastic (FRP) or stainless steel shapes and assemblies, ensuring no-rust construction.

j. Concrete equipment pads and foundations shall be not less than 4 inches high unless otherwise noted, and in general shall extend at least 4-inches beyond the equipment base unless otherwise noted. Provide wire-mesh reinforcement, chamfer exposed edges and corners and finish all exposed surfaces smooth. Concrete shall be minimum 3,000 psi test at 28 days.

k. All electrical panels, boxes, transformers, etc. which are wall-mounted both interior and exterior shall be installed on racks mounted on the walls to provide an air space behind the equipment. The rack shall consist of Kindorf channel, maximum ¾-inch depth, or equal. Kindorf channel shall be FRP Aikenstrut or equal. All electrical equipment mounted on railings or similar structures shall be complete with framework backboards to provide air space behind. The framework shall be securely fastened to the railing or structure with corrosion resistance hardware. All supports in damp or corrosive areas shall be PVC coated. Typical mounting methods shall be approved by the Engineer prior to installation.

l. All conduit penetration through floor slabs or other fire rated walls shall be complete with fire seals as manufactured by O.Z. Gedney "FIRE-STOP" or equal. U.L. approved silicone foam system shall be acceptable where approved by the Engineer.

m. Indicator lights for MCC's, control panels and other enclosures shall be as specified in other sections and where shown in the drawings. Unless otherwise shown, indicator light colors shall follow the standards below:

Power Available – WHITE

Run/ Start/ Unsafe – RED

Off/ Stop/Safe – GREEN

Failure/Alarm/Trip –AMBER

2. Hazardous Locations
   a. Conform with NEC Articles 501 and 502 for areas identified as “Hazardous Areas” on the drawings. All areas shall be classified based on NFPA 820-2024 or the latest version thereof.

   b. Provide threaded cast boxes and fitting for junction boxes and pull boxes in Class I and Class II areas. Boxes and fittings shall conform with Class I, Groups A, B, C, and D and Class II, Groups E, F, and G requirements.

   c. Fixture hangers for pendant mounted fixtures shall conform with Class I, Division I and Class II, Division I requirements.

   d. Provide conduit seals in Class I, Division I location within 18-inches of each conduit entering an enclosure containing electrical devices except for hermetically sealed switches and receptacles. Provide a conduit seal for each conduit leaving the hazardous location.

   e. Flexible connections to motors and other vibrating equipment in Class I, Division I locations shall be made with flexible fittings approved for Class I locations.

## 16010.03 EXECUTION

A. Storage and Protection of Equipment

1. All electrical equipment to be used in the construction shall be properly stored and protected against the elements. All equipment shall be stored under cover and shall not be stored at the construction site on the ground, in mud, water, snow, rain, sleet or dust. Large diameter cables may be stored on reels with weatherproof materials. Such weatherproof materials shall be heavy-duty, securely fastened and made impervious to the elements.

2. Convenient electrical construction materials such as building wire, outlet and junction boxes, wiring devices, conduit, lighting fixtures, fittings, etc., shall be stored in construction buildings, covered trailers or portable covered warehouses. Any equipment subject to damage or corrosion from excessive moisture shall be stored in dry, heated areas. Any equipment containing plastic or material subject to damage caused by excessive heat or sunlight shall be stored to prevent such damage. This includes plastic ducts and lenses.

3. Switchgear, motor controllers, control centers, panelboards, breakers, emergency lighting, engine generators and supervisory equipment, if delivered to the construction site before the building is under cover, shall be warehoused and protected.

4. All equipment shall be covered and protected from the elements and other damage and shall be stored in a clean, dry, heated atmosphere, under cover.

5. All gear and equipment delivered to the construction site after the building is under cover shall be protected as described above and, in addition, shall be provided with auxiliary heat to prevent damage caused by condensation. The gear shall also be

protected against damage caused by installation of any building systems and equipment; or damage caused by carelessness of workmen who are installing equipment connected to or adjacent to the above electrical equipment.

6. Equipment damaged as a result of the above conditions shall be properly repaired at the Contractor's expense or shall be replaced at the Contractor's expense, if, in the opinion of the Engineer the equipment has been damaged to such an extent it cannot operate properly after repairs are made.

7. All electrical enclosures exposed to construction damages such as paint spots, spackling or plaster spatter, grout splashes, waterproofing compound, tar spots or runs and pipe covering compound splashes, shall be completely covered and protected against damage.

8. In the event leakage into the building of any foreign material or fluid occurs or may occur, the Contractor shall take all steps as described above to protect any and all equipment.

B. Installation

1. The drawings indicate connections for typical equipment only. If the equipment furnished is different from what is shown, provide the modifications necessary for a safe and properly operating installation in accordance with the equipment manufacturer’s recommendations.

2. The drawings diagrammatically indicate the desired location and arrangement of outlets, conduit runs, equipment, and other items. Field inspection shall determine exact locations based on physical size and arrangement of equipment, finished elevations, and obstructions.

3. Work or equipment not indicated or specified which is necessary for the complete and proper operation of the electrical systems shall be accomplished without additional cost to the County.

4. Review demolition methods with the County's Representative prior to cutting or removing existing architectural and/or structural items or equipment. Repair damage to match existing and maintain the fire rating of the existing items affected by the work.

5. The Contractor shall do all excavating and backfilling necessary to install underground electrical work included in this section of the work. He shall establish all lines and grades required for the proper location of the work and shall be responsible for the correctness thereof. Excavation and backfill shall be performed in accordance with the requirements specified in other sections of these specifications.

6. The Contractor shall carefully coordinate the installation of all subterranean electrical work with other utility systems both new and existing. Locations of pole bases, manholes, handholes and duct banks are shown as approximate. All such items shall be staked, and utility crossings identified prior to installation. The actual staked layout shall be reviewed with the Engineer prior to the installation.

7. Arrange conduit, wiring, equipment, and other work generally as shown providing proper clearances and access.

8. The following mounting heights of the various electrical outlets and devices are to the bottom of the box or nearest course-line in the masonry wall.

   a. Switches 4' - 0" AFF

   b. Receptacles 1 ' - 6" AFF (unless otherwise noted)

   c. Disconnect Switches 4' - 6" AFF (unless otherwise noted)

9. In general, the mounting heights listed above are applicable, however, field conditions may dictate changes. Where these special conditions occur, final mounting height shall be brought to the attention of the Engineer and his decision shall be given.

10. Coordinate the work to minimize penetration of waterproof construction, including roofs, exterior walls and interior waterproof construction. Where such penetrations are necessary, provide all necessary curbs, sleeves, shields, flashings, fittings and caulking to make the penetrations absolutely watertight.

11. Provide all cutting and patching necessary for the installation of the electrical work. Any damage done to the work already in place by reason of this work shall be repaired at the Contractor's expense by a qualified mechanic experienced in such work. Patching shall be uniform in appearance and shall match with the surrounding surface.

12. Do not cut structural members without approval by the Structural Engineer.

13. Clean all surfaces prior to application of adhesives, coatings, paint, or other finishes.

14. Protect all finishes and restore any damaged finishes to their original condition.

15. Remove all construction markings and writing from exposed equipment, conduit and building surfaces.

C. Operation of Equipment

1. Adjust and test all equipment and systems in accordance with the manufacturer's instructions prior to initial operation. Do not operate equipment unless proper safety devices and controls are operational. Provide all maintenance and service for equipment which is operated during construction and protect the equipment.

2. Where specified or otherwise required, provide the services of the manufacturer's factory-trained servicemen or technicians to start-up the equipment.

D. Testing and Adjustment

1. The Contractor shall note that certain of the other sections and Appendices of these specifications require tests of various equipment. He shall make himself familiar with

these requirements and where electrical controls are involved in any of these tests, he shall become a party to the test and furnish, as part of this contract, any services or materials needed to make any electrical performance tests required.

2. Perform all tests which are specified or required to demonstrate that the work is installed and operating properly. Where formal tests are required, give proper notices, and perform all necessary preliminary tests to ensure that the work is complete and ready for the final test. All testing shall be performed prior to conditional acceptance.

3. Adjust all systems, equipment, and controls to operate in a safe, efficient, and stable manner.

4. Provide circuits that are free from ground faults, short circuits, and open circuits.

5. Other tests of a specific nature for special equipment shall be as specified under the respective equipment.

6. All loads shall be balanced evenly across phases. Balances shall be accomplished with an ammeter and all loads energized.

E. Identification and Signs

1. Mark each individual panelboard, motor controller, disconnect switch, timer, relay, and contactor to identify each item with its respective service or function. Provide nameplates with engraved lettering not less than 1/4-inch high. Use black-on-white laminated plastic, attached with rivets or stainless-steel sheet metal screws. Do not use embossed plastic adhesive tape.

2. Panelboard indices shall be completed and accurately typed with appropriate circuit identification. Identification by means of marking pens, embossed plastic tape markers or other temporary methods will not be acceptable.

3. All circuits in handholes, manholes and junction boxes shall be identified as to point of origin and termination. Tagging of such circuits shall be permanent. Paper or tape tags are not acceptable.

F. Infrared Survey/Testing

1. General

a. Conduct an infrared survey of major electrical and rotating equipment in accordance with these Specifications and Appendices. Readings shall be done with the equipment operating under loaded conditions. Motor starters shall be loaded at the full load ampere rating of the motor. All other equipment, unless indicated otherwise, shall be loaded at 80% of the overcurrent protective device rating ahead of the equipment. All equipment shall be loaded for a minimum of 30 minutes before scanning. A Load Bank, provided by the Contractor, shall be used when the connected equipment cannot provide the required load.

2. Equipment to be Tested

    a. Motor Starters and Variable Frequency Drives.

    b. Bus Bars, Bus Splices, Bus Connectors.

    c. Main Breakers.

    d. Motor Connections at Motor.

    e. Lighting Panels, Transformers and other ancillary equipment (under normal station load).

    f. Connections at Generator and Automatic Transfer Switch.

3. Infrared Scanning of Electrical Equipment

    a. Visual Inspection

        i. Inspect for physical, electrical, and mechanical condition and bus alignment.

    b. Infrared Inspection

        i. Perform a qualitative (Level I) infrared inspection on the equipment listed in Section 2 above. The infrared-scanning device used shall meet the requirements contained in Part d below.

        ii. Provide a report indicating the following.

            a. Location, equipment, date.

            b. Problem area (location of “hot spot”).

            c. Indicate temperature of “hot spot” and ambient temperature.

            d. Indicate cause of heat rise, if known.

            e. Indicate phase unbalance, if present.

            f. List of areas scanned.

    c. Test parameters

        i. Infrared scanning equipment shall detect 1 degree C rise between subject area and reference at 30 degrees C.

ii. Equipment shall detect emitted radiation and convert detected radiation to visual signal.

iii. Both identifying photographs and thermographic photos shall be provided of the deficient areas. The thermographic photos shall be as seen on the imaging system. The thermographs and identifying photos shall be contained in the report to provide a baseline inventory of the electrical system immediately preceding conditional acceptance.

d. Test Results/Tolerances

i. Operating temperature shall not exceed the manufacturers or listing agency's rating for the equipment or attached conductors. The following temperature tolerances are for equipment temperature ratings of 75 degrees C or above.

ii. The following tolerances are applied to temperature gradients/differences between phases on balanced three phase loads:

a. Temperature gradients between phases of 5 degrees C to 10 degrees C: Contractor to correct problem.

b. Temperature gradients between phases of 11 degrees C and above: Contractor to correct problem.

iii. The following absolute temperature tolerances are applied to all components:

a. Temperature of 70 degrees C or more: Contractor to correct problem.

b. Temperature of 60 degrees C to 70 degrees C: Contractor to correct problem.

c. Temperature of 50 degrees C to 60 degrees C: Contractor to correct problem.

4. Training and Instruction Period

The Contractor shall note that certain of the other sections of these specifications require training on various equipment and systems. He shall make himself familiar with these requirements and where electrical controls are involved, he shall furnish, as part of this contract, any services or materials needed to provide the training required.

END OF SECTION

# SECTION 16051

# MISCELLANEOUS ELECTRICAL DEVICES

## 16051.01 GENERAL

A. Description

This section includes materials and installation of miscellaneous electrical devices and equipment, such as disconnect switches, and limit switches.

B. Submittals

1. Submit shop drawings in accordance with the General Provisions.

2. Submit ratings and characteristics including voltage ratings, continuous current ratings, conduit entry restrictions, and enclosure type and dimensions.

## 16051.02 MATERIALS

A. Materials

1. Disconnect Switches

Provide non-fusible or fusible disconnect switches with ampere rating and number of poles as indicated in the drawings. Switches shall be NEMA heavy-duty Type HD. Provide switches in NEMA Type 3R stainless steel enclosures, unless otherwise noted. Mechanisms shall have quick-make and quick-break operating handles and provisions for padlocking in the "OFF" position. The switch shall have an interlock to prevent unauthorized opening of the hinged cover when the switch is in the "ON" position and an interlock to prevent closing the switch mechanism with the hinged cover open. Fusible switches shall be equipped with a rejection feature. Switch contacts shall be silver or tinned plated. On the front of the enclosure, attach a nameplate that identifies the load per Section 16010. Disconnect switches shall be Square D, or equal.

2. Limit Switches

a. Provide heavy-duty, precision turret head type limit switches with one normally open and one normally closed contact along with an adjustable lever arm with oil-impregnated sintered iron roller.

b. The switches shall be interfaced with the RTU, or as shown on the drawings. For door switches, mount switches on the inside door frame such that when opened, the normally open switch contacts shall close and, when closed, the normally open switch contacts shall open.

c. Provide a Square D, Class 9007, or equal.

d. For switches in hazardous locations provide intrinsically safe relays, and switches rated for the installation.

B. Generator Load Bank Connection Box

Provide and install a NEMA 3R stainless steel, lockable industrial enclosure with three single pole cam type connectors for connection of a generator load bank to the generator for testing purposes. Provide three cam type connectors (panel receptacles) rated at 600 Volt and be 90 degree style with a threaded stud. Provide all necessary lugs and connectors to connect the cable to the panel receptacle. The panel receptacle shall be manufactured by Leviton or equal, Series number 16 for generators 250 KW and below and parallel Series 16 generators exceeding 250 KW in quantity indicated on drawings. The panel receptacle shall be colored brown, orange and yellow for 480 volt system and black, red and blue for 240 volt system. Mount the receptacles on a subpanel on the interior of the NEMA 3R enclosure with adequate room in the rear for connection of the cables.

C. Generator Load Bank Test Safety Switch

1. Provide non-fusible safety switch, double throw safety switch with ampere rating and number of poles as indicated in the drawings. Switches shall be NEMA heavy-duty Type HD. Provide double throw safety switch in NEMA Type 3R stainless steel enclosures, unless otherwise noted on drawings. Mechanisms shall have quick-make and quick-break operating handles and provisions for padlocking in the “OFF” position. The switch shall have an interlock to prevent unauthorized opening of the hinged cover when the switch is in the “ON” position and an interlock to prevent losing the switch mechanism with the hinged cover open. Switch shall be lockable in all three positions. Provide nameplates for each position: “Normal (Up Position)”, “Off”, and “Loadbank Test”. Safety switch shall be Square D, or equal.

2. Safety switches shall be UL listed in accordance with Article 702 of the NEC/NFPA 70.

D. Emergency Stop/Personnel Alarm Pushbuttons

Provide maintained, mushroom style E-stop switches and Personnel emergency pushbuttons where shown on the contract drawings. Switches shall be 2-position, non-illuminated, maintained pull/maintained push. Pushbuttons shall be heavy-duty, corrosion resistant NEMA 4X with red mushroom head. Switches located in classified areas shall be rated accordingly. Switches shall be Square-D Class 9001 Type K, or equal.

## 16051.03 EXECUTION

A. Execution

1. Disconnecting Switches

a. Provide standoff brackets providing a minimum of 1-1/2-inch air space between the switch and the mounting surface. Provide 316 stainless steel brackets and concrete anchors in non-air-conditioned rooms and in exterior locations.

2. Limit Switches

    a. Mount the limit switches as shown on the Drawings, and as recommended by the Manufacturer.

    b. Provide and install all wire and conduit for installation.

3. Preliminary Inspection/Test

    a. Operate each disconnect switch three times, under load, and verify that all phases of the load are disconnected each time.

    b. Operate each device contacting limit switch to verify limit switch contacts are energized for accurate response to the motion.

    c. Operate each emergency push button switch three times, under load, and verify that equipment is de-energized and/or alarms are properly generated each time.

    d. Generator load bank connection box and load bank test safety switch shall be used as part of the generator load bank testing procedure specified in section 16200

4. Conditional Acceptance Inspection/Test

    a. Repeat Preliminary Inspection/Test as directed by the Owner.

    b. Comply with the conditional acceptance checklist in Appendix B.

END OF SECTION

# SECTION 16110

# RACEWAYS, BOXES AND FITTINGS

## 16110.01 GENERAL

A. Description

This section describes materials and installation of raceway systems, whether concealed or exposed, above or below grade. Minimum size conduit shall be ¾".

B. Submittals

1. Submit shop drawings in accordance with the General Provisions.

2. Submit material list for all conduits, fittings, boxes, conduit bodies, mounting hardware, and related accessories.

3. Submit conduit layout for each building, facility, vault, and for the site.

## 16110.02 MATERIALS

A. Rigid Steel Conduit and Fittings

1. Use rigid, thick wall, hot-dipped galvanized inside and out, with galvanized threads conforming to ANSI C80.1 and UL-6. Do not use electro-galvanizing.

2. Use insulated metallic bushings. Sizes 1 inch and smaller may be non-metallic type.

3. Use hot-dipped galvanized threaded fittings which are compatible with the conduit.

4. Use cast aluminum or hot-dipped galvanized cast-iron conduit bodies, equipped with threaded covers or gasketed sheet metal covers secured with at least two captive screws.

B. Rigid Non-Metallic Conduit and Fittings

Polyvinyl chloride (PVC) Schedule 40, 90 C rise rating. Conduit shall conform to NEMA TC-2 and UL-651.

C. PVC-Coated Conduit and Fittings

PVC-coated conduit and fittings shall be rigid steel with a .040-inch-minimum thickness of exterior PVC coating. Conduit shall have minimum 2-mil urethane coating on interior. Conduit and fittings shall be UL listed and shall conform to ANSI C80.1 and to UL-6. Conduit and fittings shall be Permacote Supreme or equivalent product of Occidental, or Robroy.

D. Liquid-Tight Flexible Conduit and Connectors

1. Use single strip steel, hot-dipped galvanized on all four sides prior to conduit fabrication. Conduit shall have overall PVC plastic jacket. Conduit sizes 1-1/4 inches and smaller shall include an integral copper bonding conductor wound spirally in the space between each convolution on the inside of the conduit. Conform to UL-360.

2. Use compression type bushings with steel or malleable iron body and insulated throat and sealing o-ring.

3. All fittings shall be PVC coated.

E. Outlet, Junction and Pull Boxes

1. Provide boxes for installation of electrical work, in compliance with codes and regulations.

2. Provide stainless steel boxes, nominal size 4 inches square by 1-1/2 inches in flush-mounted or concealed locations unless otherwise indicated. Boxes for use in concrete shall have square corner tile type covers with ribs or extensions for casting in concrete.

3. Construct pull boxes in flush-mounted or concealed locations that are larger than 4 inches square by 1-1/2 inches of stainless steel.

4. Use PVC coated threaded-hub ferrous boxes for surface-mounted or exposed locations. PVC coated cast conduit fittings may be used instead of boxes except where boxes contain devices.

5. Where threaded-hub cast boxes and fittings are not practical, provide NEMA 4X pull boxes constructed of Type 316 stainless steel. Install cover with neoprene gaskets and Type 316 stainless steel bolts. Attach conduit with “Myers” hubs.

6. Provide junction boxes in all exterior areas above wet well suitable for Class 1, Division 1 outdoor locations.

F. Electric Handholes/Manholes

1. Handholes and manholes shall be electrical-type utility boxes manufactured by Quickset, Brooks Products, or equal. Provide cast-iron covers with lifting hooks in all areas. Set the handhole and manhole on a crushed rock base 6 inches thick with horizontal dimensions same as bottom of handhole plus 6 inches all around. Crushed rock shall be 3/4-inch maximum size.

2. Provide raceway entrances on all four sides. For raceways installed under this contract, knockout panels or precast individual raceway openings may be used. On sides where no raceways are installed under this contract, provide 12-inch-high by 12-inch-wide (minimum) knockout panels for future raceway installation.

3. Utilize frames and covers made of cast iron, suitable for street loading. On the upper side of each cover, cast in integral letters not less than 2-inches high appropriate titles ELECTRIC HV (for above 600 volts), ELECTRIC LV (for 600 volts and below) or

CONTROL. Field stamp covers with handhole numbers indicated on the drawings.

4. Concrete pull boxes and handholes shall be precast with pull-in irons, hot-dipped galvanized traffic cover with hot-dipped galvanized frame, and two galvanized cable racks with porcelain blocks on each of the two longest sides. Design for AASHTO H-20 loading. Provide bead weld on cover of pull box to indicate services within pull box (electrical, telephone, fire alarm, or signal). After cables have been pulled and inspected, seal box between cover and frame with a mastic compound similar to Permagum, Dukaseal, or equal.

5. Manufacturers: Brooks Products, Inc.; Penn-Cast Products, Inc.; Concrete Conduit Company; Associated Concrete Products, Inc.; or equal.

6. Polymer concrete manholes and handholes can be used in place of precast manholes and handholes. Structures must be UL listed as an underground enclosure. All other design considerations shall be met including AASHTO H-20 loading and design. Provide and install Quazite by Strongwell, or equal.

## 16110.03 EXECUTION

A. Conduit Usage

1. Install the following types of raceway in the locations listed, unless otherwise indicated on the drawings.

   a. Exterior, Exposed:

      i. PVC-coated conduit.

   b. Interior, Exposed:

      i. PVC-coated conduit.

   c. Embedded in Concrete or Masonry:

      i. PVC-coated conduit.

   d. Underground Dirt Burial, or Below Concrete Slabs:

      i. PVC-coated conduit.

   e. Underground Concrete Encased:

      i. Provide rigid non-metallic conduit. Provide rigid steel conduit with long radius elbows for bends exceeding 45 degrees (see requirement for conduit stub-ups).

      ii. Rigid steel conduit (see requirement for conduit stub-ups).

   f. Final Connections to Motors or Vibrating Equipment: Liquid-tight flexible conduit

unless otherwise shown on the drawings.

g. Connections to Suspended Lighting Fixtures: Liquid-tight flexible conduit.

h. Conduit Stub-ups: Provide PVC-coating conduit for stub-ups.

i. All fittings for conduit or enclosures which are connected to PVC coated conduit or fittings shall be PVC coated.

j. The Contractor shall replace all PVC coated conduit and fittings which have damaged, nicked, or scared PVC coating, at no cost to the County. A repair system will not be acceptable.

B. Installation

1. Provide 30 inch-minimum cover for direct burial underground conduit.

2. Liquid tight conduit shall be a maximum of 18 inches in length.

3. Repair or replace conduit damaged during or after installation. Replace crushed or clogged conduit or any conduit whose inner surface is damaged or not smooth.

4. Support conduit and cable tray at intervals and at locations as required by the NEC. Do not use perforated strap or plumbers tape for conduit supports.

5. Conduit on Concrete or Masonry: Use PVC coated one hole aluminum iron clamps with pipe spacers (clamp backs) or Type 316 stainless steel, preformed channel. Anchor with 316 stainless steel preset inserts. Use preset inserts in pre-stressed concrete.

6. Suspended Conduit: Use fiberglass or PVC, factory made, split hinged pipe rings with Type 316 SST threaded suspension rods sized for the weight to be carried (minimum 3/8” diameter); Kin-Line, Grinnell, Elcen, or equal. For grouped conduits or cable tray, construct racks with the fiberglass threaded rods and stainless steel or fiberglass channel cross members. Construct channel to limit deflection to 1/200 of span. Clamp each conduit individually to a cross member. Where rods are more than 2 feet long, provide rigid sway bracing. All PVC coated conduits shall be terminated using Myers Hubs in any non-threaded entries.

7. Supports at Structural Steel Members: Use Type 316 stainless steel or PVC coated beam clamps in exposed locations.

8. Wherever conduit may be affected by dissimilar movements of the supporting structures or medium, provide flexible or expansion devices.

9. Dry pack with non-shrink grout around raceways that penetrate concrete walls, floors, or ceilings above ground. Use "Link Seal" around all conduits in penetrations located below grade.

10. Conduit runs are shown schematically. Supports, pull boxes, junction boxes, and other ancillary equipment are not usually shown. Provide pull boxes and junction boxes where shown. In addition, provide pull boxes and junction boxes to permit pulling of wires without damage to the conductors or insulation.

11. Install exposed conduits parallel to or at right angles to the lines of the building. Make right angle bends in exposed conduit runs with standard elbows, threaded conduit fittings, or conduit bent to radii not less than those of standard elbows.

12. Route exposed conduit to preserve headroom, access space, and work space.

13. Provide expansion fittings for raceways crossing expansion joints in structures or concrete slabs.

14. Treat threaded joints of rigid steel conduit with T&B “Kopr-Shield” before installing fittings.

15. Terminate rigid steel conduits with locknuts and bushings. Install conduit squarely and provide one locknut outside the box and a bushing inside the box. Install locknuts with dished side against the box.

16. When terminating in threaded hubs, screw the conduit or fitting tight into the hub so that the end bears against the fire protection shoulder. When chase nipples are used, install the raceway and coupling square to the box and tighten the chase nipple with no exposed threads.

17. Coat all aluminum surfaces which are in contact with concrete or masonry per Section 09900 before installation.

C. Testing

1. None required.

END OF SECTION

# SECTION 16120

# WIRE AND CABLES

## 16120.01 GENERAL

A. Description

This section describes materials and installation of wires and cables.

B. Submittals

1. Submit shop drawings in accordance with the General Provisions.

2. Submit material list for each conductor type. Indicate insulation material, conductor material, voltage rating, manufacturer, and other date pertinent to the specific cable, such as type shielding, number of pairs, and applicable standards.

## 16120.02 MATERIALS

A. Materials

1. Low-Voltage Building Wire

   a. Conductor material shall be copper.

   b. Low-voltage building wire for use at 600 volts or less shall be 600-volt insulated, Type XHHW (for all underground locations) or THWN and rated for continuous operation at 75C.

   c. No. 12 AWG minimum conductor size for power and lighting circuits.

   d. No. 14 AWG minimum conductor size for control circuits.

   e. All conductors shall be stranded.

2. Instrument Cable

   a. Reference Spec 16946.

   b. Multiple-pair cables shall have a number of pairs specified with each pair being two, No. 18 AWG stranded, tinned-copper conductors individually insulated with PVC rated at 300 volts. Conductor pairs shall have insulation pigmented black and white with white conductor numerically printed for group identification. Each pair and its 20 AWG stranded tinned-copper drain wire shall be twisted together and shielded with an aluminum-polyester tape overlapped for 100% shielding. Provide a cable shield of 2.35-mil aluminum-polyester tape overlapped to provide 100% shielding and an 18 AWG copper drain wire. Provide a flame-retardant PVC jacket per UL 13, 105C temperature rating.

3. Support Grips

    a. Provide a flexible wire mesh holding device to fit around an electrical cable for support of cable as shown on the drawings, or as required to support pump cables. The support grip shall support vertical runs of up to 99 feet with loads up to 600 pounds. Provide a single eye for attaching support grip as shown on the drawings. Support grip shall be Hubell Kellems, or equal.

B. Control Wiring

1. Field control wire, type, and color shall be the same as specified in Section 16946.

## 16120.03 EXECUTION

A. Wire Installation

1. Install wiring and cable in conduit unless otherwise noted.

2. To reduce pulling tension in long runs, coat cables with a pulling compound recommended by the cable manufacturer before being pulled into conduits.

3. Remove debris and moisture from the conduits, boxes, and cabinets prior to cable installation.

4. Group conductors No. 1/0 and smaller in panelboards, cabinets, pull boxes, and switchboard wireways; tie with plastic ties; and fan out to terminals. Lace conductors No. 2/0 and larger with marline.

B. Identification

1. Color coding of Low-Voltage Building Wire: Provide color coding throughout the entire network of feeders and circuits (600 volts and below) as follows:

| Phase | 208/120 Volts | 480/277 Volts |
|---|---|---|
| Phase A | Black | Brown |
| Phase B | Red | Orange |
| Phase C | Blue | Yellow |
| Neutral | White | Gray |
| Ground | Green | Green |

    a. Conductors No. 10 AWG and smaller shall have factory color coding with solid color insulation. Do not use onsite coloring of ends of conductors or apply colored plastic adhesives in lieu of factory color coding.

    b. Conductors No. 8 AWG and larger shall have factory color coding with solid color

insulation or shall have black insulation with onsite application of colored plastic adhesives at ends of conductors and at each splice.

c. Tagging of Conductors: Tag control wires and instrument cables in panels, pull boxes, wireways, and at each control device with adhesive type of marker: Brady, Thomas, and Betts, or equal. Tag control wires and instrument cables with same wire numbers as on the shop drawing submittals. Tag power wires in pull boxes and wireways where there is more than one circuit. Tag power conductors with motor control center or panelboard number and circuit numbers.

2. Low-Voltage Wire Splices

a. Stranded Conductors No. 8 and Larger: Use T & B "Locktite" connectors, Burndy Versitaps and heavy-duty connectors, O.Z. solderless connectors, or equal.

b. Stranded Conductors No. 10 and Smaller: Use crimp connectors with tools by the same manufacturer and/or UL listed for connectors of all stranded conductors.

c. Retighten bolt-type connectors 24 to 48 hours after initial installation and before taping. Tape connections made with non-insulated-type connectors with rubber-type tape, one and one-half times the thickness of the conductor insulation, then cover with Scotch 33 tape.

3. Splices and Terminations

a. Do not splice cables unless specifically indicated in the drawings or concurrence is obtained from the County's Representative. Make splices and terminations in accordance with the splice or termination manufacturer's instructions.

b. Give two working days' notice to the Owner's Representative prior to making splices or terminations in order to allow the Owner's Representative to be present during the actual work if he elects to do so.

4. Insulation Resistance Tests

i. Test each complete circuit prior to energizing. Insulation resistance between conductors and between each conductor and ground shall not be less than 25 megohms. Repair or replace wires or cables in circuits which do not pass this test and repeat the test.

5. Conditional Acceptance Inspection/Test

a. None required.

END OF SECTION

# SECTION 16140

# SWITCHES AND RECEPTACLES

## 16140.01 GENERAL

A. Description

1. This section describes materials and installation of light switches and receptacles.

B. Submittals

1. Submit shop drawings in accordance with the General Provisions.

2. Submit material list for each type of switch, receptacle, and cover plate. Indicate type, ratings, material, color, and manufacturer.

## 16140.02 MATERIALS

A. General

Provide switches and receptacles that are listed by Underwriters Laboratories, Inc.

B. Receptacles

1. Corrosion-Resistant Receptacles: Provide corrosion-resistant receptacles. Provide yellow melamine, duplex receptacle, Hubbell 53CM62 or equal.

2. Ground Fault Interrupter Duplex Receptacles: Receptacles shall be rated 20 amperes and comply with UL-943, Class A. Provide Leviton 6198-I, 3M GFI-2701, or equal.

C. Switches

1. Switches shall be molded composition, brown, specification grade, single pole, 20 ampere, three-way and four way as shown on the drawings.

2. 120 or 277-Volt Lighting: Provide switches rated 20 amperes, 120/277-volt a-c. Provide quiet operation, toggle type switches.

3. Explosion-Proof Switches: Provide explosion-proof switches for areas identified as “Hazardous Area” on the drawings. Provide factory-sealed tumbler switches, 20 amperes, 120/277-volt a-c. Comply with NEC Class I, Division I, Groups C and D and Class II, Division I, Groups E, F, and G.

D. Cover Plates

1. Outside, or where indicated, use individually gasketed weatherproof cover plates.

2. Provide 302 stainless steel plates in all remaining locations.

## 16140.03 EXECUTION

A. Grounding

1. Provide a bonding jumper between the grounded outlet box and the receptacle and switch ground terminal.

B. Preliminary Inspection/Test

1. Operate each switch and verify that the load is turned on and off.

2. Test each receptacle with a circuit tester that checks voltage, polarity, and grounded conditions. Repair or replace defective receptacles and repeat the test.

C. Conditional Acceptance Inspection/Test

1. Repeat Preliminary Inspection Test.

END OF SECTION

# SECTION 16155

# LOW VOLTAGE CONTROL

## 16155.01 GENERAL

A. Description

This section includes requirements for materials, testing, and installation of low-voltage motor control equipment and in accordance with the Contract Documents.

B. Submittals

1. Submit shop drawings in accordance with the General Provisions.

2. Submit manufacturer's descriptive data including ratings, circuit diagrams, dimensional data, conduit entry restrictions, and overload heater ratings. The complete wiring diagram shall show all wires continuous from end to end and identified by numbers and the physical relationship of all controls shall be identical to the arrangement shown on the general arrangement drawings. Where there is any correlation between the operation of any one unit and that of any other unit, a sequence of operations shall be furnished.

C. Ratings

Motor horsepower ratings and enclosures shown are minimum expected. This does not limit the equipment size. When motors furnished differ from the minimum ratings indicated, make the necessary adjustments to wiring, conduit, disconnect devices, motor starters, branch circuit protection, and other affected material or equipment to accommodate the motors actually installed, at no additional cost to the Owner.

## 16155.02 MATERIALS

A. Motor Control Centers

1. Furnish and install the Motor Control Centers complete, as indicated on the contract drawings, and specified herein, and as required for complete and successful control of all power and controls at the Pumping Station. The control centers shall include circuit breakers, starters, contactors, relays, timers, control buttons and switches, indicating lights, meters, terminal boards, etc., specified and as indicated on the drawings. The drawings indicate the general arrangement of the motor control centers and are subject to modifications as required by the differences in design of the equipment of the various manufacturers.

2. The motor control centers shall contain a section for mounting of the PLCs for control of the pumps as hereinafter specified and as indicated on the drawings. All wiring

entering or leaving the PLC pump control section shall be connected to terminal strips mounted in the control section. Separate terminal strips and wireways shall be provided for separation of DC and AC circuits. The remote monitor (SCADA) terminal strip shall be separate from control wiring terminal strip(s). All control wiring shall be numbered as shown on the contract documents. "AC" control wiring shall be red, "DC" wiring shall be blue.

3. When indicated on the drawings, the generator automatic transfer switch shall be furnished and installed in the MCC.

4. Motor control centers shall be dead front, dead rear, free-standing, and front accessible NEMA 1 gasketed construction. The voltage and ampere rating and physical dimensions shall be as indicated on the drawings. Wiring shall be NEMA Class I, Type B. Tag control wiring from field within 2-inches of termination at each device and terminal board. Schematics shall also show terminal numbers and interior and field wire numbers. Obtain instrument wire numbers from the instrument system supplier.

5. Provide channel iron sills and removable lifting angles. Motor control center shall be constructed of minimum 14-gauge sheet metal.

6. Provide a separate vertical-wiring compartment for each motor control center section. Provide cable supports and a hinged door separate from the unit starters.

7. Provide individual compartments separated by steel barriers and with separate hinged doors for each starter, circuit breaker, or other unit. Locate equipment to enable termination of field wiring from front without equipment removal. Motor Control Center shall have a 12” top wireway and a 6” bottom wireway.

8. Mechanically interlock starter and circuit breaker doors so doors cannot be opened with unit energized. Provide defeater mechanism to allow intentional access while starter or circuit breaker is energized. Provide provisions for padlocking external disconnect handles in the OFF position.

9. All doors shall have formed round corners with rolled edges for retaining neoprene gaskets, shall have continuous full-length hinges and shall be held closed by means of quick captive fasteners which shall present a neat appearance and shall be capable of being fastened or unfastened without requiring the use of tools. The door shall be a part of the structure and not part of the starter so it may be closed to cover the opening after the starter has been removed.

10. All starter or circuit breaker units shall be built in interchangeable modular height combination of a minimum vertical unit dimension of 12 inches. All units shall be line-plug-in "draw-out," "lock-out" type. Guides shall be provided in the structure for supporting and aligning the unit starter during its removal or replacement. Plug-in units shall have silver-plated, pressure type line disconnecting stabs of high strength copper alloy. Each unit shall have a "lock-out" latch to enable the electrician to padlock the unit in the draw-out position, and at the same time, the stabs and the entire unit shall be isolated for the bus. Each unit shall be held in place by means of quick captive

fasteners arranged so the units can be removed or remounted readily without access to the rear of the structure. Each unit shall be totally enclosed and effectively baffled to isolate any ionized gasses which may occur within the unit starter. In addition, each unit shall be ventilated so that it can be located anywhere within the structure using the same overload heaters for the same load. Breakers and starter sizes are indicated on the drawings.

11. Bus bars shall be silver plated copper and braced to withstand the rms symmetrical short circuit current ratings as shown on the drawings. Provide full horizontal bus rating for entire length of the motor control center. Do not taper the bus.

12. Provide a continuous, bottom mounted, frontal accessible 300-ampere minimum ground bus extended the full length of the motor control center.

13. Feeder circuit breakers shall be molded-case thermal magnetic type.

14. Provide quick make and quick break toggle mechanism, inverse-time trip characteristics, and trip-free operation on overload or short circuit. Automatic tripping shall be indicated by a handle position between the manual OFF and ON position. Provide trip ratings and number of poles as indicated on the drawings. Provide breakers with fault current interrupting ratings equal to or greater than the motor control center short-circuit current rating shown on the drawings. If necessary to comply with this provision, breakers shall be equipped with current-limiting fusing.

15. Means shall be provided to lock each breaker handle in the "off ' position with the cover closed by means of a minimum of 3 padlocks. Branch breakers shall have a symmetrical interrupting rating as indicated. Operating handle for MCC circuit breakers shall be mounted on MCC unit and not on unit door.

16. Combination starters shall be as described in “Combination Magnetic Motor Starters” in this section.

17. Each compartment shall have nameplates made from phenolic material with 1/4” white lettering on a black background and as specified in section 16010.

18. Motor control centers shall comply with applicable NEMA, UL, and ANSI standards for industrial control.

19. Motor control center shall be factory finished with ANSI 61 medium gray paint.

20. Motor control centers shall be Siemens 8100 Series, Allen Bradley Centerline 2100 Series, or Square D.

21. Provide rubber floor matting in front of the motor control center, ATS, and main circuit breaker, pump control panel. Rubber matting to meet ASTM Designation: D178-1 for electrical and physical requirements.

22. Verify that overall equipment dimensions are within the maximum dimensions indicated on

the plans. If larger equipment is required, submit a proposed room layout showing arrangement of electrical equipment. Provide working clearances in accordance with the NEC. Any costs due to rearrangement of equipment shall be borne by the Contractor with no additional expense to the Owner.

B. Combination Magnetic Motor Starters

1. Comply with NEMA ICS, Class A, and with NEC Article 430.

2. Combination motor starters shall include thermal magnetic circuit breakers and NEMA rated starters as shown on the drawings. The short-circuit rating shall be greater than or equal to the motor control center short circuit rating.

3. Provide 120-volt control circuit transformer where indicated. Provide 100-volt-ampere spare capacity that is in addition to contactor load plus other loads specified. Fuse one side of secondary winding and ground other side. Provide primary winding fuses Class CC rejection type where shown on drawings.

4. Provide solid state overload relays in lieu of motor starter overloads. The solid-state overload relay shall be the same manufacturer as the MCC and include 2:1 adjustable full-load amps, phase current loss protection, phase current unbalance, and a manual reset. The manufacturer shall verify the motor ratings and coordinate the solid-state overload relay with the actual horsepower ratings of the motors installed.

5. Provide 30.5 mm, heavy duty, oil tight, LED cluster, indicator lights, selector switches, elapsed run time indicators, pushbuttons, etc., as shown in the wiring diagrams and single line diagrams. Mount on the front panel of the starter. Refer to Section 16946.

6. Provide externally operable overload relay reset buttons and disconnect operators.

7. Provide control relays within the starter enclosure as shown in the schematic wiring diagrams. Control relays shall be provided with led indicator lights. 120-Volt relays shall be plug in pin-type and 24VDC relays shall be plug in, blade-type.

8. Control relays shall be magnetically held and shall have convertible contacts. Control relays shall be UL listed with minimum 10 amp rated contacts and coil voltage, number of poles, and pole arrangement as indicated on the drawings. Relays shall be IDEC Series RR3B, SquareD 8501 Type K Series, or equal.

9. Time-delay relays shall be UL listed with contacts rated 10-ampere non-inductive load, 120-volts, with coil voltage, number of poles, pole arrangement, and maximum timing adjustment as indicated on the drawings. Relays with maximum timing adjustment 180 seconds or shorter shall be plug-in, solid state type with timing knob adjustment. Provide Potter Brumfield, Syracuse Electronics, ISSC, or equal. Relays with maximum timing adjustment longer than 180 seconds shall be synchronous motor driven with timing knob adjustment. Provide Automatic Timing & Controls Series 322B, G&W Eagle Signal BR1 Series, or equal.

10. Indicating lights shall be 30.5mm, heavy duty, oil tight type, LED type, complete with color of lens indicated on drawings and legend plate. Lamps shall be 120-volt a-c. Indicating lights shall be push-to-test type. Indicating lights shall be LED cluster type.

11. Control switches shall be 30.5mm, heavy-duty, round, oil type, complete with legend plates and quantity of contact blocks required for the control function.

12. Reset timers shall be synchronous motor driven with a solenoid-operated clutch and suitable for semi-flush, panel mounting. Utilize timers with time range indicated and 10-ampere, 120-volt contacts. Provide Eagle Signal Bulletin 125 timers, Automatic Timing and Controls Bulletin 305 timers or equal.

13. Percentage timers shall be the solid-state type with repeat accuracy of 1/2% of full scale. The "on" and off times shall be adjustable.

14. Elapsed time meters shall be synchronous motor driven, 0 to 99,999.9-hour range, non-reset type, suitable for semi-flush, panel mounting.

15. Auxiliary contacts shall be provided as indicated, and as required for operation.

16. Provide a terminal strip in each starter where external controls or indicators are required. A schematic diagram shall be provided inside the cover of each starter. This diagram shall show terminal strip identifications for each external connection. Terminal strips shall be Phoenix Contact, Weidmuller, or equal.

17. All 120 VAC control wires energized from a source external from the MCC device control transformer shall be yellow in color.

C. Main Circuit Breaker

1. Main circuit breakers shall be described above for feeder circuit breakers except without the inverse - time trip characteristics. Main breakers shall be UL rated as service equipment and enclosure so marked. Mount in MCC or NEMA 12 enclosure as indicated on the drawings with external handle with requirements as required by MCC Feeder Breakers. Interrupting rating shall be 42,000 AICS minimum.

D. Power Monitor

1. When shown on the drawings, Power Monitor (PM) shall be a panel-mounted, 3-phase microprocessor-based monitoring device that provides complete electrical metering, displaying and remote monitoring of electrical parameters as listed herein and as shown on the drawings.

2. The PM shall be UL listed. The PM shall support 3 and 4 wire Wye, 3 wire Delta and single-phase systems as shown on the Drawings and as specified herein. The PM shall accept input from standard 5A secondary instrument transformers.

3. Voltage monitoring range shall be up to 300 VAC phase-to-phase for 120/208-volt system

or 300-volt phase-to-neutral and 600-volt phase-to-phase for 277/480-volt system.

4. PM shall measure True RMS voltage, phase-to-phase, phase-to-neutral, current per phase and neutral, real power, reactive power, and power factor. PM shall monitor total accumulated energy, total accumulated reactive energy and total apparent energy.

5. PM shall calculate average, max/min demand values for all readings. A time/date stamp must be recorded when a max or min is detected.

6. The accuracy shall be a minimum ±0.2% of full scale for current and voltage readings and ±0.4% for power, energy and ±1.0% for power factor readings. Accuracy shall be maintained from 10 to 115% of nominal for voltage, 3 to 140% of nominal for current and from –0.50 to 1.00 to +0.50 power factor. The resolution for current, voltage and power parameters shall be 0.1% and for power factor 1.0%.

7. The PM display shall have a standard switchboard instrument size footprint with mounting per ANSI C39.1. The PM shall have high intensity LEDs or LCD of at least 5/16-inch height letters. Displayed power measurements shall include Volts, Amps, Watts, VARs, KWH and Power Factor. The totalized power readings shall be displayed in five-digit resolution minimum. Provide a listing of the register locations in the PM where the collected data is accessible, via the communication port.

   a. The power monitor shall have the following characteristics:

| | |
|---|---|
| Current Input Range (for each channel) | 5A at full scale |
| Overload withstand | surge 10X for 3 seconds |
| Surge withstanding | per IEEE C37.90.1 |
| Frequency Range | 0-75Hz, 60Hz -Nominal |
| Temperature | -4 degrees F to 150 degrees F |

   b. Fused potential transformers shall be incorporated into the Monitoring system. Provide current transformers, fuses, potential taps, and accessories with ratios suitable for service voltage and current rating of motor control center. Current transformers shall be capable of carrying full load continuous primary current without damage to transformer insulation. Voltage and current transducers shall be self-powered, solid state device, AC input, DC output insensitive to load variations from 0 up to 19,000 ohm; with multi-turn adjustable potentiometer accessible through a siding access port providing a 0-1 mA DC output. Transducers shall be Scientific Columbus Model VT110A2 (voltage) and CT510A2 (current), or equal.

   c. Power monitoring unit shall communicate through the Open Bus communications system as shown on the drawings. Provide all required equipment, connectors, converters, and power supplies.

   d. Power monitoring unit shall be provided by Allen Bradley or Siemens as part of the motor control center.

E. Auxiliary Control Panels

Where shown on the drawings, low voltage control panels for other auxiliary equipment, such as fan control panels, grinder/ comminutor control panels, etc. shall also follow the requirements of section 16946 of these specifications.

## 16155.03 EXECUTION

A. Installation

1. Secure motor control centers rigidly to floors or mounting pads with anchor bolts or concrete wedge anchors.

2. Each Control Center shall be installed on a concrete pad 4 inches larger in all directions than Motor Control Center in accordance with the requirements of Section 16010.

B. Preliminary Inspection/Test

1. Test the operation of each interlock to verify that the interlock performs its function.

2. Set adjustable trip circuit breakers two settings above the setting that causes the breaker to trip during motor starting. Do not adjust the setting above 1,300% of the motor nameplate current rating.

3. Set main and feeder circuit breaker adjustable set points, and time delays in accordance with the manufacturer.

C. Conditional Acceptance Inspection/Test

1. Repeat Preliminary Inspection Test.

2. Operate each device a minimum of three times under load condition. Make adjustments as required to provide operation.

END OF SECTION

# SECTION 16157

# VARIABLE FREQUENCY DRIVES

## 16157.01 GENERAL

A. Description

1. This section describes materials, testing and installation of variable frequency drives (VFDs).

B. Submittals

1. Submit shop drawings in accordance with the General Provisions.

2. Submit manufacturer's descriptive data including ratings, circuit diagrams, dimensional data, conduit entry restrictions, and heat dissipation to ambient.

C. O & M Manuals

1. O & M manuals shall be provided in accordance with the General Provisions.

D. Manufacturer's Services

1. Provide equipment manufacturer's services at the jobsite for the minimum man-days listed below, travel time excluded:

   a. One man-day per drive to check the installation, calibration, the drives, supervise start up, and supervise testing of the drives. A minimum of three man-days shall be provided.

   b. One man-day to instruct the Owner's personnel in the operation and maintenance of the equipment.

E. Factory Training

1. The Contractor shall provide a factory-training course to a minimum of four County technicians. The training shall include, as a minimum, the following:

   a. Theory of Operation.

   b. Maintenance.

   c. Overhaul Instructions.

   d. Troubleshooting Techniques.

e. Bus Communications.

2. The training shall be performed by a qualified factory representative at a location within a 100-mile radius of the site and be a minimum of three man- days. Training shall be compatible and appropriate for the VFDs furnished.

F. Delivery, Storage, And Handling

1. VFDs are to be stored per manufacturer's recommendations.

G. Warranty

1. Startup shall be performed by an authorized factory representative. Warranty period for drives shall be for 2 years from the date of Substantial Completion. Warranty shall be such that the County shall not be responsible for any warranty costs including travel, labor, parts, or other costs for the full warranty period. Warranty shall cover all failures including line anomalies (including lighting strikes), load anomalies, accidental exposure to moisture or corrosives, and accidental collision or other physical damage.

**16157.02 MATERIALS**

A. General

1. Variable frequency drive systems shall consist of variable frequency controllers as specified in section 2.01.C. Where indicated on the drawings bypass starters with their associated controls and harmonic filters shall also be provided. Each drive shall operate as a simplex unit with no interaction with other drives. Horsepower and current rating of each drive shall be sufficient to drive the motor as shown on the drawings under the specified operating conditions.

a. Design equipment to operate under the following conditions:

i. Altitude to 3,300 feet above sea level.
ii. Ambient 10 C to 40 C.

b. Non-condensing relative humidity to 95%.

c. Equipment shall comply with the requirements of ANSI, IEEE, and NEMA. The electrical equipment, design, and construction shall comply with the provisions of UL508.

d. The complete VFD assembly shall be "Integrally Equipment Rated" in accordance with UL requirements and shall be suitable for connection of an available fault of

42,000 RMS symmetrical amperes. The VFD input circuit breaker shall conform to Specification 16155 for feeder circuit breakers.

e. The pump manufacturer shall be responsible for the coordination of the VFD operation with the specific pump and motor requirements.

f. Variable frequency drives shall be the current model manufactured by Siemens or Allen Bradley.

B. Enclosures

1. Equipment shall be floor standing, completely front accessible, ventilated NEMA 12 enclosure. Enclosures shall be suitable for mounting against a wall or back-to-back with other equipment, with adequate fan cooling and ventilation to sustain 40°C within the enclosure. Cooling fan filters shall be accessible for changing from outside the enclosure.

2. Provide separate enclosures for each variable frequency controller. Locate all controls within the variable frequency controller enclosure.

3. Verify that overall equipment dimensions are within the maximum dimensions indicated on the plans. If larger equipment is required, submit a proposed room layout showing arrangement of electrical equipment. Provide working clearances in accordance with the NEC. Any costs due to rearrangement of equipment shall be borne by the Contractor with no additional expense to the Owner.

C. Variable Frequency Controllers

1. Controller shall consist of an input circuit breaker (thermal magnetic), power conversion bridge, inverter, output contactor, and bypass solid state starter with contactor.

2. Controller shall be pulse width modulated (PWM) design.

3. Controller shall limit installed power line harmonics to within the latest version of IEEE-519.

4. Controller shall be variable voltage/variable frequency (constant volts per hertz).

5. VFD shall auto-derate the output voltage and frequency to the motor if an input phase is lost. This result will maintain operation without decreasing the life expectancy of the VFD. The use of this feature shall be user selectable and export a warning during the event.

6. VFD shall auto-derate the output voltage and frequency to the motor in the presence of sustained ambient temperatures higher than the normal operating range, so as not to trip on an inverter temperature fault. The use of this feature shall be user-selectable, and a warning

will be exported during the event. Function shall reduce switching frequency before reducing motor speed.

7. VFD shall auto-derate the output frequency by limiting the output current before allowing the VFD to trip on overload. The speed of the load can be reduced, but not stopped.

8. Provide a power monitor on the load side of VFDs. Monitor shall be capable of reading the following: Voltage per Phase, Current per Phase, Current Demand, Calculated Neutral Current, Minimum/Maximum Reading, and Loss of Phase.

9. VFD shall be able to catch a rotating motor operating in either forward or reverse at up to full speed.

10. The controller shall include the following features:

    a. 460-volt a-c, 3-phase, 3 wire, 60-Hz input power.
    b. 460-volt a-c, 3-phase, 3-wire, ungrounded output power.
    c. Input fusing, fast acting.
    d. Input power surge protector. (Refer to Section 16670 for requirements) (also per manufacturer's specifications)
    e. 20 to 60 Hz continuous operating range.
    f. Output current limit, 50% to 100% adjustable. Limits motor inrush current during startup.
    g. Regulation +/-3% of base speed.
    h. Adjustable acceleration and deceleration rates.
    i. Maximum and minimum speed adjustments.
    j. 115-volt a-c control power for run/stop circuits.
    k. Blower cooled with thermal switch cutout.

11. The controller shall include protective circuitry that initiates an orderly shutdown of the inverter without component failure. The controller shall shut down and require manual reset for the following fault conditions.

    a. Overload.
    b. Instantaneous overcurrent.
    c. Inverter fault.
    d. Over-frequency.
    e. D-C link over-voltage.
    f. Cabinet over-temperature.

12. The controller shall shut down for the following fault conditions. The controller shall automatically restart upon a cleared fault condition.

    a. Incorrect phase sequence.
    b. Loss of an input phase.
    c. Input under-voltage.

D. Controls

1. The following data shall be accessible via a digital display mounted on the control cabinet door.

    a. Control power on indicating light.
    b. Drive Run.
    c. Drive Fault.
    d. Drive Speed, 0% to 100% rpm, and 0-60 Hz.
    e. Elapsed time meter, six digits, reading in hours and tenths.
    f. Drive output, current and voltage.
    g. System mode selector switch, Hand/Off/Auto.
    h. Manual speed adjustment, 0-100% RPM and 0-60 Hz.
    i. Drive Start/Stop, Local mode.
    j. Critical frequency rejection feature for at least three frequency rejection settings (adjustable).
    k. Motor Over-Temperature.
    l. Ability to see the status of digital and analog inputs in real time.
    m. Ability to display drive data points at the same time during running conditions.
    n. Ability to view status of drive enabled.

2. The following operation shall be provided:

    a. With system mode in AUTO, the motor shall automatically vary in speed proportional to an ungrounded 4- to 20-mA input signal from the PLC. When the input signal drops to 4 mA or below or the input signal is lost, the motor shall shut down.

    b. With system mode in HAND, the motor shall vary in speed in response to the manual speed adjustment of the door mounted digital display or separately mounted potentiometer.

3. Drive shall have automatic adjustable timed restart following a power failure.

4. Provide five digital inputs, two relay output contacts, two 4-20mA analog speed reference outputs, and two 4-20 mA analog inputs. The digital inputs and relay outputs shall be programmable. The analog input signal shall increase the VFD output proportional to the signal.

5. The VFD shall be capable of setting a minimum speed for operation. This setting shall be configured by the Contractor during system testing and startup, with a value indicative of the system hydraulics and operation.

6. The VFD shall be configured to ramp to a preset speed when an input is energized in the VFD. The preset speed setting shall be configured by the Contractor during system testing and startup, with a value indicative of the system hydraulics and operation.

E. Factory Testing

1. Subject the variable frequency drives to a load operational test prior to shipment. Provide written certification of completed and approved factory tests.

F. Spare Parts

1. Provide a complete VFD unit, as specified herein, less the enclosure. Deliver to location as requested by the County.

G. Software

1. Provide all configuration software and cables for connection of each type of drive to a laptop computer for setting the drive parameters. The software shall operate on the latest version of Windows. A manufacturer's representative shall configure all drive parameters to operate as specified. The software and license will then be provided to the County after project completion.

H. Open Bus Communications

1. Where indicated on the drawings provide and install all required cable, conduits, and devices to implement an open bus communication from the PLC in Pump Control Cabinet to each of the Variable Frequency Drives. Each VFD shall include an Open Bus Interface Board to provide direct communications from the VFD to the PLC. All drive setup, configuration, status, alarm, and control parameters shall be accessible to the PLC via the Open bus Communications Link.

2. The equipment and devices to remain at the VFD's are:

   a. H-O-A Selector Switch.
   b. All local control capabilities.

c. Run Pilot Light and ETM.

3. Where indicated on the drawings provide Fiber Optic Loop Communications between the PLC, VFD's and MCC. Refer to Instrument Drawings for configuration. Provide and install all connectors, power supplies, fiber optic transceivers, cable and related components for operation as a redundant loop.

4. Provide all equipment, such as terminal blocks, power supplies, connections, wiring, and other equipment, in the VFD's required for this interface.

5. Provide all programming and configuration of the PLC system and VFD's for the operation of the VFD's as identified in the Process Loop Descriptions, except using open bus communications.

6. System shall be provided with Ethernet Bus Communications.

7. Systems located in the same room shall not have bus communications installed.

## 16157.03 EXECUTION

A. Installation

1. Secure drives rigidly to floors or mounting pads with anchor bolts or concrete anchors.

2. Drives shall be installed as shown on the drawings. Mount drives with the recommended clearances per the manufacturer.

B. Preliminary Inspection/Test

1. Test the operation of each interlock to verify that the interlock performs its function. Test bus communications for complete system operation.

2. The variable speed drive system shall be tested to check correct operation of each drive in the manual variable speed mode and automatic variable speed mode.

C. Conditional Acceptance/Test

1. Repeat Preliminary Inspection/Test.

2. Provide (and submit written results for review) harmonic testing to confirm the system is operating within specified harmonic distortion limits.

END OF SECTION

# SECTION 16160

# PANEL BOARDS

## 16160.01 GENERAL

A. Description

This section describes materials, testing, and installation of panelboards.

B. Submittals

1. Submit Contractor's Drawings in accordance with General Conditions.

2. Show ratings and characteristics including voltage ratings, bussing arrangement, continuous current ratings, fault current withstand ratings, neutral bus rating, enclosure type, ratings, and arrangement of overcurrent protective devices, and mounting provisions.

3. Submit outline and dimensional drawings and conduit entry restrictions.

## 16160.02 MATERIALS

A. Materials

1. Low Voltage Panel Board

Provide dead front, safety-type panelboards with voltage ratings as scheduled. Panelboards shall be circuit breaker type and suitable for short circuit ratings of 25,000 AICS. Panelboards shall be UL listed and labeled and be provided by MCC Manufacturer.

2. Cabinets

Install panelboard in the motor control center or surface mount on aluminum backplane, with hinged front doors, catches, and locks as shown on the drawings. Provide a holder for the directory on the inside of the door.

3. Breakers

a. Molded-Case Breakers

i. Provide quick-make and quick-break toggle mechanism, inverse-time trip characteristics, and trip-free operation on overload or short circuit. Automatic tripping shall be indicated by a handle position between the manual OFF and ON position. Provide trip ratings as indicated in the panelboard. Provide lock-on or lock-off devices where indicated on the drawings.

ii. Single-pole breakers shall be full module size; two poles shall not be installed in a single module. Multiple circuit breakers shall be of the common-trip type having

a single operating handle.

iii. Circuit breakers shall be rated 25,000 AICS minimum.

b. Breaker Connections

Circuit breaker current-carrying connections to the bus shall be bolted type.

c. Bus Bars

Bus bars shall be copper. Provide a copper ground bus bar installed on the panelboard frame, bonded to the box, and containing at least 10 terminal screws.

d. Space Only

Where "space only" is noted on the drawings, provide connectors, mounting brackets, etc., for the future insertion of an overcurrent device of the size indicated.

B. Directories

Provide typed circuit directories on the inside face of the door of each panel. Do not provide handwritten directories.

C. Nameplates

Provide nameplates as specified in Section 16010. Designate the identifying nomenclature, voltage and phase of the panel as shown on the drawing; for example, "PANEL A, 208Y/120V, 3-phase, 4-wire, 100-ampere bus."

D. Surge Protection

Provide integral surge protection in the panelboard as indicated in Section 16670.

**16160.03 EXECUTION**

A. Installation

1. Mount the panelboard in the motor control center as shown on the drawings.

B. Preliminary Inspection/Test

1. Operate each circuit breaker and verify that all phases of each load are disconnected.

C. Conditional Acceptance Inspection/Test

1. Repeat Preliminary Inspection/Test.

END OF SECTION

# SECTION 16200

# POWER GENERATION

## 16200.01 GENERAL

A. Description

1. Provide all equipment, labor, materials, and supervision necessary to install and test stand-by diesel engine driven electric generator set of the latest commercial type and design as specified herein. Installation shall conform to all applicable state and county codes and be satisfactory for locating at the site shown on drawing without undue detriment to the neighborhood by either noise or environmental considerations.

2. This installation of a stand-by power system shall include a generator set rated for continuous stand-by service at the rating and voltage as shown on the drawings, 1800 RPM, and capable of continuous operation between 15% and 100% of rating. The complete operable stand-by system, factory tested, ready for installation, shall be a package of new and current equipment consisting of:

   a. A diesel engine driven electric generator set to provide stand-by power.

   b. An engine-alternator control console resiliently mounted on the generator set which shall include complete engine start/stop control and monitoring systems.

   c. Mounted accessories and other equipment as specified herein and/or required for satisfactory operation and monitoring.

B. Related work specified elsewhere

1. Fuel Tank: 15550.

2. General Electrical Requirements: 16010.

3. Miscellaneous Electrical Devices: 16051.

4. Automatic Transfer Switch: 16250.

C. Responsibility

1. This generator set system shall be assembled, tested, and shipped by one supplier so there is one source of supply and responsibility.

2. The supplier shall be a factory trained and certified manufacturer's representative and shall maintain a complete service facility. The service facility shall be capable of making delivery to the generator set site all generator set parts within 48 hours of

placing the order. The supplier shall employ a manufacturer trained and certified technician on a full-time basis at the service facility capable of making repairs and responding to service calls within 24 hours of notice. Certified proof of this requirement shall be available from the supplier at the time of submission of a quote.

3. The generator set shall be supplied by Caterpillar, Kohler, or MTU Onsite Energy or approved equal. Approval will be the responsibility and at the discretion of the DPW Utilities Central Maintenance Division.

D. Quality Assurance

1. The engine generator set system, including all accessories described herein, shall meet all standards established by:

   a. Underwriters Laboratories.

   b. National Electrical Manufacturers Association.

   c. National Electrical Code.

   d. National Fire Protection Association Pamphlets 30, 31, 37, 76A and 110.

   e. MIL-STD-705B.

E. Submittals

1. Shop drawings

   a. The Contractor shall submit for approval a complete shop drawing package illustrating compliance with the specifications contained herein representing the Emergency Stand-By Power System. The power system shall not be fabricated until the shop drawing package is approved by the County.

   b. The shop drawing package shall include the following:

      i. Engine generator system plan, elevation and dimensional drawings clearly indicating all aspects of the system including points for each of the interconnections required, the space required for maintenance and overhaul, and any special interfacing requirements.

      ii. Engine generator/exciter control cubicle layout and component descriptions.

      iii. Fuel consumption rate curve at various loads, ventilation, and combustion CFM requirements.

      iv. Exhaust muffler and dimensions, vibration isolator descriptions, exhaust pipe layouts and dimensions.

      v. Schematic ladder and wiring diagrams for the generator system.

vi. Printed literature and brochures describing the system including all sizing requirements and components specified.

vii. The weight of the engine, generator, and complete system.

viii. Battery, FRP/HDPE battery boxes, and battery charger literature and description.

ix. Layout of the main fuel oil tank, float mechanism, piping schematic, and fuel connection information for the engine.

x. The specified stand-by KW of the generator shall be for continuous electrical service during interruption of the normal utility power source, and this shall be certified to this effect by the manufacturer for the actual unit supplied.

xi. Factory prototype test results performed on a unit of this size and type.

xii. Procedure for lubricating oil sampling and recommended frequency.

2. O & M Manual

a. Operations and Maintenance Manuals shall be furnished before the system is accepted. This manual shall include start up, shut down, and emergency operating instructions; repair, troubleshooting and preventative maintenance procedures; a complete parts manual; dimensional drawings, separate unit wiring diagrams and schematics, and interconnecting wiring requirements; special requirements for operation of the diesel generator between 15 and 100 percent of rating. The O&M manual shall include manuals for each component of the system, including identification of the individual parts used in the system. A copy of the approved shop drawing reflecting any past-approved changes shall also be included. The O&M Manual shall include the master shop technical service manuals, overhaul system manual literature kit and parts manuals for the generator and engine. The final O & M Manual shall be submitted and approved prior to conditional acceptance.

b. Provide two (2) hardcopy sets and two (2) CD/electronic copies of final O & M Manuals to Anne Arundel County before acceptance test commences.

F. Installation Certificate

A factory technician from the generator manufacturer shall inspect the installed generator system and certify in writing to the installer that it is installed in accordance with the manufacturer's recommendations before the system is initially started. The technician shall be present for the initial start up and make recommendations to resolve any defects experienced. A copy of the installation certificate must be submitted to the County before the generator set is conditionally accepted.

G. Generator Diagnostics Software and Instruction Manual

1. Provide engine and genset controller diagnostic software and instruction manual for troubleshooting, reading parameters and trouble codes, alarm setpoints, etc. for the engine control system for each series engine/genset provided in this contract. Diagnostic software shall be designed to restrict owner's use to "Read Only" activities to prevent making changes to engine set points and parameters.

2. Manufacturer's field technician-level training for use of the controller/ diagnostic software

shall be provided for a minimum of four (4) county diesel technicians for an 8-hour period. This is in addition to training specified elsewhere in this section or other sections of the specifications. Upon satisfactory completion of the training, the county technicians shall receive field technician training certifications as issued by the manufacturer and/or vendor.

3. Provide any required configuration software and interface cables/devices for connection of each type of generator supplied to a laptop computer.

4. Stationary generator engines shall meet EPA Tier 3 emission requirements, and portable generators shall meet Tier 4 requirements.

H. Warranty

The complete generator set, controls, accessories, and assembly shall be warranted as a whole by the manufacturer for three years from conditional acceptance for parts and labor. Satisfactory warranty documents naming Anne Arundel County, Maryland as the recipient of the warranty and setting forth the period of the warranty shall be provided before acceptance. The warranty shall identify the supplier as a manufacturer's representative capable of resolving warranty claims. However, the manufacturer shall remain responsible for its warranty. Further, individual warranties of the component parts will not be considered as satisfactory warranty documents.

I. Training

Provide off-site factory, genset technician-level training course by the factory authorized generator supplier/vendor. Training shall be provided for maintenance, troubleshooting, and repair of the engine, generator end, and controls inclusive of the microprocessor-based controller using the manufacturer's diagnostic software. The training shall be two (2), 1-day (minimum) sessions for (2) County Diesel Technicians per session at the generator manufacturing facility or the nearest factory authorized supplier/maintenance facility. Location shall be 50-miles or less from the site, or supply travel and lodging expenses for each county technician if more than 50 miles from the site.

## 16200.02 MATERIALS

A. Engine

1. The engine shall be diesel fueled, 4-cycle, liquid -cooled with mounted radiator, blower fan, and coolant pump. Full pressure - lubrication shall be supplied by a positive- displacement lube oil pump. The engine shall be equipped with replaceable water/fuel separator, and lube and fuel filters (spin on type if available). The engine speed shall be controlled by an asynchronous governor as manufactured by Woodward, Barber-Colman, or equal, to maintain generator frequency through the range from full to no load at 1800 RPM, 60 HZ. The engine shall be remote starting with a two-wire, solenoid shift, electric starter. Install at least one foot of flexible fuel line between the engine and fuel oil tank.

2. Engine protection devices provided shall include shut down for overcrank, overspeed, high coolant temperature, and low oil pressure.

3. A radiator with blower type fan shall be sized to maintain safe operation between 120- 125 degrees F ambient temperature. Total airflow restriction from the radiator shall not exceed 0.5" water at both inlet and outlet. The cooling system shall be pre-treated by the engine supplier for inhibition of internal corrosion. The radiator shall be equipped with core guard and fan guard. Cooling system shall be protected against freezing to -34°F, with a 50% ethylene glycol antifreeze solution. The antifreeze shall meet GM 1825 specifications. Provide long life per manufacturer's recommendation. Provide spin on coolant filter system where available.

B. Silencers:

1. A super critical type exhaust silencer having an attenuation factor of 35-45 decibels with bottom inlet and horizontal outlet shall be provided for the engine generator set. Silencer shall be manufactured by Kittel, Maxim, or equal, with companion flange connections at inlet and outlet, and taps for drainage. A suitable length of flexible high temperature stainless steel exhaust pipe with flanges welded to both ends shall be furnished for mounting between the engine and silencer. The exhaust system shall be wrapped with a non-asbestos preformed insulation material to reduce heat radiation and covered with a metal retainer to hold the material in place and provide additional protection.

2. Silencer shall be mounted above the engine generator set so that its weight is not supported by the engine. The exhaust pipe shall be of sufficient size to ensure that the measured exhaust back- pressure does not exceed the maximum limitations specified by the engine manufacturer. Exhaust piping shall be extended through the building or enclosure wall as indicated with all necessary weatherproof accessories. Piping shall be painted with aluminum paint capable of withstanding temperatures of 600°F.

C. Jacket Water Heater: Provide unit mounted thermal circulation type water heater incorporating separate thermostatic switch at 100°F. The heater shall be a minimum of 3 watts per cubic inch engine displacement. Heaters less than 2000 watts shall be 120-volts. Units 2000 watts and larger shall be powered through a contactor with available service voltage. Provide an exterior tank type heater, Kim-Start, or equal. For interior locations, 120-volt heaters shall be furnished to the extent possible.

D. All engine drains, including oil and coolant drains, shall be piped and valved. Coolant drain piping shall be Schedule 40 (minimum) brass. All drain valves shall be bronze or brass ball valves. Valve trim materials shall be compatible with coolant.

E. The engine shall be provided with a stainless-steel nameplate with the name of the engine manufacturer, engine model number, serial number and other pertinent engine data in accessible locations where they can be read.

F. Generator

1. The generator shall be synchronous type built to NEMA standards, rated for continuous stand-by at ratings indicated on the drawings, 60 HZ, 0.8 PF, 1800 RPM. Class F insulation or better shall be used on the stator and rotor, and no materials which will support fungus growth shall be used. The generator shall have a resettable protector for exciter/regulator protection against extended low power factor loads. The generator shall be capable of accepting full nameplate load in one step. The generator shall be rated for operating nonlinear VFD loads, or full voltage starters as required for this application.

2. An exciter/regulator shall be provided to match the characteristics of the generator and engine. Voltage regulation shall be plus or minus 1% from no load to full rated load. Voltage level adjustment shall be a minimum of plus or minus 5%. The solid-state regulator module shall be shock mounted and epoxy encapsulated for protection against vibration and atmospheric deterioration. Voltage dip due to motor starting current shall not exceed 20% for any step loading (non-VFD), which includes one sewage pump motor. Frequency dip shall be limited to 10% (non-VFD). When VFDs are present, limit voltage dip to 10% per step, 5% limit for frequency dip per step.

3. Main Line Circuit Breaker

    a. A generator-mounted main line molded case circuit breaker shall be provided as a load circuit interrupting protection device. It shall operate both manually for normal switching functions and automatically during overload and short circuit conditions. The breaker trip rating shall not exceed 100% of the generator rating or the automatic transfer switch rating.

    b. The trip unit for each pole shall have elements providing inverse time-delay during overload conditions and instantaneous magnetic tripping for short circuit. The circuit breaker shall meet standards established by Underwriters Laboratories, National Electrical Manufacturers Association, and the National Electrical Code.

    c. Generator exciter field circuit breakers do not meet the above electrical standards and are unacceptable for line protection.

4. The generator shall have minimum size as indicated on the drawings. The capacity of the generator shall be rated for two raw sewage pumps and the remaining connected loads. The generator shall be designed to operate full voltage starters or non-linear loads, such as variable frequency drives as shown on the drawings.

5. Automatic Starting System

    a. Starting Motor: A DC electric starting system with positive engagement shall be furnished. The motor voltage shall be 24-volt DC or 12VDC as recommended by the manufacturer.

    b. Provide automatic engine starting controls within the generator panel to start the engine automatically from a contact in the transfer switch.

    c. When the engine starts, the starting control shall automatically disconnect the cranking controls. The cranking disconnect means shall be electrically self-regulating to prevent recranking for a definite time after source voltage has reduced to a low value. If the engine fails to start, or any safety device operates while the engine is running, the engine shall be stopped immediately and the starting control locked out, requiring manual resetting.

    d. Controls shall provide shutdown for low oil pressure, high water temperature, overspeed, and overcrank. Controls shall include a 10 second cranking cycle limited to 3-5 attempts before lockout.

    e. The automatic engine starting control shall incorporate industrial control type elements throughout, which must operate at 80% battery voltage. Relays shall be equipped with

silver-gold contacts of the wiping type and shall have adequate pressure to insure reliable performance at battery voltage.

f. Provide a lighted factory built, wired, and tested generator set mounted control panel, NEMA 12 type, vibration isolated, dead front, 14-gauge steel panel with hinged front opening doors for providing required access to all components. Provide removable top and side panels for providing required access to cable entry and terminations. Provide the basic model controller where available. The control panel shall be furnished with the following fused AC and DC controls:

g. DC engine controls including the following: Run-stop-remote switch, remote-start-stop terminals, oil pressure gauge, charge rate ammeter, and water temperature gauge.

h. Control cabinet front mounted status lamps shall indicate: Low engine temperature, high coolant temperature, low oil pressure, overcrank, and overspeed. Manual reset capability shall be provided.

i. AC output controller display must have digital readouts of voltage, frequency, and current for each phase.

j. Digital readout control to include: AC volt meter 3-1/2” diameter, meter switch phase selector with off position, a voltage rheostat, a frequency meter 3-1/2" diameter, and hour meter, and a 3-1/2" diameter AC ammeter with phase selector switch.

k. Dry contacts for remote alarms wired to terminal strips.

l. Automatic starting controls.

m. Panel illumination lights and switch.

n. Generator "Running, Generator Failure, Generator Low Fuel (25%) and Not In Auto”, double-throw, Form C relay contacts with normally closed contacts for connection to SCADA System.

6. Battery Charger/Batteries

a. Provide a current limiting, 6-ampere battery charger to automatically recharge batteries. The DC voltage shall have an adjustable “float” setting underload from 2.15-2.35 volts per cell and an adjustable “equalize” setting under load from 2.30-2.40 volt per cell. It shall include overload protection, silicone diode full wave rectifiers, voltage surge suppressors, DC ammeter and voltmeter, AC overcurrent protection, and 0-24 hour equalize timer. The battery charger shall be suitable for 120-volt AC input. The battery charger shall be LaMarche Model A-46.

b. Provide a set of rack mounted 12-volt (less than 400KW) or 24-volt (400KW and greater) lead acid storage battery(s) of the heavy-duty diesel starting type for the engine generator set. The battery set shall be of sufficient capacity to provide for one and one half minutes of total cranking time without recharging and be sized for the cold cranking amps as

recommended by the engine manufacturer. The battery(s) shall be rated no less than 172 ampere-hours. Provide all necessary cables and clamps.

c. The batteries shall be mounted in fiberglass (FRP) or HDPE, marine type battery boxes. Batteries shall be located adjacent to the base frame on the floor, so that batteries are readily accessible for service and/or removal.

7. Engine Generator Set Base Construction

a. The engine and generator shall be mounted in perfect alignment on an all welded preformed structural steel I-beam or C channel skid type sub-base which shall provide for attachment of all specified engine and generator accessories.

b. Provide vibration isolators between the engine generator set and skid base. The quantity, size, and type of isolators shall be as recommended by the manufacturer.

8. Fuel System

a. The engine generator set shall be provided with a complete fuel oil supply system including a storage tank and fittings, fuel pumps, supply and return piping, and all necessary accessories. All work shall be done in accordance with the requirements of NFPA Pamphlets 30, 31, and 110; Code of Maryland 08.05.04; and all local regulations.

b. All materials shall be compatible for use with No. 2 commercial fuel oil.

c. The tank shall be sized to hold oil for 24-hours of operation at full running load of the facility.

d. Refer to Section 15550 for detailed fuel tank requirements.

e. The generator and fuel tank shall be provided complete with all piping, pumps, electrical connections, and associated equipment.

9. Exhaust Air Damper

Provide aluminum radiator duct adapter between exhaust damper and radiator. Each side of the radiator adapter duct shall be provided with an aluminum, gasketed inspection door to allow complete inspection and adjustment of gravity dampers and inspection of the radiator. Refer to Section 10200 for louver requirements.

10. Painting

The complete generator set shall be painted with the manufacturer's standard prime and finish paint system. Observed nicks, damage, rust, etc. to the paint system of the installed generator set shall be prepared, primed and finish coated in the field prior to conditional acceptance.

G. Weather Resistant Aluminum Enclosure (Where indicated on drawings)

1. The powder-coated aluminum, sound attenuated enclosure shall be capable of being lifted over and on top of the sub base fuel tank. Installation will be accomplished using a gusset mounting

plate on the inside bottom of the frame. The size and location of bolts shall be determined by the manufacturer. The frame base shall be weather sealed using a foam strip applied where the frame comes in contact with the fuel tank. Installation of enclosure shall be flush with outside edges of sub base fuel tank.

2. The enclosure frame shall be constructed of powder-coated aluminum or stainless-steel structural members. The joining of structural members comprising the frame shall be performed by welding (bolt construction is not acceptable).

3. The top and comer edges of the powder-coated aluminum exterior shall be covered with 2” x 2" x 3/8" aluminum angle structural members that cover the pop rivets used to attach the steel panels to the frame. These angle pieces shall be attached using self-sealing, self- threading stainless-steel bolts. The bottom exterior perimeter shall be covered with a 3" wide rub rail to cover the pop rivet head. It shall be attached in the same manner as the angle pieces.

4. Muffler / silencer shall be installed and supported inside the enclosure. A penetration through the roof for the muffler discharge piping shall be provided. An aluminum rain collar shall be installed to ensure rain tight integrity of the enclosure. The roof of the enclosure shall be cambered to permit water shedding.

5. All fasteners, bolts and nuts shall be 316 stainless steel.

6. The enclosure shall have a minimum of four access doors to permit easy access to the enclosed generator set and associated support equipment. These doors shall be mounted in an aluminum frame and be made of the same material as the enclosure sides and roof. Each door shall have stainless steel butt hinges and a standard three-point latch with external padlock handle. The hinges, handles or other hardware shall be installed so as to present a neat, tamper resistant appearance. Contractor shall provide locks standardized with the County's keying system.

7. The enclosure shall have combined fixed/gravity intake louvers and gravity exhaust louvers. These louvers shall be of sufficient size to allow the generator set manufacturer’s specified airflow for cooling and combustion air. Location, size, and number of louvers to be determined by enclosure manufacturer and calculations shall be included in the shop drawing submittal to demonstrate proper size selection. All louvers shall be made out of aluminum construction riveted into a hinged aluminum frame with a lockable, 3-point stainless steel latching mechanism or screw latches allowing ready access to the radiator and generator ends while forming a rigid, watertight assembly. The openings shall be covered with stainless steel screens to prevent foreign objects from entering the enclosure.

8. Provide aluminum radiator duct adapter between intake damper and radiator.

9. The enclosure shall be capable of attenuating generator noise to 69 dBA at 21 feet for Level III enclosures.

10. Warrantee: All materials shall be guaranteed against failure of workmanship for 3-years.

11. Enclosure shall be provided by the generator manufacturer.

12. Enclosures for 250 KW and larger shall contain lighting and a GFI duplex receptacle.

B. Spare Parts (For Each Generator Provided)

1 - Complete Set of Air Filters.

1 - Set of Fuel Filters.

1 - Set of Oil Filters.

**16200.03 EXECUTION**

A. Installation

1. Secure generator to concrete pad with type 316 stainless steel anchor bolts as recommended by the manufacturer.

2. Connect power and control conductors to the generator as shown on the drawings and as identified herein.

3. Install fuel tank, all associated fuel system devices, piping and electrical, in accordance with these specifications and the manufacturer's recommendations.

B. Pre-Shipment Testing

1. Prototype tests performed on a generator set of the same size and type, required by these specifications, shall be submitted and approved with the shop drawings, required above. The test procedures and results shall be certified by an independent testing laboratory. The tests shall be performed in accordance with NFPA 110 and document the following:

   a. Maximum power level.

   b. Maximum motor starting capacity.

   c. Voltage dip.

   d. Fuel consumption.

   e. Engine generator-cooling airflow.

   f. Governor response time.

   g. Alternator temperature rise per NEMA MG1-22.40.

   h. Harmonic analysis and voltage wave fo1m deviation per MIL-STD-705 B, Method 601.4.

   i. Three (3)-phase short circuit test for mechanical and electrical strength.

2. Factory testing of the generator set to be supplied shall be conducted in accordance with procedures certified by an independent testing laboratory and approved by the County

responsible for the operation of the specific installation. The manufacturer shall successfully test the generator set to be supplied, for items defined above, and submit the test results for approval before shipping the generator set to the job site. A two-hour load bank test shall also be performed and the results submitted before shipping the generator set.

3. Acceptance Tests

   a. An eight (8) hour load bank test shall be performed at the factory, and the results shall be submitted to the Engineer before shipping the generator..

4. The Contractor shall fill the tank with No. 2 winter mix fuel oil and replace any fuel used in testing.

C. Field Testing and Start-up.

1. Acceptance Testing: Acceptance testing of the installed generator set shall be conducted by a factory trained representative of the diesel generator manufacturer. An authorized representative of Anne Arundel County will witness the acceptance tests.

2. Prior to scheduling the acceptance testing, the following documentation shall be submitted and approved as indicated:

   a. Final O & M manuals shall be submitted,
   b. Testing procedure shall be reviewed and approved by the County.
   c. Manufacturer's Installation Certificate
   d. Certification of torsional vibration compatibility in accordance with 2013 NPFA 5.6.10.2, or latest revision.
   e. Letter of compliance from energy converter supplier in accordance with 2013 NPFA 5.6.10.5, or latest revision.

3. Test Procedure: The test procedure followed will be approved by the County and will include data taken during the prototype testing, as a minimum, and as in accordance with Section 16010.

   a. The test procedure shall be submitted to and approved by the County before the equipment is tested. Submitted procedure shall document detailed procedure and timeframe allowed for County review, so there are no delays in the project due to County review of the testing procedures.

   b. The Contractor shall furnish all testing equipment, materials, fuel, etc. needed to demonstrate the set is in compliance with the specification. Any deficiencies brought to the attention of the Contractor shall be corrected and, if warranted or requested by the County, the test shall be repeated.

4. Shutdown Demonstration: Prior to Acceptance Test, verify all automatic shutdown interlocks provided by the generator controller are functional. The minimum are considered to be low oil pressure, high coolant temperature, over-speed, voltage output, and any other protective features recommended by the manufacturer.

5. Alarm Demonstration: Prior to Acceptance Test, verify "Run" , “Low Fuel (25%)” and "Generator Failure" SCADA alarms.

6. On-site Installation Acceptance Test: Perform the on-site installation acceptance test in accordance with 2013 NFPA 110 Section 7.13.4.1, or latest revision. Collect and record all data required for test documentation.

7. Field Load Test: Perform a minimum two-hour test with the field load from the booster pumping station. Check power connections for overheating. Record transfer and cool down timing when returning to normal power.

8. Load Bank Test: Following a minimum five (5) minute cooling period, perform a 2-hour, full load test in accordance with 2013 NFPA 110.7.13.4.3, or latest revision.

    a. Load tests shall use dry-type load banks specifically utilized for this purpose. Saltwater brine tank load banks are not acceptable for this purpose and shall not be utilized for load testing.

    b. The load bank will be capable of definite and precise incremental loading and shall not be dependent on the generator control instrumentation to read voltage and amperage of each phase. The test instrumentation will serve as a check of the generator set meters.

9. Interface Demonstration: Demonstrate that the generator engine control microprocessor diagnostic interface will communication with a laptop computer utilizing the diagnostic software provided as part of this Contract.

10. Noise Control Testing: Perform a sound measurement test in the field at the property line located closest to the generator while running at full load. Test shall be witnessed and approved by a County Representative. Testing may be done concurrent with the load bank testing.

11. Transfer Switch Operation and Alarms: Confirm during testing with a simulated power failure that the transfer switch and related alarming function as required. Record delay time.

12. Fuel: The Contractor shall fill the tank with new No. 2 winter mix fuel oil and replace any fuel used in testing.

    a. Fuel and Oil Testing: Fuel and Oil supplied by the Contractor shall be sampled and tested by a third party prior to final acceptance. Fuel shall be No. 2 diesel fuel conforming to requirements specified in ASTM D975. Testing shall use Velcon VFT-0100 Water and Visual Clarity Test kit, or Equal.

    b. Fuels found to contain excess water or debris shall be rejected or replaced at the expense of the Contractor. Testing shall be repeated to demonstrate that oil and fuel are contaminant free.

13. Documentation: The following documentation shall be submitted within one (1) week of the field testing, where applicable:

a. All testing documentation from on-site testing

b. Manufacturer's certification of a rated load test at rated power factor with the ambient temperature, altitude, and fuel grade recorded. Provide in accordance with 2013 NFPA 7.13.4.6 or latest revision

14. Properly prepare and touch-up all painted surfaces which have been nicked, scratched, chipped, or corroded during construction including piping, generator enclosure (if provided), and frame.

END OF SECTION

# SECTION 16201

# PORTABLE POWER GENERATION

## 16200.01 GENERAL

A. Description

1. Provide all equipment, labor, materials, and supervision necessary to install and test portable stand-by diesel engine driven electric generator set of the latest commercial type and design as specified herein. Installation shall conform to all applicable state and county codes and be satisfactory for locating at the site shown on drawing without undue detriment to the neighborhood by either noise or environmental considerations.

2. The standby portable power system shall include a generator set rated for continuous stand-by service at the rating and voltage as shown on the drawings, 1800 RPM.

3. The complete integrated portable power generation system consisting of:

    a. Diesel engines
    b. Control System
    c. Alternators
    d. Package enclosure.
    e. Battery charger
    f. Block heater

B. Related work specified elsewhere:

    a. General Electrical Requirements: 16010.
    b. Miscellaneous Electrical Devices: 16051.

C. Responsibility

1. The portable generator set system shall be assembled, tested, and shipped by one supplier so there is one source of supply and responsibility.

2. The supplier shall be a factory trained and certified manufacturer's representative and shall maintain a complete service facility. The service facility shall be capable of making delivery to the generator set site all generator set parts within 48-hours of placing the order. The supplier shall employ a manufacturer trained and certified technician on a full-time basis at the service facility capable of making repairs and responding to service calls within 24-hours of notice. Certified proof of this requirement shall be available from the supplier at the time of submission of a quote.

3. The generator set shall be supplied by Kohler, Caterpillar, Multiquip, or MTU Onsite Energy. Approval will be the responsibility and at the discretion of the DPW Utilities Central Maintenance Division.

D. Quality Assurance

1. The engine generator set system, including all accessories described herein, shall meet all standards established by:

   a. Underwriters Laboratories

   b. National Electrical Manufacturers Association.

   c. National Electrical Code.

   d. National Fire Protection Association Pamphlets 30, 31, 37, 76A and l l0.

   e. MIL-STD-705B.

E. Submittals

1. Submit shop drawings in accordance with Special Provisions.

2. Shop Drawings

   a. The Contractor shall submit for approval a complete shop drawing package- illustrating compliance with the specifications contained herein representing the Emergency Stand-By Portable Power System.

   b. The Contractor shall submit the manufacturer' s certification that conforms to the quality assurance requirements as delineated in Section C above.

   c. The shop drawing package shall include the following:

      1) Engine generator system plan, elevation, and dimensional drawings clearly indicating all aspects of the system including points for each of the interconnections required, the space required for maintenance and overhaul, and any special interfacing requirements.

      2) Engine generator/exciter control cubicle layout and component descriptions.

      3) Fuel consumption rate curve at various load , ventilation, and

combustion CFM requirements.

4) Exhaust muffler dimensions, vibration isolator descriptions, exhaust pipe layouts and dimensions.

5) Schematic ladder and wiring diagrams for the generator system.

6) Printed literature and brochures describing the system including all sizing requirements and components specified.

7) The weight of the engine, generator, and complete system.

8) Battery, battery charger literature and description.

9) Layout of the main fuel oil tank, fuel level indication, piping schematic, and fuel connection information for the engine.

10) The specified stand-by KW of the generator shall be for continuous electrical service during interruption of the normal utility power source, and this shall be certified to this effect by the manufacturer for the actual unit supplied.

11) Factory prototype test results performed on a unit of this size and type.

12) Procedure for lubricating oil sampling and recommended frequency.

13) Submit Manufacturer's certification that the proposed fuel system will work properly, as shown on the drawings.

14) Submit detailed drawings of enclosure and fuel tank.

3. Submit layout drawing showing generator on concrete pad with dimensions.

4. O & M Manual

   a. Submit Operation and Maintenance Manual in accordance with Special Provisions.
   b. Operations and Maintenance Manuals shall be furnished before the system is accepted. This manual shall include start up, shut down, and emergency operating instructions, repair , troubleshooting and preventative maintenance procedures, a complete parts manual, dimensional drawings, separate unit wiring diagrams and schematics, and interconnecting wiring requirements, special requirements for

operation of the diesel generator between 15 and 100 percent of rating. The O&M manual shall include manuals for each component of the system, including identification of the individual parts used in the system. A copy of the approved shop drawings reflecting any past- approved changes shall also be included. The O & M Manual shall include the master shop technical service and overhaul system manual literature kit for the generator and engine. The final O & M Manual shall be submitted and approved prior to conditional acceptance.

c. Provide two (2) hardcopy sets and two (2) DC/electronic copies of final O&M manuals to Anne Arundel Cow1ty before acceptance test commences.

5. Installation Certificate

a. Comply with Special Provisions.

b. A factory technician from the generator manufacturer shall inspect the installed generator system and certify in writing to the installer that it is
installed in accordance with the manufacturer's recommendations before the system is initially started. The technician shall be present for the initial start up and make recommendations to resolve any defects experienced. A copy of the installation certificate must be submitted to the County before the generator set is conditionally accepted.

F. Warranty

1. The complete generator set, controls, accessories, and assembly shall be warranted as a whole by the manufacturer for three years from conditional acceptance for parts and labor. Satisfactory warranty documents naming Anne Arundel County, Maryland as the recipient of the warranty and setting forth the period of the warranty shall be provided before acceptance. The warranty shall identify the supplier as a manufacturer's representative capable of resolving warranty claims. However, the manufacturer shall remain responsible for its warranty. Further, individual warranties of the component parts will not be considered as satisfactory warranty documents.

G. Manufacturer's Services

1. Refer Section 16010 for Manufacturer' s Service requirements

2. Provide equipment manufacturer's services at the jobsite for the minimum man-days listed below, travel time excluded:

a. One man-day installed to check the installation, supervise start up, and supervise testing of the Generator to be energized.

b. One man-day to instruct the Owner's personnel in the operation and maintenance of the equipment, at the site during a time approved by the Owner.

H. Training

1. Provide , factory diesel technician level training course by the engine manufacturer. Training shall be provided for maintenance, troubleshooting, and repair of the engine, fuel system, generator, and controls inclusive of the microprocessor using the manufacturer's servicing tools. The training shall be two (2), 3-day (minimum) sessions for (2) County Diesel Technicians per session at the generator manufacturing facility or the nearest factory authorized maintenance facility. Location shall be 50-miles or less from the site, or supply travel and lodging expenses for each County technician if more than 50-miles from the site.

## 16200.02 MATERIALS

A. Generator

1. Provide a portable generator with minimum size as specified and indicated on the drawings. The generator shall be designed to operate linear and non-linear loads, such as variable frequency drives. The generator shall be capable of operating at 277/480 V or 120/208V, 3- phase.

2. The generator shall be synchronous type built to NEMA standards, rated for continuous stand-by at ratings indicated on the drawings, 60 HZ, 0.8 PF, 1800 RPM. Class H per NEMA MG1-1.65 shall be used on the stator and rotor, and no materials which will support fungus growth shall be used. The generator shall have a resettable protector for exciter/regulator protection against extended low power factor loads. The generator shall be capable of accepting full nameplate load in one step. The generator shall be rated for operating non-linear loads. VFD loads or full voltage starters as required for this application.

3. An exciter/regulator shall be provided to match the characteristics of the generator and engine. Voltage regulation shall be plus or minus 0.5% from no load to full rated load. Voltage level adjustment shall be a minimum of plus or minus 5%. The solid-state regulator module shall be shock mounted and epoxy encapsulated for protection against vibration and atmospheric deterioration.

4. Main Line Circuit Breaker

a. A generator mounted, electrically operated main line molded case circuit breaker shall be provided as a load circuit interrupting protection device. It shall operate both manually for normal switching functions and automatically during overload and short circuit conditions. The breaker trip rating shall not exceed 100% of the generator rating or the Manual Transfer Switch.

b. The trip unit for each pole shall have elements providing inverse time delay during overload conditions and instantaneous magnetic tripping for short circuit. The circuit breaker shall meet standards established by Underwriters Laboratories, National Electrical Manufacturers Association, and the National Electrical Code.

c. Generator exciter field circuit breakers do not meet the above electrical standards and are unacceptable for line protection.

B. Automatic Starting System

1. Starting Motor: A DC electric starting system with positive engagement shall be furnished. The motor voltage shall be 24-volt DC or 12-volts DC as recommended by the manufacturer.

2. Provide automatic engine starting controls within the generator panel to start the engine automatically from a contact in the transfer switch.

a. When the engine starts, the starting control shall automatically disconnect the cranking controls. The cranking disconnect means shall be electrically self-regulating to prevent recranking for a definite time after source voltage has reduced to a low value. If the engine fails to start, or any safety device operates while the engine is running, the engine shall be stopped immediately and the starting control locked out, requiring manual resetting.

b. Controls shall provide shutdown for low oil pressure, high coolant temperature, overspeed, short circuit. Controls shall include a 10-second cranking cycle limited to 3-5 attempts before lockout.

c. The automatic engine starting control shall incorporate industrial control type elements throughout, which must operate at 80% battery voltage.

3. Provide a UL508 Listed, lighted factory built, wired, and tested generator set mounted control panel, NEMA 12 type, vibration isolated, dead front, 14-gauge steel panel with hinged front opening doors for providing required access to all components. Provide removable top and side panels for providing required access to cable entry and terminations. The control panel shall be furnished with the following features AC and DC controls:

a. Controls

1) Analog % of current meter
2) Analog AC frequency meter
3) Analog AC voltage meter
4) Analog % of load meter (KW)
5) Cycle cranking control
6) Digital display panel
7) Emergency stop switch
8) Remote starting
9) Reset switch
10) Run-off-auto switch
11) Self diagnostics
12) Voltmeter/ammeter phase selector switch
13) Four customer fault inputs.

b. Shutdowns

I) Emergency stop
2) Fail to crank
3) High and low AC voltage
4) High and low Coolant temperature
5) Low oil pressure
6) Overcurrent
7) Overspeed
8) Short circuit
9) Under-frequency
10) Overload load

4. Battery Charger/Batteries

a. Provide a current-limiting battery charger to automatically recharge batteries. The battery charger shall be suitable for 120-volt AC input. The battery charger shall be a unit approved by the generator manufacturer.

C. Fuel System-Sub Base Tank

1. The engine generator set shall be provided with complete and integrated fuel oil supply system. Direct injection, number 2 diesel fuel. Provide a 36 Hour integrated tank when running the genset at ¾ load.

2. All work shall be done in accordance with the requirements of NFPA Pamphlets 30, 31, and 110, Coded of Maryland 08.05.04 and all local regulations.

3. All materials shall be compatible for use with No. 2 commercial fuel oil.

4. Prior to conditional acceptance, the Contractor shall fill the tank with No. 2 winter mix fuel oil and replace any fuel used in testing.

5. Provide fuel tank assembly and components which shall meet all state, local, and federal requirements for above ground storage tanks relating to fill piping, vent piping, and spill protection. Provide manufacturer' s certification that the generator provided conforms to all requirements.

D. Auxiliary Power - Panelboard

1. Provide 120/240 VAC, 1-phase, 100 Amp panel board, and associated circuit breakers in the generator enclosure to feed the Generator associated equipment such as Jacket Water Heater, Battery Charger.

E. Painting

1. The complete generator set shall be painted with the manufacturer' s standard prime and finish paint system. Observed nicks, damage, rust, etc. to the paint system of the installed generator set shall be prepared, primed and finish coated in the field prior to conditional acceptance.

2. Provide doors to permit easy access to the enclosed generator set and associated supply equipment. These doors shall be mounted in a steel frame and be made of the same material as the enclosure sides and roof.

3. The enclosure shall allow the generator set manufacturer's specified airflow for cooling and combustion air. The enclosure openings shall be covered with stainless steel screens to prevent foreign objects from entering the enclosure.

4. Provide fueling and access ladders.

5. Provide aluminum radiator duct adapter between intake damper and radiator.

6. The enclosure shall be capable of attenuating generator noise to 79 dBA at 7 meters.

7. Provide a pre-wired AC distribution package.

8. Warrantee: All materials shall be guaranteed against failure of workmanship for 3 years.

F. Spare Parts

1. Provide all spare parts as indicated below which are installed in the generator provided:

a. 1 - Set of Air Filters.

b. 1 - Set of Fuel Filters.

c. 1 - Set of Oil Filters.

**16200.03 EXECUTION**

A. Installation

1. Connect power and control conductors the generator as recommended by the manufacturer.

B. Testing

1. Prototype tests performed on a generator set of the same size and type, required by these specifications, shall be submitted and approved with the shop drawings, required above. The test procedures and results shall be certified by an independent testing laboratory. The tests shall be performed in accordance with NFPA 110 and document the following:

    a. Maximum power level.

    b. Maximum motor starting capacity.

    c. Voltage dip.

    d. Fuel consumption.

    e. Engine generator-cooling airflow.

    f. Governor response time.

    g. Alternator temperature rise per NEMA MG1-22.40.

    h. Harmonic analysis and voltage waveform deviation per MIL-STD-705 B, Method 601.4.

    i. Three (3)-phase short circuit test for mechanical and electrical strength.

2. Factory testing of the generator set to be supplied shall be conducted in accordance with procedures certified by an independent testing laboratory and approved by the County responsible for the operation of the specific installation. The manufacturer shall successfully test the generator set to be supplied, for items defined above, and submit the test results for approval before shipping the generator set to the job site. A two-hour load bank test shall also be performed and the results submitted before shipping the generator set.

3. Acceptance Tests

a. Acceptance testing of the installed generator set shall be conducted by a factory-trained representative of the diesel generator manufacturer. An authorized representative of Anne Arundel County will witness the acceptance tests. The test procedure followed will be approved by the County and will include data taken during the procedure outlined above, as a minimum.

1) The test results shall be submitted to, and approved by, the County before the equipment is accepted. The Contractor shall furnish all testing equipment, materials, fuel, etc. needed to demonstrate the set is in compliance with the specification. Any deficiencies brought to the attention of the Contractor shall be corrected and, if warranted or requested by the County, the test shall be re-performed prior to acceptance. Final O&M Manuals shall be submitted before the acceptance tests commence.

2) The acceptance test shall be performed during an eight (8) hour field test during which the manufacturer's representative shall demonstrate that the system performs in complete compliance with the specifications. As a minimum a full capacity load bank test, performed in accordance with NFPA 110 section 5-13.2. The load tests shall use dry type load banks specifically utilized for this purpose. The load bank will be capable of definite and precise incremental loading and shall not be dependent on the generator control instrumentation to read voltage and amperage of each phase.
The test instrumentation will serve as a check of the generator set meters. Load bank testing shall be performed for a period of four (4) hours at the full rated load of the generator. Salt-water brine tank load banks are not acceptable for this purpose, and shall not be utilized for this test.

b. The Contractor shall fill the tank with No. 2 winter mix fuel oil and replace any fuel used in testing.

c. Properly prepare and touch-up all painted surfaces, which have been nicked, scratched, chipped or corroded during construction.

**END OF SECTION-**

# SECTION 16250

# AUTOMATIC TRANSFER SWITCH

## 16250.01 GENERAL

A. Description

This section includes materials and installation of automatic transfer switches.

B. Related Work Specified Elsewhere

1. General Electrical Requirements: 16010.
2. Low Voltage Motor Control: 16155.
3. Power Generation: 16200.
4. Section 16920 (Phase monitor- ATS load side)

C. Submittals

1. Submit shop drawings in accordance with the General Provisions.
2. Submit manufacturer's descriptive data including ratings, circuit diagrams, dimensional data, conduit entry restrictions, and a list of accessories.

D. O & M Manuals

O & M manuals shall be provided in accordance with the General and Special Provisions.

E. Manufacturers Services

1. Provide manufacturer's services at the jobsite for the minimum man-days listed below, travel time excluded:
    a. One-man day to check the installation, supervise start-up, and supervise testing and adjustments of the transfer switches.

## 16250.02 MATERIALS

A. Materials

1. Transfer Switch
    a. Transfer switch enclosure shall be NEMA 12 steel for interior locations or NEMA 3R stainless steel for exterior locations as shown on the drawings. Stainless steel

enclosures shall not be painted. Transfer switch shall have number of poles, amperage, and voltage ratings as shown on the drawings. Withstand current rating shall not be less than 50,000 ampere rms symmetrical.

b. Switch shall be listed per UL 1008 as a recognized component for emergency systems and rated for all classes of loads. Transfer switch shall be capable of switching non-linear loads, such as VFD's, as required for this application.

c. Transfer switch shall be electrically operated and mechanically held in each direction by a single operating mechanism momentarily energized from the source to which the load shall be transferred. Accomplish mechanical locking in each direction without the aid of latching solenoids, toggle mechanisms, or gear arrangements. Total operating transfer time shall not exceed one-sixth of a second.

d. Operation shall be inherently double throw where normal and emergency contacts operate simultaneously with no momentary delay in a mid-position. An overload or short circuit shall not cause the switch to go to a neutral position. Electrical spacings must not be less than those listed in Table 15.1 of UL 1008. Do not use main contact structures not originally manufactured for transfer switch service (molded case circuit breakers or contactors). Inspection and replacement of all contacts (stationary and arcing) shall be possible from the front of the switch without any disassembly of operating linkages or power conductors. Provide a handle to permit no-load manual operation.

e. Transfer switches shall be 3 poles with solid neutral connection.

f. For projects with large motors controlled by VFDs bi-directional delayed transition shall be considered.

2. Accessories

a. Provide a solid-state sensing and control logic panel. Adjustments to time delays and voltage/frequency limits shall be dip switch adjustable. Electronic adjustments are not allowable. Include the following operational characteristics:

i. Adjustable (.5 to 6.0 seconds) time delay on engine starting to override momentary dips in normal source, set at 1 second.

ii. Full phase voltage relay supervision of the normal source with at least one close differential relay to detect "brownout" condition, set at 70% dropout and 90% pickup.

iii. Voltage/frequency lockout relay to prevent premature transfer, set at 90% voltage and 90% frequency.

iv. Engine starting control contacts (one normally open and one normally closed).

v. Adjustable (2 to 25 minutes) time delay on retransfer to normal, set at 20 minutes.

vi. Unloaded running time delay for generator cool down (adjustable .1 to 10 minutes),

set at 5 minutes.

vii. Transfer to emergency time delay (adjustable 1 to 300 seconds), set at 1 second.

b. Provide a system test switch (momentary type) on the front of the enclosure.

c. Provide a manual pushbutton to bypass the time delay on retransfer.

d. Provide LED indication of the source to which the load is connected.

e. Provide LED indication of the presence of a normal power source.

f. An in-phase monitor shall control transfer/retransfer operation between live sources when the sources are approaching and are sufficiently close to a zero-phase angle difference so as to avoid excessive motor inrush currents. The monitor shall cause in-phase transfer/retransfer to take place over engine/generator frequency ranges of 58 to 62 Hz with a utility source of 60 Hz. Normal transfer/retransfer operation shall automatically occur, without the use of manual overrides, in the event of a complete failure of the load-carrying source.

g. Transfer switch shall include four pilot contacts (10 amperes at 480-volt a-c) that open three seconds (nominal) prior to transfer and re-close three seconds (nominal) after transfer. These contacts will de-energize motor loads during the transfer time of the switch.

h. Control power supplies shall be sized by the manufacturer.

i. Provide a programmable weekly engine exercise set for Wednesday at 9:00A.

j. Provide dry contacts for remote monitoring of signals for ATS position, Utility Power Status, and Emergency Power Status. Provide interface between generator and ATS as required for interface of monitoring signals to the SCADA system. SCADA requires dry contacts

3. Manufacturers

a. The transfer switch shall be manufactured by ASCO or equivalent.

## 16250.03 EXECUTION

A. Installation

1. Secure automatic transfer switch rigidly to wall with Type 316 stainless steel anchor bolts, as shown on the drawings.

2. Connect RTU monitoring conductors to new automatic transfer switch to monitor switch positions.

3. Provide and install phase monitors, as specified in Section 16920, for monitoring power.

B. Preliminary Inspection/Test

1. Field test and calibrate timing and monitoring logic. All adjustments shall be within 5% of the previously specified set points.

2. Field test and calibrate the in-phase monitor.

C. Final Inspection/Test

1. Repeat preliminary inspection/test.

END OF SECTION

# SECTION 16450

# GROUNDING

## 16450.01 GENERAL

A. Description

This section includes materials, testing, and installation of electrical grounding.

B. Related Work Specified Elsewhere

1. General Electrical Requirements: 16010.

C. Submittals

1. Submit shop drawings in accordance with the General Provisions.

2. Submit material list for all grounding materials and equipment. Indicate size, material, and manufacturer.

## 16450.02 MATERIALS

A. The Contractor shall provide and install a ground ring of minimum #4, stranded bare copper wire around the exterior of the pump station and wet well. The wire shall be buried approximately 24" below grade. The ends of the wire shall be brought above grade and connected to the service entrance ground bus.

B. Ground Rods

Ground rods shall be copper-clad steel, 3/4-inch diameter, minimum 10 feet long, with hardened steel points.

C. Ground Clamps

Ground clamps shall be bronze.

D. Ground Resistance Tester

The ground resistance tester shall be an instrument specifically designed for ground resistance testing.

## 16450.03 EXECUTION

A. Ground Electrode

1. Install a bare copper ground loop as shown on the drawings. Bring the loop to the ground at the motors, distribution transformers, ground main service disconnect bus, or motor control centers. Buried or concealed joints or terminations are not permitted. Protect wires with PVC coated rigid steel conduit where wires stub up through slab at motor control center.

2. Install ground rods 6" below grade for new structures. Connect to ground loop with exothermic weld.

B. Equipment Grounding:

   a. Connect the ground buses of the distribution transformer to the ground bus within the panel with a grounding conductor.

   b. Ground raceways and non-current carrying parts of electrical equipment in accordance with NEC Article 250. Use the metallic conduit system for equipment and enclosure grounding. Grounding through the conduit system shall be in excess of any ground conductors shown on the drawings.

   c. Circuits in nonmetallic conduit shall carry one ground conductor for equipment grounding.

C. Preliminary Inspection/Test

Before making connections to the ground electrode, measure the resistance of the electrode to ground using a ground resistance tester. Perform the test not less than two days after the most recent rainfall and in the afternoon after any ground condensation (dew) has evaporated. If a resistance of 5 ohms or less is not obtained, provide additional ground rods as necessary, driven below grade, and connect to ground test well with No. 4 AWG bare copper wire and repeat the test until 5 ohms or less is met. The Contractor and testing company shall then re-measure the ground resistance and submit the measurements to the County. If the resistance is still above 5 ohms install an additional ground rod and inform the County. Additional work will be authorized through a change order to obtain a 5-ohm resistance.

END OF SECTION

# SECTION 16460

# TRANSFORMERS

## 16460.01 GENERAL

A. General

1. Description

   This section includes materials and installation of low-voltage (600V or less) transformers.

2. Submittals

   a. Submit shop drawings in accordance with the General Provisions.

   b. Submit ratings and characteristics including voltage, phases, connections, enclosure type and dimensions, and conduit entry restrictions.

## 16460.02 MATERIALS

A. General

1. KVA size, voltage, and phase of the transformers are indicated on the drawings.

2. Transformers to be UL listed and labeled where listing applies.

3. Transformers shall be rated for continuous operation in a 40 degrees C maximum ambient temperature.

B. Dry-Type Transformers (30 KVA and Below)

1. Construct transformers in accordance with ANSI C89.2, NEMA ST-20, and UL listed under the requirements of Standard 506.

2. Transformers 5 KVA and larger shall have two 5% FCBN taps on the primary side.

3. Transformers rated 250 VA and below shall have 55 degrees C rise, 105 degrees C insulation system. Transformers rated 0.5 KVA through 30 KVA shall have 115 degrees C rise, 180 degrees C insulation system.

4. Encapsulate core and coil in an insulating resin of the class equal to the temperature rise. They shall be embedded in a resin and filler system to attenuate the sound level.

5. Transformer shall be suitable for installation in the motor control center or wall mounting.

6. Transformers shall be Square D Company “Quiet Quality,” General Electric Company “QB, ML, QMS,” Westinghouse “EP or EPT,” or equal.

## 16460.03 EXECUTION

A. General

1. Set taps under load conditions for correct voltage.

2. Install transformers such that no metal-to-metal, concrete, plaster, or wood contact exists between the transformer and structural members.

3. Install transformer in motor control center, as indicated on drawings.

B. Preliminary Inspections/Tests

Transformers shall have insulation resistance tests made on the windings prior to being connected. The measurements shall be from primary and secondary windings to ground and between primary and secondary windings. The minimum value shall be 10 megohms.

C. Conditional Acceptance/Test

Demonstrate secondary voltage is within 5% of rated voltage at full and no load conditions.

END OF SECTION

# SECTION 16500

# LIGHTING

## 16500.01 GENERAL

A. Description

1. This section includes materials and installation of lighting fixtures as indicated in accordance with Contract Documents.

B. Submittals

1. Submit shop drawings in accordance with the General Provisions as follows:

    a. Manufacturers catalog data including complete catalog number, photometric data, and descriptive literature.

## 16500.02 MATERIALS

A. General

1. Furnish lighting fixtures of the type indicated on the drawings, complete with lamps, sockets, wiring, and mounting hardware.

2. The use of a manufacturer's name and model or catalog number in the drawings is for the purpose of establishing the standard of quality, photometrics, and general appearance desired only. Products of other manufacturers will be considered in accordance with the General Provisions.

B. Lamps

1. Fluorescent:

    a. 32 watt – T-8, energy saving, rapid start, 3000 lumen minimum initial output lamps for use with low ambient type electronic ballasts only, or of similar type for other fixtures.

2. High Pressure Sodium:

    a. Mogul base, instant restrike, unless otherwise noted.

3. Incandescent:

    a. Ceiling or wall-mounted vapor proof w/guard and globe as noted on the drawings.

4. LED:

    a. Ceiling or wall mounted as noted on the drawings.

5. Manufacturers:

    a. Fluorescents: General Electric, Sylvania, Westinghouse, or equal.

    b. Incandescent: Crouse Hinds, or equal.

    c. High Pressure Sodium: Lithonia, or equal

    d. LED: General Electric, or equal

C. Ballasts

1. Fluorescent:

    Provide solid-state, low temperature, electronic T-8 ballasts compatible with the lamps provided. Provide ballasts with 97% minimum power factor, less than 20% THD, less than 1.7 current crest factor, Class A sound rating, IEEE 587A (ANSI C62.41) transient protection, FCC Part 18C, Class A EMI filtering, and UL listed.

2. High Pressure Sodium:

    Provide indoor-outdoor low temperature type ballasts. Ballasts shall be single lamp, volts and watts as indicated. At any lamp voltage, from nominal through life, lamp wattage shall not exceed 5% for +/-10% line voltage variation. Ballasts shall have a minimum power factor of 90% and be magnetic regulator type.

3. Manufacturers:

    Advance, General Electric, Jefferson, Universal, or equal.

D. Fixture Types

Refer to the lighting schedule on drawings for fixture type.

**16500.03 EXECUTION**

A. Installation

1. Install lighting fixtures as close as possible to the locations shown on the drawings, making adjustments only for the purpose of avoiding interferences.

2. Install lighting fixtures plumb and level, with fixture surfaces parallel and perpendicular to walls and other major structures.

3. Install continuous rows of fixtures straight and true and equipped with necessary parts, such as joining straps, couplings, and nipples.

4. Support fluorescent lighting fixtures at two points minimum from structural elements which are capable of carrying the total weight. Mount fixtures rigidly with no rocking action. Where fixtures are mounted in or on a suspended grid-type ceiling, support fixtures at two points in addition to support from the ceiling grid.

5. Aim exterior adjustable lighting fixtures after dark. Notify the Engineer at least three days in advance.

6. Provide pendant stem-mounted fixtures with swivel hangers. Stem shall be one piece without coupling and shall be finished the same color as the canopy and the fixture, unless otherwise noted.

7. Provide mounting and anchoring of fixtures in accordance with the manufacturer's requirements.

8. Emergency lighting units shall be arranged to provide the required illumination automatically in the event of any interruption of normal lighting such as failure of public utility or outside electrical power supply, opening of a circuit breaker or fuse or any manual act(s) including accidental opening of a switch controlling normal lighting facilities. Provide all the required components for a complete operation.

B. Preliminary Inspection/Test

Operate each fixture, at least five times, demonstrating that all lamps and fixtures are fully operational.

C. Final Inspection/Test

Repeat Preliminary Inspection/Test.

END OF SECTION

# SECTION 16670

# SURGE SUPPRESSION

## 16670.01 GENERAL

A. Description

This section describes the materials and installation requirements for transient voltage surge suppressors (TVSS) for the protection of AC electrical circuits from the effects of lightning induced currents, substation switching transients and internally generated transients resulting from inductive and/or capacitive load switching.

B. References

The following standards and publications are referenced for use in various sections of this specification.

1. ANSI/IEEE C62.41-1980 (Formerly, IEEE Std 587-1980), Guide for Surge Voltages in Low Voltage AC Power Circuits. For purposes of this specification, Category C shall assume a maximum voltage amplitude of ten kilovolts and a maximum current amplitude of twenty kilo amperes.

2. ANSI/IEEE C62.1-1984, Standard for Surge Arrestors for AC Power Circuits.

3. ANSI/IEEE C62.33-1982, Standard for Test Specifications for Varistor Surge Protection Devices.

4. ANSI/IEEE Standard 81-1983, Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of Ground System.

5. Underwriters Laboratories, UL 1449, Standard for Safety, Transient Voltage Surge Suppressors, Latest edition.

C. Manufacturers Qualifications

1. All surge suppression devices shall be manufactured by a company normally engaged in the design, development, and manufacture of such devices for the protection of electrical circuits and electronic equipment.

2. The surge suppressor manufacturer shall provide factory repair service for all non-encapsulated assemblies and replacement parts for all encapsulated units.

D. Warranties

1. All surge suppression devices shall be guaranteed by the manufacturer of the suppression

devices for a concurrent five-year period on the equipment.

2. Should the suppressor be destroyed by lightning, a one-time replacement shall be provided during the warranty period at no cost to the owner.

E. Submittal Requirements

1. Provide product data for each suppressor type in accordance with General Provisions.

2. The surge suppression submittal shall also include, but shall not be limited to, the following additional data:

   a. Dimensions for each suppressor type indicating mounting arrangement and required accessory hardware.

   b. Manufacturer's certified test data derived from test results conducted on a completed unit indicating the ability of the product to meet or exceed the requirements of this specification.

## 16670.02 MATERIALS

A. Service Entrance Suppressor Device

1. Main distribution panel location shall be defined as designated in ANSI/IEEE C62.41-1980, location Category C.

2. Suppressors shall be listed in accordance with UL 1449, Standard for Safety, Transient Voltage Surge Suppressors latest edition.

3. For 3 phase, 4-wire configurations, suppressors shall provide suppression elements between all phases and each phase conductor and the system neutral, providing a total of six (6) suppression elements.

4. Suppressor manufacturers shall provide certified test data confirming a fail short failure mode.

5. Visible indication of proper suppressor connection and operation shall be provided.

6. Suppressors shall meet or exceed the following criteria:

   a. Maximum single impulse current rating: 25,000 amperes (8 x 20 us - waveform).

   b. Pulse life rating: 10,000 amperes (8 x 20 us - waveform): 30 occurrences.

   c. Pulse life rating: 5,000 amperes (8 x 20 us - waveform): 180 occurrences.

   d. Maximum clamping voltage and current rating:

| Phase Voltage (RMS) | MaximumClamp Voltage (Peak) | Current Waveform 8 x 20 us |
|---|---|---|
| 120 volts | 450 volts | 5,000 amps |
| 120 volts | 570 volts | 10,000 amps |
| 240 volts | 785 volts | 5,000 amps |
| 240 volts | 880 volts | 10,000 amps |
| 277 volts | 1,040 volts | 5,000 amps |
| 277 volts | 1,250 volts | 10,000 amps |
| 480 volts | 1,600 volts | 5,000 amps |
| 480 volts | 1,820 volts | 10,000 amps |

e. Suppressors shall have turn-on and turn-off times of less than one nanosecond.

f. Suppressors shall be of solid-state componentry and shall operate bi-directionally.

7. Panel Board Suppressor Device

   a. Subpanel location shall be defined as designated in ANSI/IEEE C62.41-1980 location Category B.

   b. Suppressors shall be UL listed in accordance with UL 1449 Standard for Safety, Transient Voltage Surge Suppressors, Latest edition.

   c. For 3 phase, 4-wire configurations, suppressors shall provide suppression elements between all phases and each phase conductor and the system neutral. An additional suppression element is required between the system neutral and the electrical grounding conductor providing a total of seven (7) suppression elements.

   d. The suppressor manufacturer shall provide certified test data confirming a failed short failure mode.

   e. Visible indication of proper suppressor connection and operation shall be provided.

   f. Suppressors shall meet or exceed the following criteria:

      i. Maximum single impulse current rating: 10,000 amperes (8 x 20 us - waveform)

      ii. Pulse life rating: 5,000 amperes (8 x 20 us - waveform): 50 occurrences.

      iii. Pulse life rating: 1,000 amperes (8 x 20 us - waveform): 100 occurrences.

      iv. Maximum clamping voltage and current rating:

| Phase Voltage (RMS) | Maximum Clamp Voltage (Peak) | Current Waveform 8 x 20 us |
|---|---|---|
| 120 volts | 490 volts | 5,000 amps |
| 120 volts | 875 volts | 10,000 amps |
| 240 volts | 810 volts | 5,000 amps |
| 240 volts | 1,150 volts | 10,000 amps |
| 277 volts | 1,170 volts | 5,000 amps |
| 277 volts | 1,540 volts | 10,000 amps |
| 480 volts | 1,750 volts | 5,000 amps |
| 480 volts | 1,980 volts | 10,000 amps |

g. Suppressors shall have turn-on and turn-off times of less than one nanosecond.

h. Suppressors shall be solid-state componentry and operate bi-directionally.

i. Suppressors shall also be provided for variable frequency drives.

**16670.03 EXECUTION**

A. Service Entrance Installation

1. Install one SPD at the main circuit breaker at each utility service entrance to the facility, according to manufacturer's recommendations, and as shown on the drawings.

2. The SPD shall be installed on the load side of the service entrance.

3. The SPD ground shall be bonded to the service entrance ground.

4. Suppressors shall be close nippled to the device being protected. The mounting position of the suppressor shall permit a straight and short lead length connection between the suppressor and the point of connection.

5. Securely mount a surge suppressor to the wall, or panel with stainless steel hardware.

6. Conductors for connection of surge suppression shall be as recommended by the manufacturer for this application and shall be wrapped together the full length of the conductors.

B. Panel Board Installation

1. Install SPD as indicated on the drawings and according to manufacturer's recommendations.

2. Conductors between SPD and point of attachment shall be kept short and straight.

3. Neutral and ground shall not be bonded together at the panelboard locations.

C. Other Installation

Install SPD as required by equipment specifications and as shown on the drawings.

D. Testing

Provide factory certified test reports for each model of suppressor supplied, including test methods and equipment.

END OF SECTION

# SECTION 16900

# GENERAL INSTRUMENTATION REQUIREMENTS

## 16900.01 GENERAL

A. Description

This section includes requirements for materials, testing, and installation of a programmable controller system and instrumentation as specified herein and indicated on the drawings.

1. Instrumentation equipment, materials, and workmanship shall comply with the latest revisions of the following codes and standards:

   a. Instrumentation: Instrument Society of America (ISA).

   b. Wiring: National Electrical Code (NEC), ISA S5.3 and S5.4.

   c. Control Panels and Equipment: NEMA, UL, and ANSI.

   d. Control Logic: Joint Industrial Council (JIC).

2. The system supplier (Subcontractor) shall provide the specified equipment under the following sections:

   a. Instrumentation: 16920.

   b. Programmable Controller System: 16942.

   c. Cabinets, Control Systems, and Consoles: 16946.

   d. Description of Operation: 16965.

B. Submittals

1. Submittal Drawings and Data: Submittals shall be in accordance with the General Provisions with the following additional requirements. These drawings and data shall be submitted as a complete package at one time.

   a. Submittals shall be in three-ring hard-cover binders and arranged for convenient use including tab sheets, all indexed, and cross referenced.

   b. Detailed JIC-style schematic diagrams of each discrete I/O point.

   c. Detailed instrumentation diagrams of each analog I/O point and control loop, per ISA S5.3 and S5.4 standards.

d. Data sheets for each component, together with a technical product brochure or bulletin. The data sheets shall show:

   i. Component name.

   ii. Manufacturer's model number.

   iii. Project location.

   iv. Input and output characteristics.

   v. Requirements for electric supply.

2. The data sheets shall be grouped together in the submittal by systems or loops. If within a single system, a single component is employed more than once, one data sheet with one brochure or bulletin may cover all identical uses of that component in that system.

3. Submit component interconnect drawings showing the interconnecting wiring between each component including equipment supplied under other sections requiring interfacing with the control system. Submit wiring diagrams, schematics and loop drawings for each panel and enclosure provided. Drawings shall include terminal block and wire identification for panel and field equipment connections. This shall include the PLC/ Hydrostatic Level Transducer, SCADA control panel, MCC terminal blocks and field equipment terminal blocks.

4. Submit arrangement and construction drawings for pump control panel, bubbler panel, and for other special enclosed assemblies for field installation. These drawings shall include dimensions, identification of all components, preparation and finish data, nameplates, and the like. These drawings also shall include enough other details to define the style and overall appearance of the assembly including a finish color sample.

5. Submit installation, mounting and anchoring details for all new and relocated components or entry details.

6. Complete detailed bills of material.

7. Operation, maintenance, and repair manuals.

   a. The organization of the initial submittal shall be compatible to eventual inclusion one volume of the operation, maintenance, and repair manuals.

   b. Operation manuals shall be prepared and submitted to the Engineer in accordance with the General Provisions.

   c. In addition to the General Provisions, the complete operation and maintenance manual shall contain all the information included in the submittal drawings and data, and the additional information required herein, all bound in hard cover binders and arranged for convenient use including tab sheets, all indexed and cross referenced, and all final as-

built drawings.

d. The operation manual shall contain:

i. Programming operating instructions written for the benefit of plant operating personnel for normal operational conditions.

ii. Calibration and maintenance instructions.

iii. Trouble-shooting instructions.

iv. Instructions for ordering replacement parts.

8. Software
   a. Submit all configuration software logic on USB drive in applicable PLC language.

   b. Software shall be registered to Anne Arundel County per the requirements of Section 16942. Submit verification prior to purchase.

C. Qualifications and Responsibility of the Subcontractor

1. The Contractor shall furnish and install all proposed hardware and software as specified herein. All systems shall be the unit responsibility of a Control System Integrator subcontracted by the Contractor. The system installation and wiring connections to peripheral equipment and instruments shall be the responsibility of this subcontractor using qualified personnel possessing the necessary equipment and having experience in making similar installations. Evidence of such qualification, as well as notification of the supplier assuming unit responsibility, shall be furnished to the County in writing prior to commencement of the work. The qualification evidence shall include the following:

   a. The subcontractor shall have had a minimum of five years' experience with the installation of systems similar to those to be installed in this project.

   b. The Subcontractor's main place of business shall be located within a 50-mile radius of the jobsite.

   c. A list of completed similar installations including name and address of owner, name of project, and date of completion.

   d. The name and qualifications of supervisory personnel to be directly responsible for the installation of the control system.

   e. The supervisory personnel shall be regularly employed by the Control System Integrator. The employment address of the supervisory personnel shall be within a 50-mile radius of the jobsite.

2. The Control System Integrator shall be responsible for coordinating and interfacing with equipment and instrumentation supplied under other divisions of the contract documents, which are an integral part of the system. This interfacing shall be incorporated in the detailed systems drawings and data sections. The proposed field instruments shall be new.

Manufacturers and model or type numbers are provided as part of the instrument narrative descriptions. The proposed manufacturers are those on which the instrument design has been based.

3. The Engineer will witness calibration and final checkout of the instrumentation and control system, prior to testing to determine if the system complies with the contract documents.

D. System Programming and Configuration

1. The Control System Integrator shall provide all programming required for system configuration; communications to the I/O, communications via the Open Bus network, and general system operation. The Contractor shall make the system completely operational, less the PLC control strategy logic.

2. All PLC programming shall be provided using ladder logic programming per the programming software standard instruction library.

3. The Control System Integrator shall be responsible for providing all software, hardware, and equipment necessary for configuration, programming, and testing of the specified control system equipment and instrumentation.

E. Warranty

The Contractor shall repair or replace defective components, rectify malfunctions, and correct faulty workmanship, at no additional cost to the County during the one-year warranty period. To fulfill this obligation, he shall utilize technical service personnel designated by the equipment supplier who was originally assigned project responsibility. Services shall be performed within five calendar days after notification by the County.

## 16900.02 MATERIALS

A. Designated Components

In these specifications and on the plans, all systems, and other elements are represented schematically and are designated by numbers, as derived from criteria in Instrument Society of America Standards. The nomenclature and numbers designated herein and on the plans shall be employed exclusively throughout shop drawings, data sheets, and the like. Any other symbols, designations, and nomenclature unique to a manufacturer's standard methods shall not replace those prescribed above, as used herein, and on the plans.

B. Instrument Tagging

1. Attach a stainless-steel tag to the instrument at the factory. Permanently mark the stainless-steel tag with the instrument tag number. The manufacturer's standard metal nameplate as a minimum shall denote model number, serial number, operating electrical voltage and amperage (when applicable), and date of manufacture.

2. Once final field calibrations have been completed, the contractor shall tag the instrument with the final calibrated range on an engraved plastic tag. The tag shall be black with white engraved lettering and attached to the instrument with a stainless-steel wire-tie.

C. Instrument System Power

1. Power provided for the instrument system at the facility shall be 120-volt A-C, single phase, 60 Hz.

2. Where D-C power supplies are not furnished integral with any one instrument system loop, then provide separate solid-state power supplies. Power supplies shall be sized for the load plus 25% spare capacity.

D. Matching Style, Appearance, and Type

All display instruments of each type shall represent the same outward appearance, having the same physical size and shape and the same size and style of numbers and points.

## 16900.03 EXECUTION

A. Execution

1. Uniformity of Components

Components which perform the same or similar functions shall, to the greatest degree possible, be of the same or similar type, the same manufacture, the same grade of construction, the same size, and have the same appearance.

2. Mounting of the Programmable Controller and Instruments

a. Mount the programmable controller (PLC) equipment and instruments in accordance with the installation detail drawings as prepared by the Contractor and reviewed by the Engineer. Install equipment so that it is rigidly supported, level and plumb, and in such a manner as to provide accessibility; protection from damage; isolation from heat, shock, and vibration; and freedom from interference with other equipment, piping, and electrical work. Cabinets shall not be installed until heavy construction work adjacent to PLC panels have been completed to the extent that there shall be no damage to the PLC and terminal equipment.

b. All devices, including accessories, shall be located where they shall be accessible from grade, except as shown otherwise.

c. Mount all equipment in cabinets as specified under this contract. Associated terminals shall be mounted on a common panel or rack; mounting panels and rack shall be constructed as described herein.

d. Coordinate the installation of the electrical service to the components related to the system to assure a compatible and functionally correct system. All accessories shall be coordinated, and installation supervised by the Contractor.

e. Test the completed system after installation to assure that all components are operating

within the specified range and all interlocks are functioning properly.

B. Calibration

1. Each instrument requiring factory calibration shall be furnished with a calibration data sheet. The calibration data shall be factory certified to NIST standards and a copy of the calibration data sheets included with the O&M manuals.

2. In addition to factory calibration, calibrate systems after installation in conformance with the component manufacturer's instructions. This shall provide that those components having adjustable features are set carefully for the specific conditions and applications of this installation and that the components and/or systems are within the specified limits of accuracy. Defective elements which cannot achieve proper calibration and accuracy, either individually or within a system, shall be replaced. Accomplish this calibration work by a technical field representative of the single instrument supplier. He shall certify in writing to the Engineer that all calibrations have been made and that all systems are ready to operate.

3. Once final field calibrations have been completed, the contractor shall tag the instrument with the final calibrated range on an engraved plastic tag. The tag shall be black with white engraved lettering and attached to the instrument with a stainless-steel wire-tie.

C. Factory Testing

1. Operational tests shall be performed prior to shipping the control system to the jobsite to demonstrate that the hardware and configuration is correct and will perform each operation required for all specified conditions. The connections and wiring to all the open bus communications modules shall be performed at the factory test with the specified components. Additionally, all instrumentation shall be included and connected to the PLC control system for demonstration. The Engineer and a representative for the County shall have the right to witness the tests. After the testing is completed, provide a certification and log of all tests to the County for review and comment. The panel wiring shall be checked against the submittal drawings.

2. The factory witness test shall take as long as necessary to demonstrate to the County and the Engineer that the hardware performs each operation as required per the specifications. The control system equipment shall not be shipped to the site until the factory test is successfully completed and approved by the County.

D. Fourteen days prior to factory system testing, submit a written detailed test procedure for review by the County. Notify the County in writing four weeks in advance of the scheduled testing.

E. Preliminary Inspection/Testing

1. After the control system installation is complete, all instruments are calibrated, and all wiring is installed and connected, a preliminary test shall be performed by the Contractor.

2. All hardware and configuration software shall be exercised through point-to-point tests,

including the factory test procedure by the Instrument System Subcontractor, in the presence of the Engineer, in order to demonstrate achievement of the specified performance.

3. Schedule tests among all parties involved so that the tests may proceed without delays or disruptions by uncompleted work. Coordinate operational tests dependent upon completion of work specified elsewhere.

F. Conditional Acceptance Inspection/Test

1. When hardware and system configuration is assessed to have been successfully carried through a preliminary test and the County concurs in this assessment, a date for Conditional Acceptance Testing, involving the County's operating personnel will be agreed upon.

2. The complete control system and instrumentation shall be rechecked by the contractor as required in the preliminary inspection test at this time to verify proper operation, and final adjustments shall be made.

3. Upon 100% successful completion of the preliminary testing of the debug period, the system start-up testing shall consist of 14 consecutive days of system testing. The operational tests shall have a success factor of 95% system uptime. If the instrumentation, hardware control system, cabling, or configuration should fall below the 95% factor, the system problems shall be corrected by the contractor and the system start-up shall start over again from day one. This will continue until the system functions for 14 consecutive days with a 95% uptime success factor. The contractor is responsible for all hardware operation of the system, and the initial determination of the problem.

4. Following start-up testing, submit electronic copy of all PLC configuration files.

G. Operator Training (On-Site)

1. Provide the County's operation and maintenance personnel and/or the Engineer with three (3) days of formal instruction in the functions and operations of the hardware, system configuration, and overall system operation as provided under this contract, prior to the Conditional Acceptance Inspection/Test. The training shall cover overall system theory, hardware architecture, system configuration and diagnostics. Emphasis shall also be placed on safety features, maintenance, and features, which may require readjustment, resetting or checking and recalibration.

2. The training shall include PLC operation, Open bus operation, I/O configuration, instrument indication and control, configuration software and PLC interface. The training sessions shall be provided at the County's facilities and on the equipment furnished under this contract. The approved final O&M manual shall be utilized as a guide for the training sessions. The education and instruction of operating personnel shall be a qualified instructor familiar with the requirements for this project. Each training session shall be for eight hours of formal instruction. Session dates shall be directed by the County.

3. A detailed training session curriculum shall be provided to the Engineer a minimum of four weeks prior to the start of the training session.

H. PLC Training (Off-Site)

1. The following training shall be provided for a minimum of (4) county personnel. The training shall be with the same equipment as provided for the project.

2. Provide “Rockwell Automation Developing an RSLogix500 Project Course,” or equal.

3. Training shall be provided within 50 miles of site at authorized training facility.

END OF SECTION

# SECTION 16920

# INSTRUMENTATION

## 16920.01 GENERAL

A. Description

1. This section includes requirements for supplying and testing calibrated field-mounted transmitters, and associated equipment to be provided under Section 16900.

B. Submittals

1. Submit shop drawings for the instrumentation in accordance with Section 16900 and Section 5.04 of the General Provisions.

2. Submit certified dimensional drawings and catalog cuts for each size and type of instrument specified herein. Catalog cuts are to be highlighted to define specific materials of construction and features specified herein. Show tag number of each applicable instrument.

3. Submit instruction bulletins for each type of instrument specified herein. Show tag number for each applicable instrument. The instruction bulletin shall include installation instructions, wiring diagrams, power requirements, maintenance instructions, and any other details of a specialized nature to the instruments furnished.

4. Submit certificates of compliance that the flow meter satisfies the requirements stipulated in this section.

5. Submit Operating and Maintenance Data.

6. Submit Manufacturer's Certification that equipment has been installed properly and observed to function properly when operated.

## 16920.02 MATERIALS

A. Instrumentation Provided Under This Section Includes:

1. Hydrostatic Level Transducer

2. Display Meters.

3. Phase Monitor.

4. Float Switch.

5. Airflow switch (Drywell Supply/Exhaust Fans).

6. Gas Monitoring System.

7. Flow Meters/Transmitter.

8. Chart Recorder.

B. Gauge Pressure Indicating Transmitter

1. The gauge pressure-indicating transmitter shall provide an electronic signal proportional to the calibrated pressure range. The pressure sending element shall be silicone oil filled with a process media operating temperature range of -40° F to 220° F. The transmitter shall be mounted with a carbon steel high-pressure flange and adapter with 1/2-inch NPT connection. The gauge pressure indicating transmitter shall have the following features:

   a. Independent external zero and span adjustments.

   b. Overrange protection, 0 psig to 2000 psig.

   c. Vent/drain valve.

   d. Integral output signal indicator, calibrated 0% to 100% linear scale.

   e. Universal mounting bracket suitable for either wall or pipe mounting.

   f. Two electrical conduit connections, 1/2-inch NPT female.

   g. NEMA 4X enclosure.

2. Accuracy of the pressure transmitter shall be +0.25% of calibrated span.

3. The transmitter shall be calibrated without the use of a microprocessor or external device with the following features:

   a. 4-20 mA Points.

   b. Linear or Square Root Output.

   c. Damping

   d. Engineering Units.

   e. Two-Wire Loop Powered Device.

4. The pressure transmitter shall be that manufactured by one of the following:

   Endress & Hauser, #PMC 51 or latest version thereof.

5. Gauge Pressure Transmitter

| | |
|---|---|
| GENERAL | |
| Service | Hydrostatic Level Transducer /Wetwell Level |
| Quantity | 2 |
| Tag No. | PITl and PIT2 |
| Mounting | Level Transducer Panel |
| Diaphragm Material | 316SS |
| Output Signal Output | 4-20mA D-C |
| Signal to Instrument | PLC |
| Range | 0-20 ft. $H_2O$, Field Verify |
| Calibrated Range | 0-160 inches. $H_2O$ |
| Enclosure | NEMA4X |
| Loop Power | 24VDC |
| SERVICE CONDITIONS | |
| Process Media | Compressed air to measure sewage level |
| Specific Gravity | 1.0 |
| Oper. Press psig (min/max) | 0/100 PSI |
| Temp. (F) (min./max.) | 40/80°F |

C. Display Meters

1. The display meters shall be 24 VDC powered device with a DC input 4-20 mA. The display meter shall be a digital indicator and shall display 3.5 digits with an accuracy of +0.1% of full scale.

2. Provide a display meter for each wet well level indication. The calibrated range of the indicator should match the calibrated range of the transmitter.

3. Install the display meters for the wet well level on the Pump Control Panel

4. Provide Red Lion Model #CUB5PB00, 24 Volt DC, or equal.

D. Phase Monitor (ATS Load Side)

1. The phase monitor shall protect three-phase equipment against incorrect phase sequence, phase loss, and under-voltage conditions. All three phases are monitored individually for a pre-selected over and under voltage limit. This phase monitor is in addition to the line side in-phase monitor supplied with the ATS. The monitor shall also provide transient protection. The monitor shall be phase-sequence sensitive (ABC only). An LED shall indicate that all conditions are normal and glow on fault. The phase monitor shall be UL

listed for this application. The phase monitor shall be surface mount type with terminal screw connections. The phase monitor shall include an output contact for remote indication of an alarm condition.

2. The three-phase, phase monitor shall be NTE Electronics R68-5A10-480 and SQUARE D 8501NR51; or equal; with options as indicated:

| GENERAL | |
|---|---|
| Service | Station Power |
| Quantity | 1 |
| Tag No. | JSL |
| Type | 100 to 600 VAC, 3 phase |
| Mounting | Automatic Transfer Switch (Load Side) |
| Response Time | 100 milliseconds |
| Operating Temp. | 0 degrees C to 40 degrees C |
| Reset | Automatic |
| Indicator | LED |
| Output | (1) SPDT Contact, 5 AMP to RTU via Pump control panel |
| Under Voltage | Adjustable |

3. Single- phase monitors shall be Diversified Electronics VBS Series, Style A, or Equal.

E. Float Switch

1. Float (ball) shall be 5-1/2" diameter leakproof, shockproof, corrosion resistant and constructed of type 316 stainless steel. Float shall have continuously welded seams.

2. Switch assembly shall be a mercury-free, tilt type sensor, which shall be non-floating displacement type with less than 1-inch differential. Switch assembly shall be permanently encapsulated in a plastic cartridge (glass shall not be acceptable). Switch contacts shall be rated a minimum of 20 amperes at 115 VAC. Switch shall be a single pole, single throw type. Furnish normally closed contacts. The float body shall be grounded by the green insulated conductor of the cable supporting the float switch.

3. Cable shall be provided with the sensor and shall be PVC insulated, oil resistant suitable for use in raw wastewater applications. Cable shall be sealed at sensor utilizing a flexible boot and compression type lock seal. Cables shall be a 3-wire cable provided with a minimum size conductor of No. 14 AWG with green grounding conductor. Float switch cable length shall be furnished with continuous length to mount float switches in the wet well and up to the existing explosion-proof junction box on the pump station exterior, plus an additional 5 feet of cable. Excess cable shall be coiled, and tie wrapped to mounting supports.

4. The float system shall be designed to protect against cable stress associated with constant flexing and shall incorporate a neoprene sleeve from the float through a flared stainless steel clamp tube. This design shall provide for a projected flexing life of 35 years of 15-minute cycling. The float system shall have a manufacturer's three (3) year guarantee against defects in material and workmanship.

5. Provide a wetwell high level float and a drywell flood float as shown on the drawings.

6. Float switches shall be Model 9G-EF, mercury-free, Direct Acting Float Switches with cables and weights, as manufactured by Siemens Water Technologies, or equal.

F. Air Flow Switch

1. The flow switch shall utilize a rugged, hermetically sealed reed switch which is encapsulated in a polypropylene switch housing that fits into a standard heavy duty leak proof stainless steel body. The flow switch shall be field adjustable from normally open to normally closed. The airflow switch shall be suitable for installation in Class 1, Division 2 hazardous locations. The switch shall be UL recognized and CSA certified.

2. Flow switch shall be manufactured by W.E. Anderson (Dwyer) Model No.V4, or equal.

3. GENERAL

| | |
|---|---|
| Service | Dry Well Supply and Exhaust Fans |
| Quantity | 2 |
| Tag No. | AFSI-1, AFSI-2 |
| Wetted Material | 316 stainless steel |
| Magnet: | Ceramic. |
| Temperature Limit: | -4 to 220 deg. F. (-20 to 105 deg. C) |
| Range | 0-100 FPM |
| Location | Supply and Exhaust Fan Duct (Dry Well) |
| Mounting | ½"NPT |
| Switch Type: | SPDT snap switch |
| Contacts/Relay | 5A@120VAC |
| Enclosure Rating: | Weatherproof and Explosion-proof. Listed with UL and CSA for Class I, Groups C and D, FM approved. |
| Conduit Connection: | ¾" female NPT |
| Process Connection: | ¾" male PDT<br>Provide ¾" fitting to HVAC pipe/duct. |
| Mounting Orientation: | Within 5 deg. of vertical for proper operation |
| Set Point Adjustment: | For universal vane: five vane combinations. |

Agency Approvals: UL, CSA, CE, FM, SAA and ATEX.

G. Gas Monitoring System (When indicating on drawings)

1. General

a. Gas monitoring systems shall include a sample pump/module and gas detection sensor to continuously sample and monitor combustible gas concentrations and an appropriate control module for the gas sensor that is capable of accepting, converting and transmitting signals from the sensor. Combustible gas monitors shall measure methane gas and provide an output signal proportional to the gas concentration measured at the sensor element and sample pump. The complete gas monitoring system, including sensor, controller, sample module and accessory equipment, shall be supplied by a single manufacturer.

b. Performance Requirements:

| | | |
|---|---|---|
| c. | Accuracy: | +/- 5 % of range |
| d. | Ambient Temperature: | -40 to 60 degrees C |
| e. | Operating Range: | 0-100% LEL Methane |
| f. | Relative Humidity Range: | 0-100% |
| g. | Operating Voltage | 240 V DC supplied by remote power supply |

2. Sensor

a. Gas sensor shall sample and monitor the atmosphere. Sensor shall be rated for use in Class 1, Division 1, Group C and D environments as specified by the National Electric Code. Sensors and sample module shall be mounted with stainless steel wall mounting brackets and hardware as shown on the Drawings and/or as recommended by the manufacturer.

b. Combustible Gas Sensor: Combustible gas sensor shall be of the infrared type, resistant to poisoning by hydrogen sulfide and silicone.

c. Sampler shall be provided with sufficient tubing length to allow mounting of the filter assembly in the wet well remote from the monitor/analyzer as shown on the contract drawings.

3. Monitor Analyzer/Transmitter

a. The gas sensor shall be paired with a microprocessor-based monitor Analyzer/Transmitter with built-in self diagnostics. Monitor shall be of modular construction with plug-in circuit boards for easy service and repair and shall be wall mounted with corrosion resisting enclosure. The monitor shall have dual 3-digit LED displays to indicate the concentration of the gas being monitored. The displays on the monitor shall show the concentration of gas being measured, along with an indication of whether the gas is within calibration, under range, and over range. Each monitor shall have an individual warning, alarm, and fault indicating lights for each gas being monitored along with a green powered light. A

SPDT relay rated at 5 amps 120 VAC resistive shall be provided for each gas being monitored along with a common relay to power a strobe and/or audible alarm. Sensor input 4-20 mA signals shall be provided for each gas being measured.

b. An adjustable alarm set point shall be provided for each gas being monitored. When the alarm setting is exceeded for a specific gas, the specific alarm light and relay associated with that gas shall be activated. The light and relay shall remain in the alarm state until the condition has cleared and the alarm is manually reset. A switch external to the enclosure shall provide reset action. An audible alarm shall be activated when any gas alarm level is exceeded. The audible alarm shall be capable of being silenced by a switch external to the monitor enclosure. Such action shall not disable the audible alarm if an alarm condition recurs.

c. The controller shall provide a monitor fault alarm for the gas being monitored. If the combustible gas reading goes below zero by more than 10 percent of full scale, the alarm associated with that gas shall be activated. If the oxygen reading exceeds 23 percent of full scale, the alarm associated with oxygen shall be activated.

d. The complete gas monitoring system shall be operable at ambient temperatures from 32 F to 125 F and over a humidity range of 0% to 95% relative humidity. The system shall have measurement ranges or O to 100 percent CEC combustible gas for combustible. The response time for a 67 percent change of any gas concentration shall be within the following limits: 5 seconds for combustible gas.

e. Calibration shall be performed through the instrument panel via a manufacturer- supplied magnet. It shall not be necessary to open the monitor enclosure to perform calibration or adjustment of the unit.

4. The system reading when measured on zero gas or a known concentration shall change less than 5 percent full scale per month for each gas. With the exception of monthly checks and recalibration, no periodic maintenance shall be necessary.

5. Manufacturer/Model:

   Gas monitoring systems shall be Model A-Ultima X Monitoring System with methane sensor, as manufactured by MSA Instruments, or equal.

6. Spare Parts:

7. Provide one (1) spare methane gas monitor sensor element.

H. Ultrasonic Clamp-On Flow Meter/Transmitter (When indicated on drawings)

1. Microprocessor - Based Ultrasonic Flow meter

2. The flow meter shall be of the ultrasonic type operating on the transit time principle measuring the time differential from upstream to downstream transducers and shall provide for indicating

and transmitting of sewage flow velocity in full pipes.

3. The flow meter shall be accurate within +/- 2% of rate (plus +/- 0.05% of full scale). The meter shall have a repeatability of +/-0.3% for flow velocities greater than 1 foot/second (0.3 meter/second).

4. The meter shall operate on the following pipe materials: carbon steel, stainless steel, ductile iron, cast iron, FRP, PVC, and cement-mortar lined pipes.

5. The ultrasonic flow meter shall be designed for use in water / wastewater applications. The flow meter shall operate with flow in either direction. Flow meter shall also have ability to determine flow, totals (forward and reverse) and/or any diagnostic parameter needed.

6. The electronic flow sensing device (transducers) shall be capable of being mounted to the outside of the pipe, installed and removed without interrupting flow in the line. The transducers shall be designed to operate continuously at temperatures up to 176 degrees F. A stainless steel sensor holder will be provided as a means of quickly mounting and demounting the transducer. The flow meter shall provide information for optimizing transducer placement as well as diagnostic parameters to assist in troubleshooting. Parameters should include but not be limited to liquid sound speed, signal strength, delta time, Reynolds number and signal quality.

7. The sensors shall be constructed of stainless steel and shall have a rating of NEMA 4X with an option of NEMA 6P, with jacketed flexible cable 30 feet in length.

8. Transducer elements with common cable lengths shall be directly interchangeable between instruments by means of a standard pin connector without requiring a calibration factor.

9. The flow meter shall meet all electromagnetic capability (EMC) requirements according to EN 61326/Al (IEC 1326) "Emission to class A requirements" and NAMUR Recommendation NE 21/43.

10. The flow meter electronics shall be designed to operate at temperatures between -10 and +140 degrees F. The housing is to be powder coated cast aluminum with a NEMA 4X rating. The meter shall be field programmable without the need for external devices.

11. A signal strength meter with separate loss-of-signal indication shall be provided with circuitry to drive all outputs to zero upon loss of signal.

12. For ease of service by plant personnel, the flow meter shall provide self and application diagnostic parameters to isolate any fault condition to either equipment failure or abnormal flow conditions. The unit shall have the ability to produce a Field Verification report consisting of transmitter and sensor diagnostics, health status, and comparison to previous checks or factory condition by means of an external device compliant with ISO and GMP standards. The read-only report shall be suitable for governmental or agency reporting.

13. The ultrasonic flow meter shall be capable of operation in a straight segment of full flowing pipe at least ten pipe diameters long upstream and five pipe diameters long downstream of the transducer mounting location.

14. The transmitter shall include signal processor circuitry to condition the signal generated by the flowing liquid. The signal shall be corrected for random variations with the frequency spectrum. The circuitry shall employ automatic frequency tracking and digital filtering techniques.

15. The transmitter circuitry shall employ a damping mechanism that adjusts the depth of the digital filter when interference peaks are present.

16. The meter's 4-20 mA analog, and pulse outputs shall be proportional to flow. The analog output shall be active/passive selectable, galvanically isolated, time constant selectable (0.05 to 100 seconds), full scale value selectable, temperature coefficient: typical 0.003% of reading per ºF (0.005% o.r./ºC); resolution: 0.5 mA. The frequency output shall be full scale frequency, 2-100 Hz on/off ratio 1:1, pulse width maximum 2 seconds. An open collector status output shall indicate either system or process error, or flow direction. A low flow cutoff will be standard which can be turned on or off. When specified, the unit will be capable of remote operation via manufacturer specific protocol or HART®.

17. Power consumption shall be no more than 12 VA including - independent of meter size. Input power required will be from 85 to 260 VAC, 46 to 65 Hz.

18. A 2-line (via push button Control), 16 characters per line, LCD backlit display shall indicate flow rate and/or total flow. The unit shall have at least 1 totalizer with 7-digit plus 7-digit overflow with sign and units. The totalizer value is protected by EEPROM during power outages. The display shall also be capable of indicating error messages such as error condition and low flow cutoff.

19. The standard meter shall be suitable for use in non-hazardous environments or in FM approved non-incentive Class I, Division 2, Groups ABCD applications.

20. The ultrasonic flow meter shall be of the Endress Hauser PROline Prosonic Flow 93WA1.

I. Chart Recorder (When indicated on drawings)

1. Provide a chart recorder with a one to four channel microprocessor based circular chart unit and totalizer card. A print head shall produce up to four analog traces on a blank heat sensitive chart. The recorder shall include self-diagnostic systems that check critical operations and provide error messages about detected faults.

2. The recorder shall be configurable to meet a variety of applications and shall be able to display process variables as well as chart records. Process variables shall be input using the keypad and display. The digital display shall present setpoints, outputs and other variables in the desired engineering units. These values shall be changed by following the prompts on the display. The circular chart variables shall also be configurable. Chart speed and chart data range shall be entered through the keypad. Alphanumeric chart shall also be output on the chart for marking and identification.

3. The chart recorder shall be manufactured by Honeywell, Model DR 4500 Truline, or equal, with options as indicated.

4. Chart Recorder

| GENERAL | |
|---|---|
| Service Quality | Pump |
| Tag No. | Station Flow |
| INSTRUMENT | 1 |
| Location | FIT |
| Mounting | Pump Station |
| Scale | Panel |
| Channels | Configurable |
| Input | 2 |
| Input From | 4-20 mA d-c |
| Accuracy | Transmitter |
| Enclosure Class | +/-0.1% |
| Power | NEMA 12 |
| Integrator (Totalizer) | 120 VAC, 60 Hz |
| Flow Range | Yes, Microprocessor Based |
| | ---- GPM |

5. Spare Parts

   a. The Contractor shall furnish to the County all necessary spare parts of components required to maintain the instrumentation system prior to final acceptance of work. The Contractor shall provide a spare parts listing of all necessary spare parts and quantities for review by the County. The spare parts shall include but not be limited to, the following minimum requirements:

   b. Minimum Spare Part List

| Item Part | Description | Quantity |
|---|---|---|
| Gauge Pressure Transmitter | Complete Unit | 1 each |
| Display Meter | Complete Unit | 1 each |
| Gas Monitor | Gas Sensor Element | 1 each |

c. The Contractor shall deliver to the County all the required spare parts upon conditional acceptance of the work. The spare parts shall not be used as replacement parts during the guarantee or startup period.

## 16920.03 EXECUTION

Refer to Section 16900 regarding mounting, calibration, testing and training requirements.

END OF SECTION

# SECTION 16942

# PROGRAMMABLE LOGIC CONTROLLER

## 16942.01 GENERAL

A. Description

This section includes requirements for materials, testing, and installation of programmable logic controllers (PLCs).

B. Related Work Specified Elsewhere

General Instrumentation Requirements: 16900.

C. Submittals

Refer to Section 16900.

## 16942.02 MATERIALS

A. Materials

1. Manufacturers

The PLCs shall be Allen Bradley 1400 series Micro Logix or equal. If equal is approved, contractor shall be required to provide any signal isolation that may be required for a functional system.

2. Programmable Logic Controllers

a. The PLCs shall be a 16-bit PLC microprocessor-based stand-alone device. It shall be a process and logic controller designed for industrial environments. It shall be capable of a mix of logic, timing, counting, computation, library of preprogrammed subroutines, and PID loop control capabilities necessary for the unit process application.

b. The PLC shall come complete with central processor, memory, power supply, interconnecting cables, and discrete and analog I/O interfaces.

c. The PLC and associated hardware shall have the following ratings:

d. Operating Temperature: 0°C to 60°C.

e. Humidity: 5% to 95% relative (non-condensing).

f. The PLC shall meet the following specifications:

i. Operating Voltage: 24VDC

ii. Maximum Scan Time: 4.4 ms per 1 K of ladder logic.

g. PLC System Alarm: The PLC shall monitor the internal operation of the PLC system for failures. If a failure is detected, the system shall shut down and freeze all inputs and outputs in their last states until the error is cleared. As a minimum, the following failures shall cause the PLC to shut down:

i. Memory failure.

ii. Memory parity error.

iii. I/O cycle failure.

iv. Operating system failure.

3. Memory

a. Memory shall be read/write RAM, with an EEPROM module provided.

b. During each scan cycle, the PLC shall update the input and output table, execute the entire ladder logic program, and communicate with special functions modules installed in the rack or attached to the network. The PLC shall scan only the portion of memory utilized by the ladder logic program. Unprogrammed portions shall be skipped.

4. Math, Data and Control Functions

a. The PLC hardware and software shall perform the following functions:

i. Logic Control: The PLC shall be capable of performing the same functions as conventional logic systems including on delay timers, off delay timers, counters, and drum sequencers.

ii. Compare Function: The PLC shall perform the compare function that compares two integers or floating-point numbers for less than, equal to, greater than, and not equal to.

iii. Move Function: The PLC function shall move an integer or floating-point value from one memory location to another memory location when an internal permissive is enabled.

iv. Math Function: The PLC shall be capable of performing addition, subtraction, multiplication, and division on integer or floating-point numbers.

v. Square Root Function: The PLC shall be capable of taking the square root of a positive integer or floating-point number.

vi. Binary to BCD Function: The PLC processor shall be capable of converting a positive binary number to a positive four-digit BCD coded number.

vii. BCD to Binary Function: The PLC processor shall be capable of converting a positive four-digit BCD coded number to a positive binary number.

viii. Integration: The PLC shall integrate an input as a function of time. The integrated value shall be stored by the PLC until the PLC initiates a reset command.

ix. Averaging: The PLC processor shall provide a resettable averager that integrates the input in time increments, divided by the number of times it integrates. The PLC shall reset the averager at the end of each time cycle.

x. Elapsed Time Meter (ETM): Motors specified for scheduled servicing shall be accomplished by monitoring the accumulative run time using a resettable ETM at the PLC with a range in hours in one-minute increments, divided by the number of times it integrates. The PLC shall reset the averager at the end of each time cycle.

xi. PID Loop Function: The PLC shall perform all the functions of the conventional three-mode (PID) analog controller. The controller shall perform proportional only control, proportional plus reset, and proportional plus reset plus derivative and integral only control.

b. The PLC shall be able to generate a minimum 16 PID loops with a minimum sample time for 1.0 seconds. PID tuning constants shall have the following adjustable range:

| | |
|---|---|
| i. Proportional Gail | 0.0% to 99.99% |
| ii. Reset Time | 0.01 to 999.99 minutes |
| iii. Derivative Time | 0.00 to 999.99 minutes |

B. Input/Output

1. The following specifications for input/output modules is for general definition of the connections to the I/O modules. The module part numbers are identified in Item F. Provide the latest module available should the part numbers in Item F be obsolete or unobtainable from the manufacturer.

2. Analog transmitters and receivers have 4- to 20-ma signals. Discrete (on/off) inputs originate from dry relay contacts. For discrete control output, provide relays with dry contacts.

3. The discrete input modules shall be 24-volt d-c and have noise filters or use other techniques to reject short-time constant noise and 60-Hz pickup.

4. The discrete output modules shall be 24-volt DC solid-state drivers suitable for operating control relays. Each discrete output module shall include fuses and fuse blown indicators.

5. The analog input modules shall be suitable for accepting 4 to 20 ma from either 2 or 4 wire transmitters. The input power shall be from an external 24-volt d-c power supply.

6. The analog output modules shall be 4 to 20-ma signals suitable for driving into a 0- to 600-ohm load without load adjustments. The output power shall be from an external, 24-volt d-c power supply provided by the Contractor.

7. Discrete PLC I/O modules shall have individual LED status lights for each I/O point. All discrete and analog modules shall be wired to terminal blocks for termination of the I/O wires. Individual I/O points shall be capable of withstanding low energy common mode transients to 1,500-volts.

8. Refer to drawings for I/O module types, chassis, and layout. Provide a minimum of 25% spare I/O, or spares noted on the drawings, whichever is greater.

C. Programming Software: The PLC programming software shall be supplied by the Contractor, and be of the same manufacturer as PLC. The programming software shall run on a laptop or personal computer, and provide the means for directly entering, debugging, and documenting the Ladder Logic or special function program, both on-line and off-line. Provide all cabling and accessories for direct connection to the PLC. The software shall be the latest version, with provisions, modules, and software for all communications. The software shall be licensed to Anne Arundel County, Maryland, Department of Public Works, Utilities Electrical Coordinator, Central Maintenance.

D. Manufacturers

1. Allen Bradley 1400 series Micro Logix or equal

E. Spare Parts

The Contractor shall furnish to the Engineer all necessary spare parts of components required to maintain the system. Prior to final acceptance of work, the Contractor shall provide a spare parts listing of all necessary spare parts and quantities for review by the Engineer. The spare parts shall include the following minimum requirements.

F. Minimum Spare Parts List

| Part Description | Quantity |
|---|---|
| Power Supply | 1 each |
| CPU and Memory Module | 1 each |
| Analog Input Module | 1 of each type |
| Discrete Input Module | 1 of each type |
| Discrete Output Module | 1 of each type |

## 16942.03 EXECUTION

A. Refer to Section 16900 for instrument mounting, system calibration, configuration, and programming, testing and training requirements.

B. Refer to Section 16920 for general instrumentation requirements for interfacing to the PLC's.

END OF SECTION

# SECTION 16946

# CABINETS, CONTROL SYSTEM, AND DEVICES

## 16946.01 GENERAL

This section includes requirements for materials, and installation of the cabinets, control panels and consoles to be provided by the Control Systems Integrator subcontractor under Section 16900. All control panels shall be UL rated.

## 16946.02 MATERIALS

A. Cabinets, Panels and Enclosures

1. The enclosures shall be floor, wall or post-and-backboard mounted as indicated on the drawings. Interior enclosures shall be NEMA 12 for dry locations unless otherwise specified or indicated on the drawings. Provide NEMA 4X, non-metallic enclosures for wet interior locations. Provide NEMA 3R stainless steel enclosures for exterior locations unless otherwise noted. Access door shall have continuous hinges with neoprene gaskets. Cabinets shall be constructed from formed 12-gauge steel. All exposed edges and welds on the enclosure shall be ground smooth. Provide padlock hasp on all exterior mounted cabinets.

2. The interior and exterior of steel enclosures shall be painted with a rust-inhibiting primer and two coats of epoxy gray paint or gray polyester powder paint over phosphatized surfaces. Stainless steel enclosures shall not be painted.

3. The interior shall be provided with a formed 12-gauge subpanel for attaching surface-mounted components and a hinged subpanel for front panel mounted hardware. All components shall be attached with screws and the subpanel shall be threaded. Rivets or back of panel nuts shall not be allowed. Each interior shall be equipped with lighting, 120-volt 15-ampere duplex GFI receptacle and circuit breakers where shown on the drawings. One circuit breaker shall be provided for the lights and outlets. The other circuit breakers shall be for the PLC and instrumentation equipment as indicated. The interior shall be painted with two coats of white enamel paint. Refer to instrumentation drawing for enclosure size and installation details. Enclosures shall be a Hoffman, or equal.

B. Panel Control Circuit Devices and Components

1. General: All components, except those on the front panels, shall be mounted behind on fixed or swing-out panels; terminal blocks for field connections shall be mounted on fixed channels located near the bottom of the sections but clear of the conduit entry area. Fixed panels shall be located so as not to prevent access within the cabinets to other components, wiring, and terminal blocks on fixed panels or front panels.

2. Control Relays: Control relays shall have either 24-volt d-c or 120-volt a-c coils. Control relays shall be 10-ampere, 300-volt, DC relays shall be blade type and AC relays shall be

pin type with dust cover, LED indication, and sockets. All relays shall be of one manufacturer, IDEC Series RR3, Square D 8501K Series, or equal.

3. Circuit Breakers: Circuit breakers shall be single-pole, 120-volt, 20-ampere rating.

4. Wire marking: Each signal and circuit conductor connected to a given electrical point shall be designated by a single unique number which shall be shown on all shop drawings. These numbers shall be marked on all conductors at every terminal using white numbered wire markers which shall be Thomas & Betts sleeve markers, T&B Shrink-Kon, or equal.

5. Terminal Blocks: Terminal block shall be high-density type molded plastic with barriers and box lug terminals and shall be rated at 300-Volts. White marking strips, fastened securely to the molded sections shall be provided with printed wire numbers or circuit identifications. Terminal screws will be accessible with a standard size narrow blade screwdriver. Provide all required terminal blocks and 25% spare numbered terminal blocks. Terminal blocks shall be Phoenix Contact Type UK with mounting rack or equal.

6. D-C Power Supplies: Provide d-c power supplies as required for analog loops and d-c circuits. Each power supply shall be enclosed and include internal short-circuit protection. Current requirements shall not exceed 75% of manufacturer maximum rating. All power supplies shall provide a regulated DC output voltage within +/- 3% and shall be suitable for DIN rail mounting.

7. Receptacles: Duplex receptacles shall be molded composition, ivory, specification grade. Duplex receptacles for 120-volt, single-phase, 3-wire service to be rated 20-amperes, 125-volts, back or side wired, NEMA Type 5-20R. Provide ground fault interrupter type where indicated.

8. DC Signal Conditioner: Provide a DC Signal Conditioner where required to drive or isolate loads. The signal conditioner shall have input and output ranges compatible with the associated equipment. The DC input/output isolation shall allow up to 600 V differences between grounds. The conditioner shall have an accuracy of +/-0.1% of input span, a zero and span adjustment and a maximum response time of 100msec. The operating temperature range shall be 0 to 60 degrees C. Power for the signal conditioner shall be 120 VAC at 60 Hz. Provide an Action Instruments Action Pak Model 4300, or equal.

9. Push Buttons, Selector Switches, and Indicating Lights: Push buttons, Selector Switches, and Indicating Lights shall be 30.5-mm, round, heavy duty, oil tight type with synthetic rubber boots and include any special gasketing required to make the installation watertight. Indicating lights shall be push-to-test LED type.

10. AC Power Line Protector: The AC power line protector shall be a solid state low pass non-linear filter to protect I/O cabinet equipment from spikes, transients, and noise on incoming AC power lines. The protector shall be rated 120-volts A-C, 15 amps, 60 Hz. The response time shall be 5 nanoseconds nominal with maximum attenuation and sinusoidal restoration through 50 microseconds. The protector load regulation shall be 1% or better across the range. The operating temperature range of the protector shall be -40 to +70 degrees C. The AC power line protector shall be an Islatrol manufactured by Control

Concepts Corporation, or equal.

11. Cycle Timer: For fan controls, provide a cycle timer with a 120 VAC motor, timing range of 1.2 seconds to 300 hours, 5 amp contacts, and a repeat accuracy of +/- 0.31%. The cycle timer shall be manufactured by Omron, model H3CR-F8-300AC100-240, or equal.

12. Intrinsically Safe Relays (ISR)

    a. Where indicated, intrinsically safe relays shall be provided with an energy barrier limiting the available voltage and current in the Hazardous Location. The relays shall interface with non-explosion proof field devices which are mounted in the hazardous Locations. The circuits shall be rated and suitable for field device protection in Class I, Division I, Group D Hazardous Locations.

    b. The relay shall be constructed of plastic and glass reinforced nylon and suitable for back plate or DIN rail mounting. Terminals shall have captive screws with self-lifting clamps.

    c. Intrinsically safe relays shall be single channel, accepting a dry contact input. The relay shall operate on 24VDC power supply and shall be provided with one SPDT programmable output relay to obtain (1) N.O. or (1) N.C. contact. 120 VAC may be used for pump control.

C. Panel Control Circuit Wiring

1. Instrumentation signal cables shall be of the type used for process control with shielded pairs or triads with polyvinyl jacket and overall shield over the multiple pairs or triads. The instrumentation cable shall be rated 300 volts at 90 C or better. The size of the instrumentation cable shall be AWG No. 16 with seven strands minimum, unless otherwise specified elsewhere. All instrumentation cables shall meet all the requirements of IPCEA S-61-402 and shall be UL listed.

2. 120-volt a-c wiring within the panel shall be AWG No. 14 MTW or THHN. Main power (120-volt a-c) to the panels shall be wired using color coded AWG No. 12. A-C power to all system power supplies, CRTs, printers, and computers, shall be accomplished using molded 3-wire plug cords.

   Wires shall be color coded per the following table:

| | |
|---|---|
| BLACK | L1 (hot) |
| WHITE | L2 (neutral) |
| RED | A-C control circuits |
| BLUE | D-C circuits |
| YELLOW | Interlock control circuits wired from an external power source |
| GREEN | Equipment ground |

*All conductors in this section shall be stranded.

a. All interfacing between the cabinet and the field shall be accomplished at a terminal strip (TB-1). No internal panel wiring shall be connected to terminals on the “field side” of TB-1. Likewise, no field wiring shall be connected to terminals on the "panel side" of TB-1. DC and AC voltage circuits shall be separated utilizing independent terminal strips and wireway ducts.

b. Wiring run from components on a swing-out panel to other components on a fixed panel shall be made up in tied bundles. These shall be tied with nylon wire ties and shall be secured to panels at both sides of the hinge loop so that conductors are not strained at terminals.

c. Wiring run to control devices on the front panels shall be tied together at short intervals and secured to the inside face of the panel using Panduit adhesive mounts with Eastman No. 910 adhesive.

d. Wiring to rear terminals on panel-mount instruments shall be run in plastic wireways secured to horizontal brackets run above or below the instruments in about the same plane as the rear of the instruments.

e. Conformance to the above wiring installation requirements shall be reflected by details shown on the shop drawings for the Engineer’s review.

f. Signal conditioners and control interface relays shall be provided wherever proper instrument interfacing dictates use of these components. Each auxiliary device shall be assigned a tag number and shall appear on the panel shop drawings.

g. All electrical devices within the panel shall be identified by tag number, machine printed on a label visible from the panel interior. Labels shall be laminated plastic with an adhesive backing. The labels shall be consistent in size throughout the panel.

h. When input connections are made to existing circuits, the Contractor shall verify the control voltage. Provide power for the existing circuits compatible with the existing controls for dry contact inputs, powered outputs, and analog circuits as required.

i. All components, device, PLC I/O (including spares) shall be wired to terminal blocks. Each terminal block shall include a unique number. This is to include all contacts from relays in the control cabinet.

D. RTU System

1. RTU cabinet, function, wiring and components shall be per the detail shown in Design Modification Tracking and as verified by the SCADA group during design meetings.

   a. The Contractor shall obtain the services of a communications expert for antenna work. Communications expert shall have a minimum of 5 years experience and possess a line sweep certification.

2. The Contractor shall meet with the County's SCADA group prior to antenna installation to determine the required frequency and model. The Contractor shall produce and submit a written record of the meeting. Antenna shall be sized and tuned as required by the SCADA group.

3. Antenna shall be pole mounted as shown in Detail Drawing E100-10 Rev. 1.

4. A line sweep Return Loss test shall be performed of the antenna system at the specified frequency of the antenna after the antenna system has been installed. The antenna, cable, lightning arrester, jumper cables, and all connectors shall be included in the test of the system and have a return loss of 15db or greater. A report of the return loss test shall be provided to the County prior to Conditional Acceptance.

## 16946.03 EXECUTION

Refer to Sections 16900 and 16920.

END OF SECTION

# SECTION 16965

# DESCRIPTION OF OPERATION

## 16965.01 GENERAL

A. Description

1. A control system consisting of motor controls, a pump control panel with programmable controllers, a bubbler system panel and PLC programming software will be provided for the Project as shown on the drawings.

2. This section provides information with regard to the system operation, and overview of components. For actual quantities and requirements of equipment refer to specifications and drawings.

B. Pump Control Panel

A pump control panel will be provided in the Pump Station to control the raw sewage pumps. The control panel is designed to house the programmable logic controllers which will provide automatic control and process and alarm monitoring for the raw sewage pumps.

## 16965.02 CONTROL DESCRIPTIONS

A. General Description

1. The two raw sewage pumps will be located in the lower level of the dry well.

2. Full voltage starters in a motor control center will be provided for each pump as shown on the drawings.

3. Two Transducers will be provided into the wet well to sense the sewage level in the wet well, as the means of control.

B. Raw Sewage Pump Motor Controls

1. A full voltage motor controller in a motor control center will be provided for each raw sewage pump unless otherwise shown. Each drive enclosure will house the following:

   a. Main Disconnect Switch.

   b. NEMA rated Motor Starter as indicated.

   c. Motor Overload Solid State Relay.

d. Control Transformer.

e. H/O/A Selector Switch.

f. Run Relay.

g. Run Indication Light.

h. Elapsed Time Meter.

i. Devices and Controls as shown on the Drawings.

C. Pump Control Panel

1. A pump control panel will be provided in the pump station to control the two raw sewage pumps. The pump control panel will house the following:

a. Control Circuit Breakers and Fuses.

b. Transient Voltage Surge Suppressor.

c. Redundant Programmable Logic Controllers (PLC's).

d. Two 24 VDC Power Supplies.

e. Control Relays

f. Digital Displays (in inches of water)

2. The selector switches and push buttons shall be wired as shown on the drawings.

D. Wet Well Transducer System (Typical 2)

1. See section 16920.

2. The PLC will monitor both wet well level transducers and control off the higher of the two signals. If the difference between the two signals is larger than six inches then the PLC will output a pressure transducer fail alarm.

E. Programmable Controller Inputs and Outputs

1. The programmable controller inputs and outputs for the Raw Sewage Pumps will be wired to and from the PLC located in the Pump Control Panel, as shown on the drawings.

2. Description of Operation

a. The two raw sewage pumps will be operated by the motor controls and will be controlled by the individual H/O/A selector switches located on the MCC. The "hand" and "off" positions of the H/O/A selector switches provide manual start/stop control of the pumps. When the H/O/A switch is in the "hand" position, the pump may be

manually controlled. When the pump H/O/A switches are in the "auto" position, the raw sewage pumps will be automatically controlled by the PLC from a start/stop signal as indicated. The signal will respond to the wet well level as follows:

i. Level setpoints will be programmed in the PLC for the following wet well levels:

a) Lead Pump Stop.

b) Lead Pump Start.

c) Lag Pump Stop.

d) Lag Pump Start.

e) Wet Well High Level.

b. A level controller will be configured in the programmable controller to control the starting and stopping of the pumps.

c. When the water level in the wet well rises to the elevation of the "lead pump start" level setpoint, the PLC will start the lead raw sewage pump. As long as the wet well level is within the required range the lead pump will run continuously. When the water level in the wet well is drawn down to the "lead pump stop" level setpoint, the PLC will stop the pump.

d. If the lead raw sewage pump cannot maintain the level, the water level in the wet well will rise to the "lag pump start" level setpoint. When this level is reached, an adjustable delay timer in the programmable controller will be started. When this timer times out, the PLC will start the lag pump and a "Lag Pump Required Alarm" will be generated to the RTU. As long as the water level is above the lag pump stop level, both pumps will run continuously. When the water level in the wet well is pumped down to the "lag pump stop" level setpoint, the PLC will shut down the lag pump. The lead pump will continue to run until the "lead pump stop" level setpoint is reached.

e. The alternation of the two raw sewage pumps will be controlled by the pump alternation selector switch. The operator will manually select the lead pump by means of the lead pump selector switch located on the Pump Control Panel. When the selector switch is in the "auto" position, the pumps will alternate automatically from the PLC program after each pump cycle. The alternation of pumps will not occur if two pumps are running.

f. A "wet well high-level alarm" float switch will be mounted in the wet well and is wired directly to the SCADA system via an intrinsically safe relay. If the water level in the wet well rises to the elevation of the high-level alarm float switch, a signal will be energized to the SCADA system.

g. A 24 VDC relay will be provided in the Pump Control Panel for the two 24 VDC power supplies. This relay will be energized continuously by the main 24 VDC power supply in the control panel. The programmable controller shall provide failure monitoring for

the main 24 VDC power supply as follows:

i. The 24 VDC relay will have two normally open contacts and two normally closed contacts in addition to the normally open contact being utilized for failure monitoring of the power supply. The main 24 VDC power supply in the Pump Control Panel will be wired through two normally open relay contacts, and each back-up 24 VDC power supply will be wired through two normally closed relay contacts. If the main 24 VDC power supply fails, the 24 VDC relay will be de-energized, and the back-up 24 VDC power supply will automatically come on-line.

F. RTU Alarms

1. The following outputs are generated by the PLC and transmitted to the SCADA RTU for alarming:

| | |
|---|---|
| a. Pressure Transmitter Fail | Control Relay In Pump Control Panel from PLC |
| b. Lag Pump Required | Control Relay In Pump Control Panel from PLC |
| c. PLC Failure | Control Relay In Pump Control Panel from PLC |

2. The following outputs are generated by the field device, but wired directly to the RTU via the Pump Control Panel, and transmitted to the SCADA RTU for alarming:

| | |
|---|---|
| a. Station Entry | From Field Device to Terminal Blocks in Pump Control Panel |
| b. ATS Emergency Position | From Field Device to Terminal Blocks in Pump Control Panel |
| c. Station Power Failed | From Field Device to (Load Side of ATS) Terminal Blocks in Pump Control Panel |
| d. Personnel Emergency | From Field Device to Terminal Blocks in Pump Control Panel |
| e. Drywell Flood | From Field Device to Terminal Blocks in Pump Control Panel |
| f. Alternative Power Fail | From Field Device to Terminal Blocks in Pump Control Panel |
| g. High Wetwell | From Float in Wetwell Via Terminal Blocks In Pump Control Panel to RTU |
| h. Control Power Fail | Control Relay in Pump Control Panel |
| i. Gas Detection | Control Relay in Wet Well Gas |

| | |
|---|---|
| | Detection Monitor Panel |
| j. Ventilation (Drywell) | Control Relay in Wet Well<br>Ventilation Monitor Panel |
| k. Generator Running | Generator Control Panel Contacts |
| l. Grinder Running | From Terminal blocks in Grinder Panel |
| m. Grinder Fault | Generator Fault |

3. The Station Entry Alarm shall be generated when the door limit switch is activated and the signal is transmitted to the RTU.

4. The ATS Emergency Position Alarm shall be generated when the signal is generated from the ATS to the RTU.

5. The Station Power Fail Alarm shall be generated when the signal is generated from the phase monitor installed on the load side of the ATS to the RTU.

6. The Pressure Transducer Fail alarm shall be generated when the PLC detects one of the pressure transducers fails and transmits a signal to the RTU, after a preset time period.

7. The Drywell Flood Alarm shall be generated when the dry well float switch is activated and a signal to the RTU.

8. The Lag Pump Required Alarm shall be generated, the lag pump required is activated and the PLC generates a lag pump required signal, after a preset time period.

9. The PLC Fail Alarm shall be generated when the normally closed contact is generated from a normally closed contact from a relay on an output of the PLC to the RTU.

10. The Control Power Fail Alarm shall be generated when the 24VDC relay and 120 VAC relay is deactivated at the pump control panel to the RTU.

11. The High Wet Well Alarm shall be generated when the high wetwell float is activated. The signal is connected directly to the RTU. Connection to RTU shall use a 24 VDC ISR. High Wet Well alarm and ISR to be removed from PCP and wired directly to RTU.

12. The Wet Well Gas Detection Alarm shall be activated when levels of gas match the high setpoint of gas in the wet well.

13. The Generator Running shall be activated when the primary electrical power is switched to stand-by generator power.

14. A ventilation air flow alarm shall be activated when there is a failure of the dry well supply or exhaust fans when provided. The alarm will provide a local indication as well as a remote alarm to the RTU.

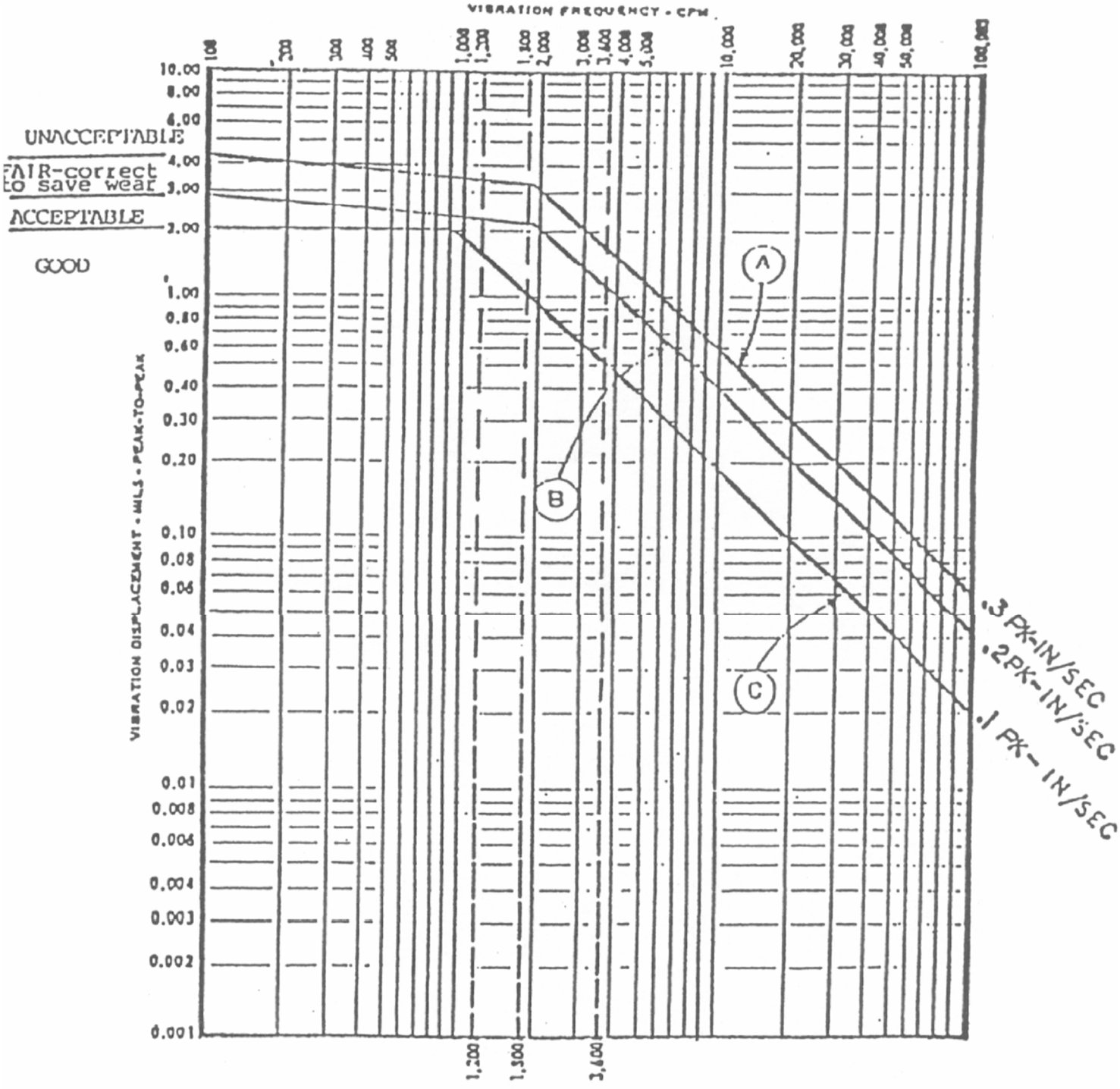
**16965.03 EXECUTION**

Refer to Sections 16900, 16920 and 16946.

END OF SECTION

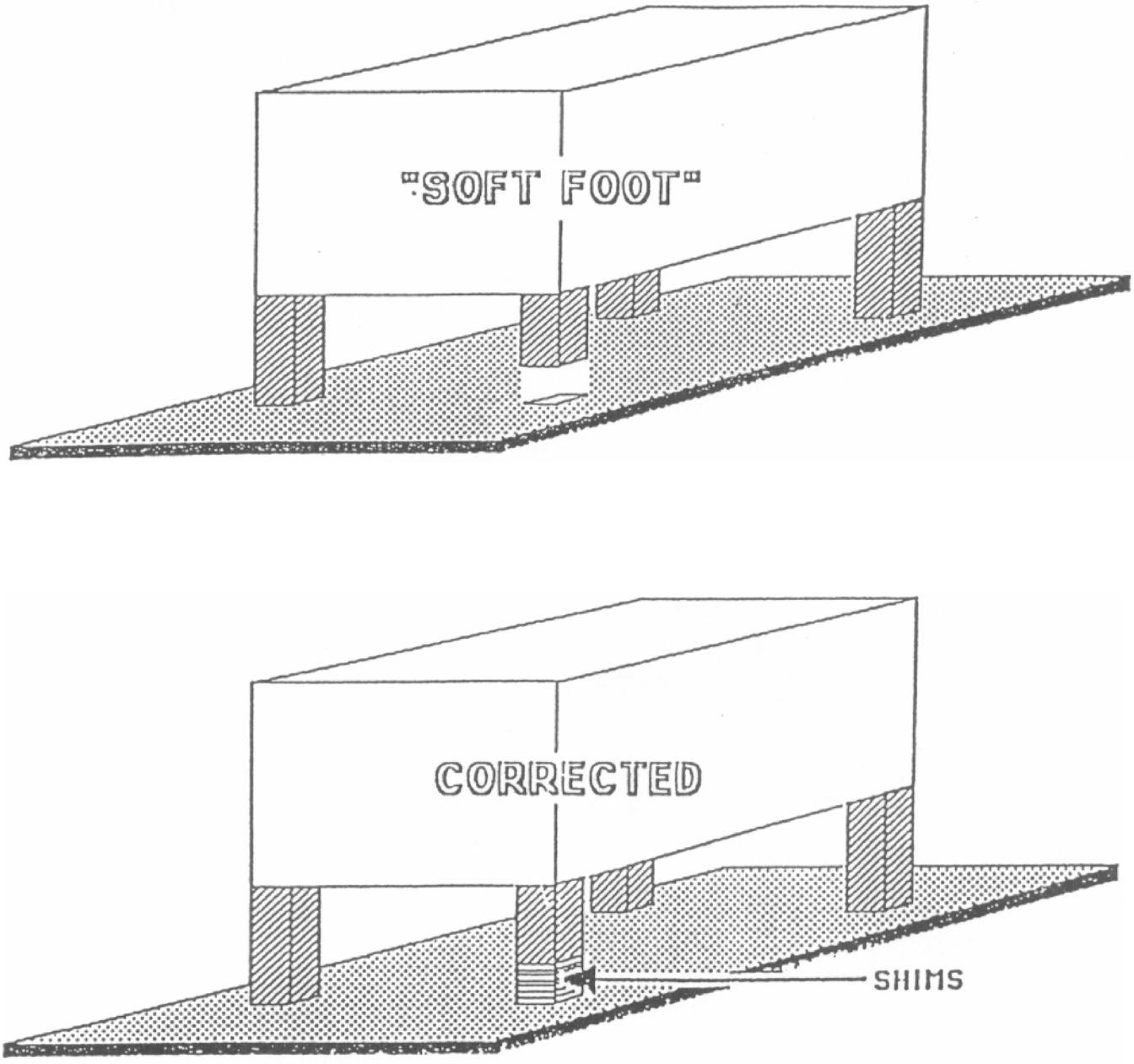
## APPENDIX A

| | |
|---|---|
| DRAWING NO. 1 | VIBRATION SEVERITY – CHART NO. 1 |
| DRAWING NO. 2 | SOFT FOOT (DESCRIPTION) |
| DRAWING NO. 3 | SOFT FOOT TEST |
| FORM NO. 1 | MACHINERY ALIGNMENT REPORT |

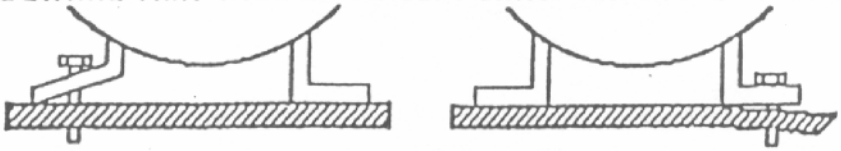



VIBRATION SEVERITY CHART NO. 1

(VIBRATION ACCEPTANCE CURVES)



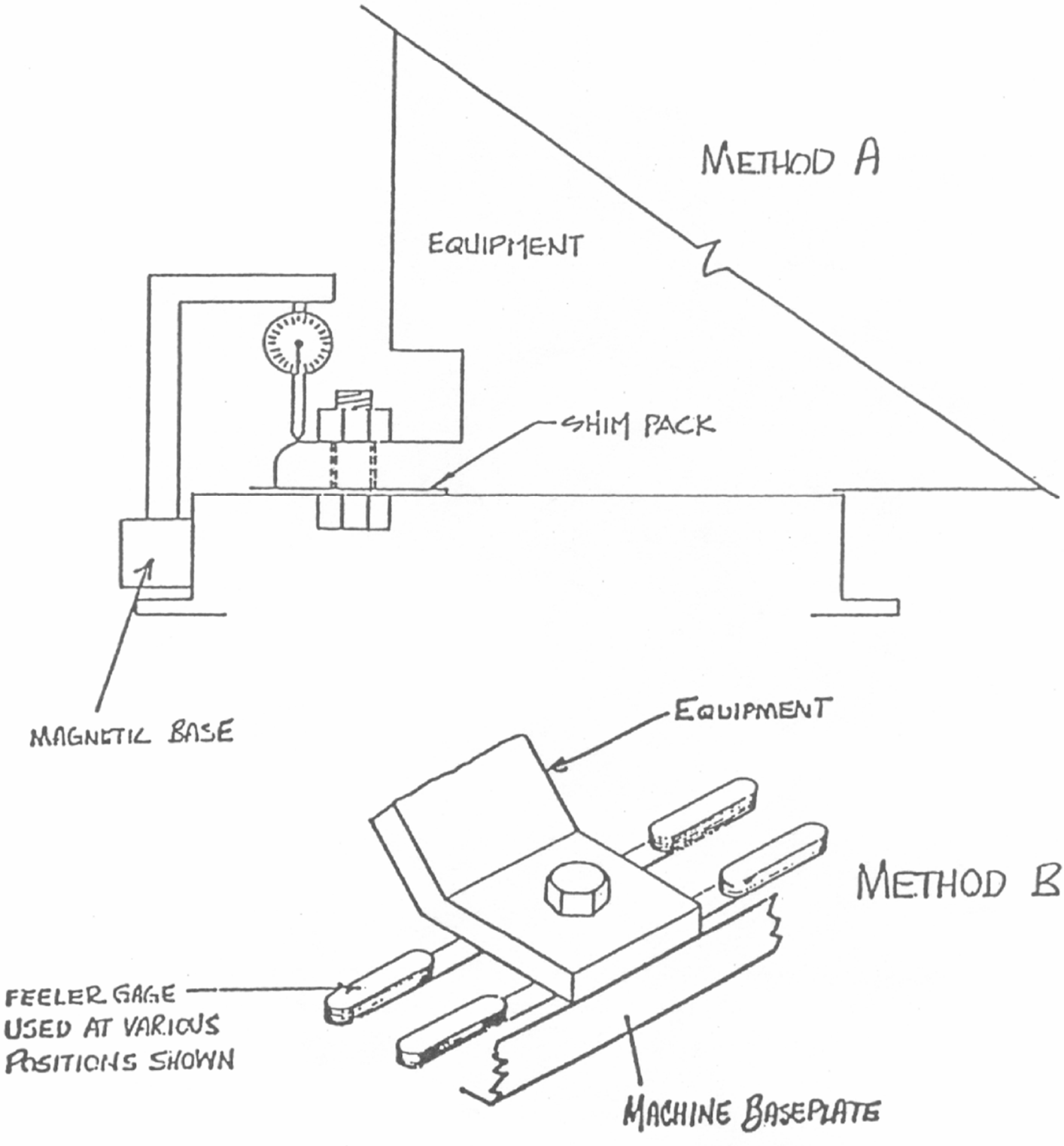

NOTE: "SOFT FOOT" IS SOMETIMES A RESULT OF A BENT "FOOT" OR A BENT BASEPLATE. IN SUCH CASES, IT MAY BE NECESSARY TO INSTALL A TAPERED SHIM OR "JURY RIG" BY "SANDWICHING" A STRIP OF SHIM STOCK BETWEEN TWO NORMAL SHIMS. ALSO, BEWARE THAT WARPED OR BENT SHIMS CAN CAUSE "SOFT FOOT".



"SOFT FOOT"

# SOFT FOOT TESTS

(EITHER METHOD ACCEPTABLE)



**ANNE ARUNDEL COUNT**

**MACHINERY ALIGNMENT REPORT**

Date: _____ Plant: _____

Done by: _____

Equip I.D. #: _____ Location in Plant: _____

Equip Type: _____

Equip Name _____

Manufacture: _____ (Motor) Serial #: _____

_____ (Gear box) _____ (Gear box)

_____ (Driven) (Driven)

Max Input RPM _____ Max Output RPM

Manufactures alignment instruction available: _____

---

Specified Alignment: Ang (Vert) _____ Offset (Vert) _____

(Hor) _____ (Hor) _____

Actual alignment (Before): Ang (Vert) _____ Offset (Vert) _____

(Hor) _____ (Hor) _____

Actual alignment (Final): Ang (Vert) _____ Offset (Vert) _____

(Hor) _____ (Hor) _____

Coupling Gap: _____ Coupling Type/Manufacturer: _____

Alignment Equipment Used:

_____ _____

Alignment Method Used: ☐ Reverse Indicator ☐ Rim and Face Indicator

_____ ☐ Rim (Indicator) Face (Feeler gage) ☐ Laser

Comments:

_____

_____

_____

_____

# APPENDIX B

**PUMP STATION**

**CONDITIONAL ACCEPTANCE CHECKLIST**

**AND**

**START-UP TEST PROCEDURES**

**Revised April 2024**

DATE:_____/____/_____

PROJECT NAME: _____

INSPECTOR: _____

CHECK OFF

1. **Review Inspector's Checklist and recheck items that are not marked completed.**

2. **OPERATOR / TECHNICIAN TRAINING**

   _____ Pumps and motors

   _____ Grinder

   _____ Valves and actuators

   _____ Motor control center

   _____ Instrumentation systems

3. **SPARE PARTS**

   _____ Number required (attach required list - indicate parts provided)

   _____ Condition/preservation (list discrepancies)

   _____ Released to Operations

   _____ Released to Maintenance

## 4. OPERATION AND MAINTENANCE MANUALS

_____ Specified number of hard copies and electronic copies delivered

## 5. TESTING/ ACCEPTANCE PREPARATION

*PUMP STATION EQUIPMENT*

_____ Manufacturer's installation certificates completed and signed.

_____ PLC program loaded, tested and 'debugged' by County.

*SCADA*

_____ Communications and station alarms established with Millersville.

**NOTE: Items 1 thru 5 to be completed prior to walk through, conditional acceptance.**

## 6. CONTROLS AREA

*ELECTRICAL*

_____ MCC: General condition, breakers on, indicator lights working, buckets and compartments clean of dust, wiring debris.

_____ Pump Control Panel: General condition, breakers on, indicator lights working, interior lights, convenience receptacle working, interior clean of dust, wiring debris.

*GAS DETECTOR*

_____ Detector installed, operational and calibration certification

_____ Wet well gas detection alarm panel tested and operating

## 7. WET WELL

_____ Explosion proof junction boxes at grade. Remove lids and make sure seal offs are filled. Replace lids and secure.

_____ Wet well supply fan operation. Ventilation fan guard/motor support. Fan case condensate drain. Rain hood and bird screen.

_____ Gooseneck vent pipe: Birds screen in place, vent painted.

_____ Wet well supply fan automatically comes on continuously with wet well. Hatch switch, intermittent timer operation all other times

_____ 60 minute cycle timer (10 on - 50 off)

_____ Joints sealed/ good workmanship. No infiltration or inflow observed

_____ Check pipe and conduit penetrations and seals for leaks

_____ Combustible Gas Detection sensor easily accessible from ladder for maintenance. Calibrated?

_____ Wet well ventilation pipe properly supported and proper distance above grating or floor.

*HATCHES*

_____ Corrosion resistant hardware and fasteners

_____ Automatic hold open device(s).

_____ Slam latch with removable key, spare keys furnished

_____ Flush handle

_____ Hatch drain to wet well

*LADDER*

_____ Fiberglass construction

_____ Rungs 1-inch square

_____ Maximum run spacing 12 inches on center

_____ Non-skid grooves on top of rungs

_____ Minimum dimension from wall to centerline of rung is 7- inches

_____ No toe interference behind rungs at any location (no pipes, conduits, etc.)

_____ Ladder properly secured to structure

_____ Locking extension poles as specified

**8. VALVE VAULT**

_____ Joints sealed/ good workmanship. No infiltration observed.

_____ Check pipe and conduit penetrations for leaks.

_____ Exercise all valves from full open to full closed (control flow to prevent spills)

*HATCHES*

_____ Corrosion resistant hardware and fasteners

_____ Automatic hold open device(s).

_____ Slam latch with removable key, spare keys furnished

_____ Flush handle

_____ Hatch drain in place

**9. BYPASS SYSTEM**

_____ Pump around connections and valving as specified

_____ Male couplers with dust caps on brass chain in place

_____ Grade level valve boxes as specified

_____ Exercise all valves from full open to full closed (control flow to prevent spills)

**10. SITE**

_____ Paving as specified, no birdbaths

_____ Site graded to prevent ponding and flooding

_____ All grass areas growing and as specified; four inches of topsoil required

_____ All trees and shrubbery alive and as specified

_____ Stone provided over vinyl cloth weed barrier as specified

_____ Check operation of swing gates and slide gates

**11. DRY WELL**

_____ Ventilation supply and exhaust fans working. Ventilation fan guard/motor support

_____ Ductwork properly secured. Fan case condensate drain. Rain hoods, bird screens.

_____ Dry well ventilation air flow monitoring alarm panel working. Both

fans "on" should give Green light. Turn off one fan should give Red light and RTU Alarm, Both fans off should give Red light and RTU Alarm.

_____ Joints sealed / good workmanship. No infiltration observed.

_____ Check pipe and conduit penetrations, pump hand hole covers and flanges for leaks.

_____ Exercise pump valves from full open to full closed (control flow to prevent spill)

_____ Pump piping flexible connectors/ expansion joints- check for leaks/tie rods in place

_____ Check valves: Caps tight, lever weights adjusted, springs adjusted , no back leakage

**12. PUMP AND PUMP STATION CONTROL TESTING**

_____ Begin filling wet well

_____ Check pump starters/ VFD to insure that HAND or MANUAL mode for each pump works. Pump down in Hand to lead stop level or slightly below.

_____ Return starters/ VFD's to AUTO. Continue to refill wet well

_____ Lead Pump on @ Wet Well Level _____

_____ Turn Lead Pump off. Continue to fill wet well

_____ Lag Pump on @ Wet Well Level _____

_____ Lag Pump Required Alarm Rec'd (RTU)

_____ Turn Lag Pump off. Continue to fill wet well

_____ High Level Alarm Rec'd (RTU) @ Wet Well Level _____

_____ High Level Alarm @ Pump Ctrl Panel Wet Well Level

_____ Return starters/ VFD's to AUTO. Both pumps should start

_____ Lag pump stop @ Wet Well Level _____

_____ Lag Pump Required Alarm clears (RTU)

_____ Lead pump stop (note Lead pump #) @ Wet Well Level _____

_____ Refill wet well to Lead Pump on level. Check that Lead pump alternated

_____ With Lead pump running, simulate power failure by opening main pumping station breaker

_____ Check generator operation/ start

_____ Power transfers in specified times

_____ Lighting available

_____ Alarm signals received at Millersville: Generator Run, ATS Emergency Power, Station Power

_____ PLC controls/ bubbler controls reboot

_____ At least one pump comes back on automatically. Turn off and let wet well fill to lag pump start level.

_____ Put lead pump back in auto and let both pumps run on generator simultaneously until both pumps stop

_____ Check generator operation, look for coolant or oil leaks, unusual noises, appearance of exhaust

_____ Restore Normal power to station by reclosing main breaker

_____ Power retransfers to Normal power in specified time. RTU power alarms clear at Millersville

_____ PLC controls/ bubbler controls reboot

_____ At least one pump comes back on automatically.

_____ Generator continues running for 5 minute cool down, then shuts off

_____ Alarm signals back to normal at Millersville

**13. RELIABILITY TESTING**

_____ Operate pumping station in recirculation mode or live force main mode as agreed between the contractor and County and for the number of days specified

_____ Testing/acceptance per Specifications

_____ Check amp draw: Pump #1_____ Pump #2 _____

_____ Check GPM vs. TDH for each pump:

| | GPM | TDH |
|---|---|---|
| Pump #1 | _____ | _____ |
| Pump #2 | _____ | _____ |

_____ Check that measured operating conditions meet design conditions.

**14. _____ ALL PUNCHLIST ITEMS COMPLETED BY CONTRACTOR**

**15. <u>AS-BUILT DRAWINGS</u>**

_____ Red-lined copies provided to county for processing

**16. _____ CONDITIONAL ACCEPTANCE SIGN-OFF**

Cc: (When Completed:)

Contractor: _____

Construction Management: _____

Design Engineer: _____

Project Engineer: _____

# PUMP PERFORMANCE TESTING

PART 1 - General

A. Pumps shall have a completed operational performance test as installed on site. This performance test is to ascertain that the pumps and motors are actually operating as designed and that specifications have been met. Each pump shall be tested to show that it operates quietly without heavy vibration, cavitation, bearing overheating, etc., under operation conditions. (Also, see vibration performance testing, Appendix D).

B. Pump testing should be carried out by personnel qualified to measure pump performance and shall be done in the presence of the manufacturer's representative. An authorized representative of the County shall also witness the tests.

PART 2 - Equipment to be Tested:

A. Pumps

B. Pump motors

PART 3 - Testing Prerequisites:

A. A schedule should be agreed upon by all parties in advance of the test. The schedule should be as complete a program as possible and give particulars on the range of hydraulic conditions to be tested.

B. Flow path established for pump tests (i.e. recirculation to wet well or pumping through force main).

C. All measuring devices and instrumentation should be calibrated and adjusted prior to testing. Calibrated pressure test gauges shall be used for head measurements.

D. On coupled motor/pump arrangements shafts shall be checked and verified for proper alignment, coupling gap settings and lubricated if necessary.

E. All pump clearances shall be properly set as recommended by the manufacturer to suit anticipated operating conditions. These shall be recorded and included in the final test report and also included in Operations and Maintenance (O&M) manuals.

F. Prior to testing, pump bearings, motor bearings, and splines and steady bearings shall be checked for proper lubrication.

G. Proper impeller rotation shall be verified for each pump under normal power and emergency power. Phase of 3-phase power shall be checked for both conditions.

H. On satisfactory completion of preliminary inspections the pumps can be lined- up, and primed and then started. The pumps, motors and instruments should be checked for proper operation, scale readings, evidence of malfunction or obvious mechanical problems. When equipment is determined to be functioning properly the tests shall then be conducted.

PART 4 - Test Parameters

A. As a minimum, the following values are to be measured on-site and compared against design conditions/values:

a. Capacity vs. head for each pump. As a minimum this will include readings as near normal operating conditions as possible and at shut-off head (except positive displacement pumps) and marked on shop drawing/performance curves.

b. Net positive suction head (NPSH) available over entire normal operation range to ensure that proper suction conditions are being met and marked on performance curves. The NPSH available at installation shall exceed the NPSH required over the normal full operating range. This will require use of suction pressure gauges installed with equipment and/or portable gauges.

c. Pump speed (not required on submersible style pumps).

d. Motor voltage between each phase and ampere draw on each phase at normal operation conditions. Voltage unbalance between phases shall not exceed 2%. Maximum current unbalance not to exceed 5%.

e. Motor and pump bearing temperature rise. Note any deficiencies and actions to be taken to correct.

f. Motors shall be megger tested on each phase and results recorded and included in O&M manuals. Megger testing is to be performed

from MCC terminals on load side of starter. Readings of less than 1 megohm must be investigated and corrective actions taken. Submersible pumps and cable shall be megger tested as follows:

i. Each pump and power cable shall be meggered dry (each phase) before they have been submerged for the first time on- site.

ii. Pumps will then be submerged to the normal working level. After a minimum of two (2) hours submergence the pumps and cable shall be meggered again and results recorded.

g. Pump and motor vibration (see section on vibration testing, Appendix D).

PART 5 - Documentation

A. Factory certification that pumps will perform at each designcondition.

a. Motor certifications.

b. Pump installation certificates.

c. Pump service card submitted.

d. Shaft alignment certification.

e. Shop drawings with performance curves.

f. A final performance and inspection report shall be submitted containing complete records, including any notes or comments on inspection, readings, observations and other information relative to the testing of the pumps. Sample forms for field acceptance tests is shown at the end of this section and may be used as a guide for inclusion into the O&M manuals. All actual operating conditions tested are to be compared against design and summarized in the report. All problems, findings or corrective actions necessary to bring equipment into compliance shall also be well documented.

## RECORD OF PUMP PERFORMANCE TEST

STATION NAME_____

MOTOR/PUMP NO. _____

GPM_____RPM _____VAR/CONST _____

MOTOR HP _____MGFR _____

DESCRIPTION/CONDITION:

_____

_____

SHAFT ASSEMBLY DESCRIPTION/CONDITION

_____

_____

PUMP SIZE _____ROTATION_____

CAPACITY_____ PACKING/SEALS _____

IMPELLER_____ INSPECTION PLUG _____

BASE & FOUNDATION:

DESCRIPTION_____

CONDITION_____

OBSERVE OPERATION

VIBRATION_____

CAVITATION _____

NOISE_____

HEAT_____

VIBRATION DATA AVAILABLE (yes) (no)

# APPENDIX C

## ELECTRICAL INFRARED TESTING PROCEDURES

INFRARED SURVEY/TESTING

I. General

Conduct an infrared survey of major electrical and rotating equipment in accordance with the guidelines contained herein. All equipment tested and readings taken should be done with the equipment operating under loaded conditions. Motor starters shall be loaded at the fall load ampere rating of the motor. All other equipment, unless indicated otherwise, shall be loaded at 80% of the overcurrent protective device rating ahead of the equipment. All equipment shall be loaded for a minimum of 30 minutes before scanning. A load bank shall be used when the connected equipment can't provide the required load.

II. Equipment to be Tested

4. Motor Starters
5. Bus Bars, Bus Splices, Bus Connectors
6. Main Breakers
7. Automatic Transfer Switch
8. Generator Breaker
9. Motor Connections at Motor
10. Lighting Panels, Transformers and Other Ancillary Equipment (under normal station load)
11. Any other components as directed by the County

III. Infrared Scanning of Electrical Equipment

A. Visual Inspection

1. Inspect for physical, electrical, and mechanical condition.

2. Inspect for bus alignment.

B. Infrared inspection. Perform a qualitative (Level 1) infrared inspection on the equipment listed in Section H above. The infrared scanning device used shall meet the requirements contained in Part D below.

C. Provide a report indicating the following:

1. Location, equipment, date
2. Problem area (location of "hot spot")
3. Indicate temperature of "hot spot" and ambient temperature
4. Indicate cause of heat rise if known
5. Indicate phase imbalance, if present
6. List of areas scanned.

D. Test Parameters

1. Infrared scanning equipment shall detect 1° rise between subject area and reference at 30°C.

2. Equipment shall detect emitted radiation and convert detected radiation to visual signal.

3. Both identifying photographs and thermographic photos shall be provided of the deficient areas. The thermographic photos shall be as seen on the imaging system. The thermographs and identifying photos will be contained in the report to provide a baseline inventory of the plant's electrical system immediately preceding conditional acceptance.

E. Test Results/Tolerances. Operating temperatures shall not exceed the manufacturer's or listing agency's rating for the equipment or attached conductors. The following temperature tolerances are for equipment temperature ratings of 75° C. or above.

1. Three phase equipment - the following tolerances are applied to temperature gradients/differences between phases on balanced three phase loads:

   a. Temperature gradients between phases of 5°C. to 10°C. indicate possible deficiency and warrant investigation.

   b. Temperature gradients between phases of 11° C. and above indicate deficiency; repair as soon as possible.

2. The following absolute temperature tolerances are applied to all components:

   a. Temperature of 70°C. or more requires immediate correction.

   b. Temperature of 60°C. to 70°C. requires correction as time permits.

   c. Temperature of 50°C. to 60°C. indicates possible deficiency and warrants investigation.

# APPENDIX D

## VIBRATION TESTING PROCEDURE

1. Vibration Performance Testing Dry Pit Submersible Pumps
2. Vibration Performance Testing Vertical Coupling Pumps
3. Vibration Performance Testing Vertical Built Together Sewage Pumps Rigid Mount with Concrete Base
4. Vibration Performance Testing Vertical Built Together Sewage Pumps Semi-Rigid Mount with Steel Base

# APPENDIX D.1
# VIBRATION PERFORMANCE TESTING
# DRY PIT SUBMERSIBLE PUMPS

A. General

1. Perform a vibration analysis on all dry pit submersible pumps after a complete installation that includes all piping, buttresses, controls, and operational testing. All final vibration readings used for acceptance will be taken with the machinery under normal full load operating conditions. All vibration tests shall be performed with clean water; unless approved in writing prior to testing, from the Department of Public Works, Central Maintenance. The analysis is to be performed by a certified level 1 Vibration Analyst whose credentials are approved in advance by the County. An authorized representative of the County shall also witness the testing.

2. Overall lateral vibrations (i.e. vibrations acting side-to-side, up and down or axially) are all that is required in the field.

B. Methods for Taking Vibration Data

1. Vibration shall be taken with an FFT analyzer or data collector. Spectrum plots shall be available in printed form. The test equipment shall also be capable of providing a complete broadband or “overall (OA)” value in addition to individual frequency components. The type, model, serial number, and latest certified calibration date of all test equipment used in the measurement of vibration levels for machine acceptance shall be documented. Measurements will be taken with a Hanning Window setting and (4) linear, non-overlapping averages.

2. The sensor used shall be an accelerometer with a magnetic mount. Handheld pickups are not acceptable unless machine casing design interferences preclude the use of a magnetic base. The magnetically mounted sensors shall be mounted such that the magnetic base can be attached firmly without rocking.

3. Vibration amplitude readings shall b in inches/second. Root Mean Square (RMS) vs. frequency in Cycles Per Minute (CPM) shall be used. Both a vibration spectrum and overall value shall be recorded for each measurement point shown on the testing diagram at the end of this section.

4. When coupled or belt-driven equipment is running and operating under load, record vibration data. If the equipment fails to meet the vibration tolerances, record the vibration readings on the driver unit disconnected

from the driven equipment. Use this data to compare with the vibration of the complete unit to determine the source of the problem.

C. Documentation

1. An electronic copy of the vibration report on tested machinery shall be provided to the Engineer for distribution, review, and approval. The vibration report, at a minimum, shall include the following:

   a. outlining the procedures used;
   b. stating the vibration standards used for the equipment;
   c. stating the analysis results for each piece of equipment;
   d. discussing the source of any unacceptable vibration found (rotor unbalance, shaft misalignment, bearing problems, vane pass vibration, etc.) and recommended actions to correct.

2. A complete set of vibration spectra shall also be provided for each piece of equipment tested under this contract. Vibration spectra printouts shall be provided in the following manner:

   a. Vibration measurement point location description
   b. Performance test condition description
   c. Vibration amplitude (y-scale): Linear scale and with maximum scale set the same for all measurements.
   d. Vibration frequency (x- scale): Linear scale, Cycles Per Minute, maximum scale set the same for all measurements.
   e. Maximum of two spectra per page
   f. Cursor marker placed on 1X, 2X and 3X peaks (minimum)

D. Tolerances

1. Vibration tolerances to be applied to each measurement point on the Dry Pit Submersible Sewage Pumps in the field are as follows:

   a. The “Overall (OA)” or total broadband unfiltered reading shall be no more than .25 inches/second RMS vibration velocity.

   b. Vibration tolerances to be applied to the individual frequency peaks in the vibration spectrum shall be as follows:

| Frequency Range | Tolerance |
|---|---|
| Subsynchronous (below motor RPM) | No vibration peaks in excess of .05 inches/sec RMS velocity |
| At motor or pump RPM | Not to exceed .10 inches/sec RMS velocity |

| Frequency Range | Tolerance |
|---|---|
| At impeller blade pass frequency | Not to exceed .25 inches/sec RMS velocity |
| Above impeller blade frequency out to 120,000 Cycles Per Minute (CPM) | No vibration peaks in excess of .04 inches/sec RMS velocity |

2. On Variable Frequency Drive (VFD) applications, vibration shall be evaluated against the above tolerances as follows:

   a. Store and evaluate the vibration data against the above tolerances at all measurement points designated on the attached testing diagram under full speed conditions. These readings shall be included in the vibration report.

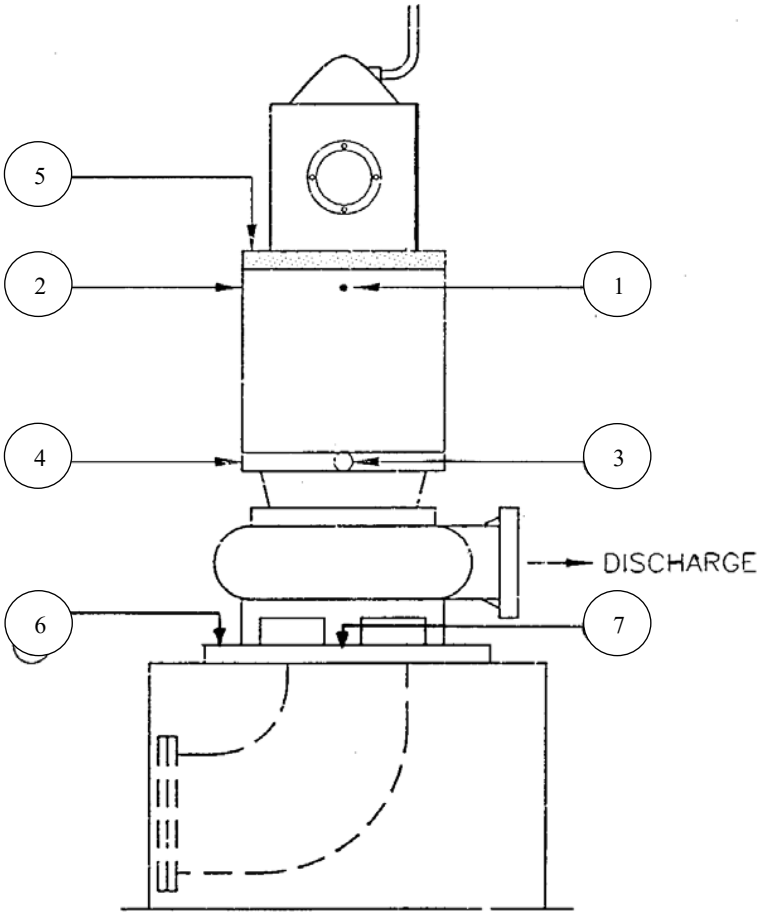
   b. Select the measurement point with the highest amplitude vibration frequency of interest and/or overall vibration level and place the accelerometer at that location.

   c. The equipment speed shall then be manually reduced at the VFD in 1 Hertz increments from full speed to designated minimum speed (or flow) while observing or storing (vibration analyst option) the vibration data.

   d. Note and record any significant increases in vibration which may indicate a critical speed or resonance problem. Also note and record the pump shaft speed or VFD Hertz output setting at which the problem (if any) occurs. Include any problem speeds or speed ranges in the vibration report. This data will be used to program frequency ‘skip’ settings into the VFD as necessary.

B. Refer to Drawing Number 4, below, for minimum test vibration sensor location positions.

NOTE: 1. POSITIONS 2 & 4 ARE IN LINE WITH DISCHARGE PIPING
2. POSITIONS 1 & 3 ARE 90 DEGREES FROM DISCHARGE PIPING
3. PROVIDE ONE (1) AXIAL READING MINIMUM (5, 6 & 7)
4. NUMBERING SYSTEM IS FOR REPRESENATION ONLY




| | | |
|---|---|---|
| PREPARED BY A.A. COUNTY BUREAU OF UTILITIES OPERATIONS TECHNICAL SUPPORT SERVICES | VIBRATION TEST POINTS FOR DRY PIT SUBMERSIBLE PUMPS | DWG NO. 4 |

# APPENDIX D.2
# VIBRATION PERFORMANCE TESTING
# VERTICAL COUPLED PUMPS

A. General

1. Perform a vibration analysis on all dry pit submersible pumps after a complete installation that includes all piping, buttresses, controls, and operational testing. All final vibration readings used for acceptance will be taken with the machinery under normal full load operating conditions. All vibration tests shall be performed with clean water; unless approved in writing prior to testing, from the Department of Public Works, Central Maintenance. The analysis is to be performed by a certified level 1 Vibration Analyst whose credentials are approved in advance by the County. An authorized representative of the County shall also witness the testing.

2. Overall lateral vibrations (i.e. vibrations acting side-to-side, up and down or axially) are all that is required in the field.

B. Methods for Taking Vibration Data

1. Vibration shall be taken with an FFT analyzer or data collector. Spectrum plots shall be available in printed form. The test equipment shall also be capable of providing a complete broadband or “overall (OA)” value in addition to individual frequency components. The type, model, serial number, and latest certified calibration date of all test equipment used in the measurement of vibration levels for machine acceptance shall be documented. Measurements will be taken with a Hanning Window setting and (4) linear, non-overlapping averages.

2. The sensor used shall be an accelerometer with a magnetic mount. Handheld pickups are not acceptable unless machine casing design interferences preclude the use of a magnetic base. The magnetically mounted sensors shall be mounted such that the magnetic base can be attached firmly without rocking.

3. Vibration amplitude readings shall be in inches/second. Root Mean Square (RMS) vs. frequency in Cycles Per Minute (CPM) shall be used. Both a vibration spectrum and overall value shall be recorded for each measurement point shown on the testing diagram at the end of this section.

4. When coupled or belt-driven equipment is running and operating under load, record vibration data. If the equipment fails to meet the vibration tolerances, record the vibration readings on the driver unit disconnected

from the driven equipment. Use this data to compare with the vibration of the complete unit to determine the source of the problem.

C. Documentation

1. An electronic copy of the vibration report on tested machinery shall be provided to the Engineer for distribution, review, and approval. The vibration report, as a minimum, shall include the following:

   a. outlining the procedures used;
   b. stating the vibration standards used for the equipment;
   c. stating the analysis results for each piece of equipment;
   d. discussing the source of any unacceptable vibration found (rotor unbalance, shaft misalignment, bearing problems, vane pass vibration, etc.) and recommended actions to correct.

2. A complete set of vibration spectra shall also be provided for each piece of equipment tested under this contract. Vibration spectra printouts shall be provided in the following manner:

   a. Vibration measurement point location description
   b. Performance test condition description
   c. Vibration amplitude (y-scale): Linear scale and with maximum scale set the same for all measurements.
   d. Vibration frequency (x- scale): Linear scale, Cycles Per Minute, maximum scale set the same for all measurements.
   e. Maximum of two spectra per page
   f. Cursor marker placed on 1X, 2X and 3X peaks (minimum)

D. Tolerances

1. Vibration tolerances to be applied to each measurement point on the vertical close-coupled pumps in the field are as follows:

   a. The “Overall (OA)” or total broadband unfiltered reading shall be no more than .28 inches/second RMS vibration velocity.

   b. Vibration tolerances to be applied to the individual frequency peaks in the vibration spectrum shall be as follows:

| Frequency Range | Tolerance |
|---|---|
| Subsynchronous (below motor RPM) | No vibration peaks in excess of .05 inches/sec RMS velocity |
| At motor or pump RPM | Not to exceed .10 inches/sec RMS velocity |

| Frequency Range | Tolerance |
|---|---|
| At impeller blade pass frequency | Not to exceed .25 inches/sec RMS velocity |
| Above impeller blade frequency out to 120,000 Cycles Per Minute (CPM) | No vibration peaks in excess of .04 inches/sec RMS velocity |

2. On Variable Frequency Drive (VFD) applications, vibration shall be evaluated against the above tolerances as follows:

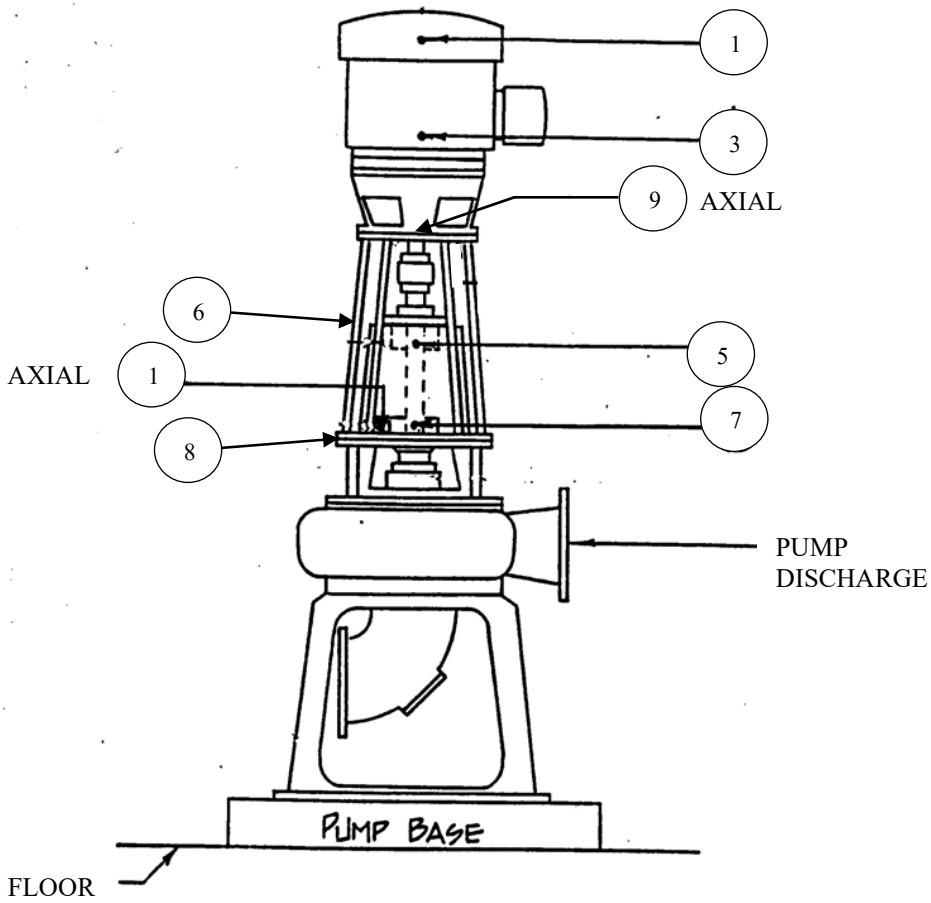
   a. Store and evaluate the vibration data against the above tolerances at all measurement points designated on the attached testing diagram under full speed conditions. These readings shall be included in the vibration report.

   b. Select the measurement point with the highest amplitude vibration frequency of interest and/or overall vibration level and place the accelerometer at that location.

   c. The equipment speed shall then be manually reduced at the VFD in 1 Hertz increments from full speed to designated minimum speed (or flow) while observing or storing (vibration analyst option) the vibration data.

   d. Note and record any significant increases in vibration which may indicate a critical speed or resonance problem. Also note and record the pump shaft speed or VFD Hertz output setting at which the problem (if any) occurs. Include any problem speeds or speed ranges in the vibration report. This data will be used to program frequency ‘skip’ settings into the VFD as necessary.

E. Refer to Drawing Number 2, below, for minimum vibration sensor test location positions.




NOTE: 1. POSITIONS 2, 4, 6 & 8 ARE IN LINE WITH DISCHARGE PIPING
2. POSITIONS 1, 3, 5 & 7 ARE 90 DEGREES FROM DISCHARGE PIPING
3. PROVIDE TWO (2) AXIAL READING MINIMUM (9 OR 10)
4. NUMBERING SYSTEM IS FOR REPRESENATION ONLY

| | | |
|---|---|---|
| PREPARED BY A.A. COUNTY BUREAU OF UTILITIES OPERATIONS TECHNICAL SUPPORT SERVICES | VIBRATION TEST POINTS FOR VERTICAL COUPLED PUMPS | DWG NO. 2 |

# APPENDIX D.3
# VIBRATION PERFORMANCE TESTING
# VERTICAL BUILTOGETHER SEWAGE PUMPS
# RIGID MOUNT WITH CONCRETE BASE

A. General

1. Perform a vibration analysis on all dry pit submersible pumps after a complete installation that includes all piping, buttresses, controls, and operational testing. All final vibration readings used for acceptance will be taken with the machinery under normal full load operating conditions. All vibration tests shall be performed with clean water; unless approved in writing prior to testing, from the Department of Public Works, Central Maintenance. The analysis is to be performed by a certified level 1 Vibration Analyst whose credentials are approved in advance by the County. An authorized representative of the County shall also witness the testing.

2. Overall lateral vibrations (i.e. vibrations acting side-to-side, up and down or axially) are all that is required in the field.

B. Methods for Taking Vibration Data

1. Vibration shall be taken with an FFT analyzer or data collector. Spectrum plots shall be available in printed form. The test equipment shall also be capable of providing a complete broadband or “overall (OA)” value in addition to individual frequency components. The type, model, serial number, and latest certified calibration date of all test equipment used in the measurement of vibration levels for machine acceptance shall be documented. Measurements will be taken with a Hanning Window setting and (4) linear, non-overlapping averages.

2. The sensor used shall be an accelerometer with a magnetic mount. Handheld pickups are not acceptable unless machine casing design interferences preclude the use of a magnetic base. The magnetically mounted sensors shall be mounted such that the magnetic base can be attached firmly without rocking.

3. Vibration amplitude readings shall be in inches/second. Root Mean Square (RMS) vs. frequency in Cycles Per Minute (CPM) shall be used. Both a vibration spectrum and overall value shall be recorded for each measurement point shown on the testing diagram at the end of this section.

4. When coupled or belt-driven equipment is running and operating under load, record vibration data. If the equipment fails to meet the vibration

tolerances, record the vibration readings on the driver unit disconnected from the driven equipment. Use this data to compare with the vibration of the complete unit to determine the source of the problem.

C. Documentation

1. An electronic copy of the vibration report on tested machinery shall be provided to the Engineer for distribution, review, and approval. The vibration report, as a minimum, shall include the following:

   a. outlining the procedures used;
   b. stating the vibration standards used for the equipment;
   c. stating the analysis results for each piece of equipment;
   d. discussing the source of any unacceptable vibration found (rotor unbalance, shaft misalignment, bearing problems, vane pass vibration, etc.) and recommended actions to correct.

2. A complete set of vibration spectra shall also be provided for each piece of equipment tested under this contract. Vibration spectra printouts shall be provided in the following manner:

   a. Vibration measurement point location description
   b. Performance test condition description
   c. Vibration amplitude (y-scale): Linear scale and with maximum scale set the same for all measurements.
   d. Vibration frequency (x- scale): Linear scale, Cycles Per Minute, maximum scale set the same for all measurements.
   e. Maximum of two spectra per page
   f. Cursor markers placed on 1X, 2X and 3X peaks (minimum)

D. Tolerances

1. Vibration tolerances to be applied to each measurement point on the vertical builtogether pumps in the field are as follows:
   a. The “Overall (OA)” or total broadband unfiltered reading shall be no more than .22 inches/second RMS vibration velocity.
   b. Vibration tolerances to be applied to the individual frequency peaks in the vibration spectrum shall be as follows:

| Frequency Range | Tolerance |
|---|---|
| Subsynchronous (below motor RPM) | No vibration peaks in excess of .03 inches/sec RMS velocity |
| At motor or pump RPM | Not to exceed .10 inches/sec RMS velocity |

| Frequency Range | Tolerance |
|---|---|
| At impeller blade pass frequency | Not to exceed .20 inches/sec RMS velocity |
| Above impeller blade frequency out to 120,000 Cycles Per Minute (CPM) | No vibration peaks in excess of .04 inches/sec RMS velocity |

2. On Variable Frequency Drive (VFD) applications, vibration shall be evaluated against the above tolerances as follows:

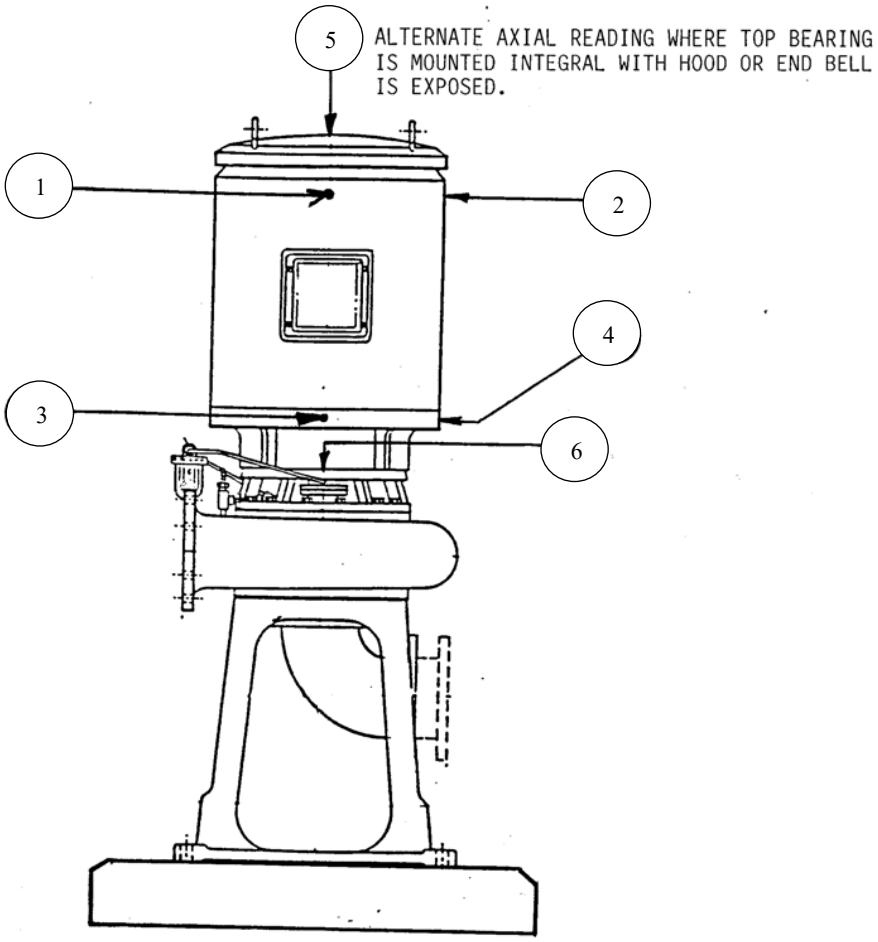
   a. Store and evaluate the vibration data against the above tolerances at all measurement points designated on the attached testing diagram under full speed conditions. These readings shall be included in the vibration report.

   b. Select the measurement point with the highest amplitude vibration frequency of interest and/or overall vibration level and place the accelerometer at that location.

   c. The equipment speed shall then be manually reduced at the VFD in 1 Hertz increments from full speed to designated minimum speed (or flow) while observing or storing (vibration analyst option) the vibration data.

   d. Note and record any significant increases in vibration which may indicate a critical speed or resonance problem. Also note and record the pump shaft speed or VFD Hertz output setting at which the problem (if any) occurs. Include any problem speeds or speed ranges in the vibration report. This data will be used to program frequency ‘skip’ settings into the VFD as necessary.

E. Refer to Drawing Number 1, below, for minimum vibration sensor test location positions.




NOTE: 1. POSITIONS 2 & 4 ARE IN LINE WITH DISCHARGE PIPING
2. POSITIONS 1 & 3 ARE 90 DEGREES FROM DISCHARGE PIPING
3. PROVIDE ONE (1) AXIAL READING MINIMUM (5 OR 6)
4. NUMBERING SYSTEM IS FOR REPRESENATION ONLY

| | | |
|---|---|---|
| PREPARED BY A.A. COUNTY BUREAU OF UTILITIES OPERATIONS TECHNICAL SUPPORT SERVICES | VIBRATION TEST POINTS FOR RIGID MOUNT VERTICAL BUILT TOGETHER SEWAGE PUMPS | DWG NO. 1 |

# APPENDIX E

# LOAD BANK TESTING PROCEDUR

# GENERATOR LOAD BANK TESTING AND ENGINE TESTING

I. General

A. Provide all equipment, labor, materials and supervision necessary to test the stand-by diesel engine driven electric generator set specified. Tests shall be performed as installed on-site.

B. Acceptance testing of the installed generator set shall be conducted by a factory trained representative of the generator set manufacturer. An authorized representative of Anne Arundel County will also witness the acceptance tests. The test results shall be submitted to and approved by the County before the generator set is accepted. The contractor shall furnish all testing equipment, materials, fuel, etc., needed to demonstrate the set is in compliance with the specification. Any deficiencies brought to the attention of the contractor shall be corrected and if warranted or requested by the County, the test shall be re- performed prior to acceptance. Final Operations & Maintenance (O&M) manuals shall be submitted before the acceptance tests commence.

C. The acceptance tests shall be performed during a field test during which the manufacturers representative shall demonstrate that the system performs in complete compliance with the specifications. As a minimum, a load bank test performed in accordance with NFPA 110 section 5-13.2 (copy of which is included at the end of this section) as modified by the County shall be conducted. The load test shall use dry type load banks specifically utilized for this purpose. The load bank will be capable of definite and precise incremental loading and shall not be dependent on the generator control instrumentation to read voltage and amperage of each phase. The test instrumentation will serve as a check of the generator set meters. Salt water brine tank load banks are not acceptable for this purpose and are disallowed and will not be utilized for this test.

D. Load bank testing shall be performed for a period of four (4) hours at the full rated load of the generator, and witnessed by a County representative.

**I.** Generator Engine and Load Bank Testing Outline

A. Prechecks

1) Fuel, fluid levels, belts, hold-down bolts, etc.

2) Run generator long enough to establish proper operation and make sure all pumps, motors etc. are turning in the proper direction under emergency power.

3) Shut down generator and allow it to cool to "cold start" condition.

B. Perform NFPA 110 testing (as modified by the County) as follows:

1) "Cold-start" test (NFPA 110, 5-13.2 (a) through (g)) where a normal power failure is simulated and the maximum expected emergency load supplied. Record engine and generator performance data. Maximum emergency starting load will be supplied using facility load plus pump starting loads as detailed later in this section.

2) In lieu of NFPA 110 5-13.2.3 (h) & (i), hook up the dry-type load bank to generator and perform a stepped load test on the generator at 25%, 50%, 80% and 100% of the nameplate KW rating of the generator. Each step to last fifteen (15) minutes record engine and generator data as detailed later in this section.

IMPORTANT NOTES!

a) Depending on the sizing of the generator breaker, the load bank may be required to be tied into the line side of the breaker in order to test the generator at 100% load for extended period. In this case properly sized separate overcurrent protection shall be provided.

b) Set shall be loaded based on the KW amperage rating and not KVA amperage rating.

3) Return normal power to the station and record time delay on retransfer and time delay on prime mover cool down period and shut down (NFPA 110, 5-13.2.3 (j)).

4) Allow prime mover to cool down for five (5) minutes.

5) Perform a full-load (100% KW rating) test immediately after the cool down period in accordance with NFPA 11, 5-13.2.6. Record data listed in 5-13.2.3.(c) through (h) at 100% load acceptance.

6) Continue running generator at full-load for four (4) hours in lieu of the two (2) hours required by NFPA 110, 5-13.2.5. Record performance data every fifteen (15) minutes.

7) Test all engine protective devices for proper operation and set-point tolerances as detailed later in this section. Record final settings.

- END OF OUTLINE -

III. Test Parameters, Procedures and Tolerances

A. Perform the "cold-start" test and record data as required by NFPA 110, 5-13.2 by doing the following:

Sewage Pumping Stations

1) Trip normal power and put one pump in "hand" position simultaneously.

2) Engine starts under dry-transformer load and one pump starting load.

3) Ten (10) seconds later put second pump in hand. Engine now accepts dry-transformer load, one pump running load plus second pump stating load.

NOTE: During this test also observe and record the maximum voltage dip due to pump starting loads. The generator should pull both pumps (first one then the other) with no more than a 20% dip under the maximum station load conditions of ___KW.

Other Facilities

1) Apply load in steps used for generator sizing (design consultant specify).

B. Perform a stepped load-bank test. As a minimum, the following shall be observed and recorded at 25%, 50%, 80% and 100% stepped load during testing of diesel generators on-site:

1) Volts and amps on each phase - Voltage unbalance between phases shall not exceed + 1% of rated voltage.

2) Frequency - Frequency regulation shall be 0% with isochronous governing and within 3% with speed droop governing.

3 ) K W

4) Oil pressure - shall not deviate more than 10% above the manufacturers recommended oil pressure at full load and operating temperature.

5) Water temperature shall not exceed 2 10 F at any time.

6) Hour meter readings.

7) Note and record color and appearance of exhaust after engine has stabilized at each step by simple description such as clear, little haze, white, bluish, gray, dark, etc. Except for normal engine warm-up and load change stabilization, the stack should remain clear or with little haze over entire operating range.

NOTE: A sample form used by the County load bank testing program to document items (1) - (6) above is included as a guide at the end of this section. While taking readings, the engine should be running uniformly without unusual sounds, knocking or excessive vibration.

C. Perform a full-load test in accordance with 5-13.2.4-2.7 of NFPA 110 for four (4) hours in lieu of two (2) hours. In addition to the data required in paragraph B (1)-(7) above record cylinder exhaust temperatures using a hand-held contact pyrometer or other approved device. Cylinder exhaust temperatures should be within 50F of each o her to indicate loads a e being dvided equally among cylinders. This requirement will also necessitate that the proper absolute exhaust temperatures at 100% load be known and recorded for comparison between cylinders.

D. Test engine protection devices for proper operation and settings including shut-down for overcrank, overspeed, high coolant temperature and low oil pressure under simulated conditions. Check proper operation of status lights and resets. Performance tolerances:

1) Overcrank protection shall include a 10 second cranking cycle limited to 3-5 attempts before lockout. Record final field setting:

- Overspeed setting shall be set at 15% above rated speed. Record final field setting.

- High coolant temperature shut-down setting shall not exceed 2 10F. Record final setting.

- Low oil pressure shut-down shall not occur at less that 10 psi. Record final setting.

2) If engine fails to start or any safety devices operate while the engine is running, the engine shall stop immediately and starting controls locked out requiring manual resetting. All alarm indicators shall be checked for proper operation.

E. Test time delay on diesel cool-down period and shut-down shall not be less than five (5) minutes.

F. Test automatic starting, "Run-off-Auto" switch.

G. Check adjustment and operation of governor.

H. Check proper pump rotation and diesel ventilation fan (where installed) rotation under emergency power vs. normal power.

I. Check proper operation of ventilation louver devices.

J. Check operation of jacket water heater.

K. Perform vibration test (see Vibration Testing Section).

IV. Documentation

The following documentation is to be submitted to the County prior to acceptance:

A. Evidence of prototype testing

B. Results of factory tests of the generator set supplied

C. Installation certificates.

D. A final on-site performance and inspection report summarizing load bank test results, engine controls testing, observations and other information relative to standby generator testing. This data is to be included as part of the Operation and Maintenance (O&M) Manuals. All problems, findings or any corrective actions necessary to bring generators into compliance shall also be well documented.

E. Final O & M manuals.

F. Shop drawings.

A copy of section 5-13 of NFPA 110 Emergency and Standby Power System 1985 has been included at the end of this section.

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END OF SECTION

:ure. An automatic dry chemical system shall not be ised unless the manufacturers of the EPS certify that the ry chemical system will not damage the EPS system or hinder its operation or reduce its output. Where sprinkler protection is provided in the EPS equipment rooms or eparate buildings, hoods or shields of noncombustible naterials shall be installed to protect the critical equipment.

-11.3 Where the EPS rooms or separate buildings are equipped with fire detection systems, the installation hall be in accordance with applicable standards. (*See NFPA 72A, Standard for the Installation, Maintenance nd Use of Local Protective Signaling Systems for Guard's Tour, Fire Alarm and Supervisory Service; NFPA 72B, Standard for the Installation, Maintenance and Use of Auxiliary Protective Signaling Systems for Fire Alarm Service; NFPA 72C, Standard for the Installation, Maintenance and Use of Remote Station Protective Signaling Systems for Fire Alarm and Supervisory Service; NFPA 72D, Standard for the Installation, Maintenance and Use of Proprietary Protective Signaling Systems; and NFPA 72E, Standard on Automatic Fire Detectors.*)

-11.4 The EPS equipment shall be adequately protected from damage due to lightning.

-11.5* In recognized seismic risk areas EPSS components such as electrical distribution lines, water distribution lines, fuel distribution lines and others which erve the EPS shall be designed to minimize damage from hquakes and to facilitate repairs should an earthe occur.

-11.6* In seismic-prone areas for Level 1 and 2 ystems, EPS, transfer switches, distribution panels, circuit breakers and associated controls must be capable of erforming their intended functional operation during nd after being subjected to the anticipated seismic nock.

-12 Distribution.

-12.1 The distribution and wiring systems within EPSS hall be installed in accordance with applicable standards. (*See NFPA 70, National Electrical Code.*)

-12.2 Where applicable, in addition to the requirements of 5-12.1, distribution and wiring systems of evel 1 EPSS shall be installed in accordance with applicable standards. (*See Chapter 8, Essential Electrical ystems in Health Care Facilities, of NFPA 99, Standard or Health Care Facilities.*)

-12.3 The wiring between the EPS output terminals nd the first distribution overcurrent protection terminals within the EPSS shall be located at a minimum istance to enhance system reliability and safety.

-12.4 If the conduit attaching point to the EPS is on he forcing function side of the EPS's vibration isolation ystem, flexible conduit section(s) shall be installed be- en the EPS unit(s) and any of the following so at- ed:

(a) The transfer switch.

(b) The control and annunciator wiring.

(c) Any accessory supply wiring such as jacket water heaters.

Stranded wire of adequate size shall be used to minimize breakage due to vibration. Bushings shall be installed to protect wiring from abrasion with conduit terminations.

5-12.5 All AC-powered support and accessory equipment necessary to the operation of the EPS shall be supplied from the load side of the automatic transfer switch(es), or the output terminals of the EPS, ahead of the main EPS overcurrent protection, as necessary to assure continuity of the EPSS operation and performance.

5-12.6 The starting battery units shall be located as close as practicable to the prime mover starter to minimize voltage drop. Battery cables shall be sized to minimize voltage drop in accordance with the manufacturer's recommendations and accepted engineering practices.

5-12.7 The electrical distribution system of the EPSS shall be complete with properly sized overcurrent and fault current protective equipment. (*See NFPA 70, National Electrical Code.*)

5-13 Installation Acceptance.

5-13.1 Upon completion of the installation of the EPSS, the EPS shall be tested to ensure conformity to the requirements of the standard, both in power output and in function. The authority having jurisdiction shall be given advance notification of the time the final test will be performed in order that the authority may witness these tests.

5-13.2 An on-site acceptance test shall be conducted as a final approval test for all Emergency Power Supply Systems. For new Level 1 installations, the EPSS shall not be construed to meet this standard until the acceptance tests shall have been conducted and test requirements met.

5-13.2.1 The test shall be conducted after completion of the installation with all EPSS accessory and support equipment in place and operating.

5-13.2.2 Test Results. The EPSS shall perform within the limits specified in the standard.

5-13.2.3 The on-site installation test shall be conducted in the following manner:

(a) With prime mover in a "cold start" condition and emergency load at normal operating level, initiate a normal power failure by opening all switches or breakers supplying the normal power to the building or facility. Test load shall be that load which is served by the EPSS.

(b) Observe and record the time delay on start.

(c) Observe and record the cranking time until the prime mover starts and runs.

(d) Observe and record the time required to come up to operating speed.

(e) Record voltage and frequency overshoot.

(f) Observe and record time required to achieve steady-state condition with all switches transferred to the emergency position.

(g) Record voltage, frequency, and amperes.

(h) Record prime mover oil pressure, water temperature where applicable, and battery charge rate at 5-minute intervals for the first 15 minutes, and at 15-minute intervals thereafter.

(i) Continue load test with building load for one hour, observing and recording load changes and the resultant effect on voltage and frequency.

(j) Return normal power to the building or facility, record the time delay on retransfer to normal for each switch (set for 15 minutes minimum) and the time delay on prime mover cooldown period and shutdown.

5-13.2.4 After completion of the test performed in 5-13.2.3, the prime mover shall be allowed to cool for 5 minutes.

5-13.2.5 Full-Load Test. A load shall be applied for a two-hour, full-load test. The building load can serve as part or all of the load, supplemented by a load bank of sufficient size to provide a load equal to 100 percent of the nameplate kW rating of the EPS, less applicable derating factors for site conditions. Unity power factor is acceptable for on-site testing, provided that rated load tests at rated power factor have been performed by the manufacturer of the EPSS prior to shipment.

5-13.2.6 A full-load test shall be initiated immediately after the cooling time allowed in 5-13.2.4 by any method which will start the prime mover and, immediately upon reaching rated rpm, pick up 100 percent of nameplate kW rating on one step, less applicable derating factors for site conditions.

*Exception: For gas turbines, the load can be applied in steps.*

5-13.2.7 Record the data listed in 5-13.2.3(c), (d), (e), (f), (g), and (h) at first load acceptance and every 15 minutes thereafter until the completion of the two-hour test period.

5-13.2.8 Cycle Crank Test. Utilize any method recommended by the manufacturer to prevent the prime mover from running. Put the control switch into "run" to cause the prime mover to crank. Observe the complete crank/rest cycle specified in 3-5.4.2 and Table 3-5.4.

5-13.2.9 Test all safeties specified in 3-5.5 and 3-5.6 as recommended by the manufacturer.

5-13.3 The following shall be made available to the authority having jurisdiction at the time of the acceptance test:

(a) Evidence of the prototype test of 3-2.1 (for Level 1).

(b) Certified analysis of 3-5.10.2.

(c) A letter of compliance specified in 3-5.10.5.

## Chapter 6 Routine Maintenance and Operational Testing

### 6-1 General.

6-1.1 The continuing reliability and integrity of the EPSS is dependent on an established program of routine maintenance and operational testing. The routine maintenance and operational testing program shall be based upon the manufacturer's recommendations, instruction manuals, and the minimum requirements of this chapter and the authority having jurisdiction.

6-1.2 Consideration shall be given to temporarily providing a portable or temporary alternate source whenever the emergency generator is out of service.

### 6-2* Manuals, Special Tools and Spare Parts.

6-2.1 At least two sets of an instruction manual(s) for all major components of the EPSS shall be supplied by the manufacturer(s) of the EPSS and shall contain:

(a) A detailed explanation of the operation of the system.

(b) Instructions for routine maintenance.

(c) Detailed instructions for repair of the EPS and other major components of the EPSS.

(d) Pictorial parts list and part numbers.

(e) Pictorial and schematic electrical drawings of wiring systems, including operating and safety devices, control panels, instrumentation and annunciators.

6-2.2 For Level 1, one set of the instruction manual shall be kept in a secure, convenient location near the equipment. The other set shall be kept in a different source location.

6-2.3 Special tools and testing devices required for routine maintenance shall be available for use when needed.

6-2.4 Replacement for parts identified by experience as high mortality items shall be maintained in a secure location(s) on the premises. Consideration shall be given to stocking spare parts as recommended by the manufacturer.

### 6-3 Maintenance and Operational Testing.

6-3.1* The EPSS shall be maintained so as to provide reasonable assurance that the system will be capable of supplying service within the time specified in type and for the time duration specified in class.

6-3.2 Routine maintenance and operational testing program shall be initiated immediately after the EPSS has passed acceptance tests.

6-3.3 A written schedule for routine maintenance and operational testing of the EPSS shall be established.

6-3.4 A written record of inspections, tests, exercizing, operation, and repairs of the EPSS shall be maintained on the premises. The written record shall include:

LOAD BANK TEST REPORT

FACILITY_____DATE_

NAMEPLATE DATA

KW_____KVA_____PF _

VOLTS AMPS HZ

| TIME | VOLTS | | | AMPS | | | HZ | HOURS | OIL PRESS | WATER TEMP | KW |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | A-B | B-C | C-A | A | B | C | | | | | |
| L G | | | | | | | | | | | |
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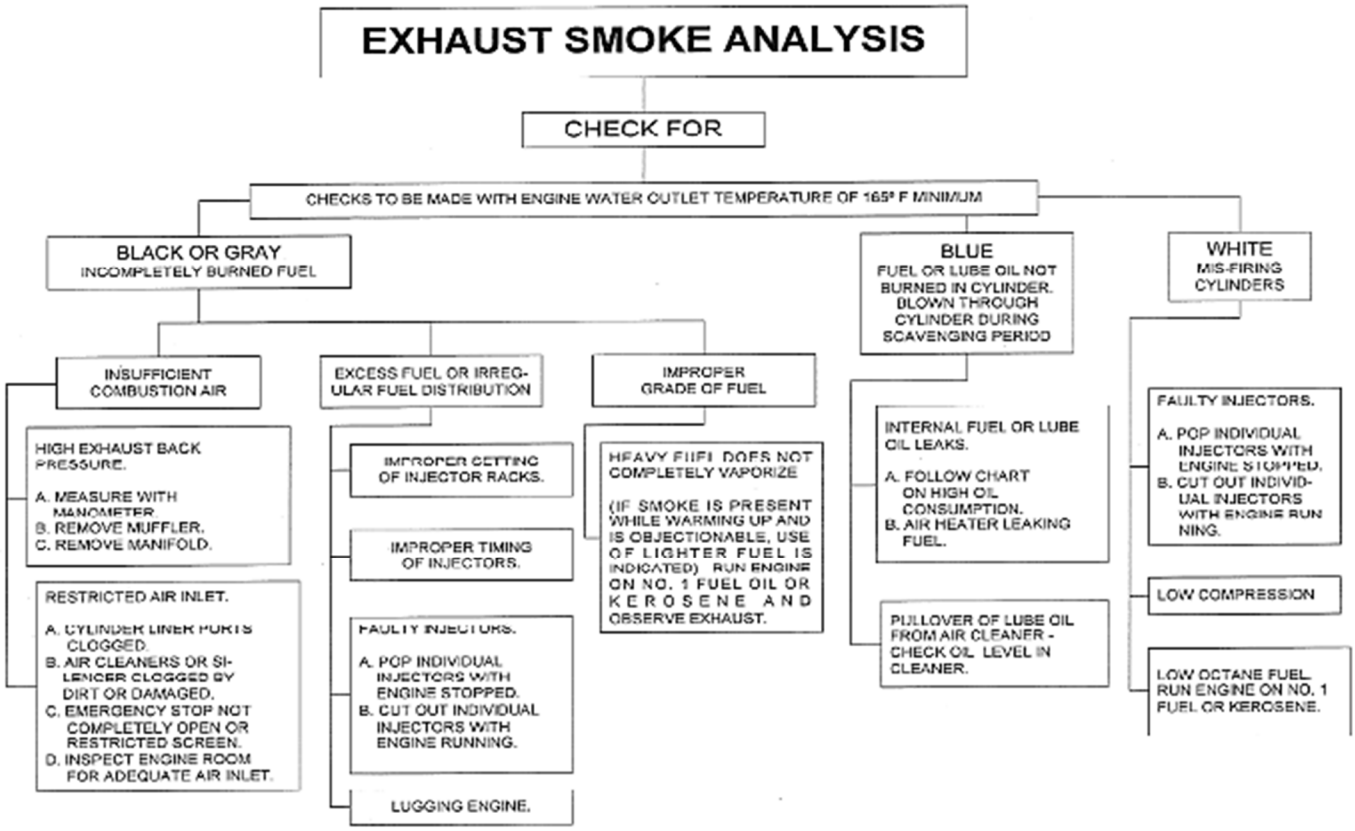
LOAD RATE 25%_____TESTED BY: _

LOAD RATE 50% OBSERVED BY:

LOAD RATE 80% APPROVED BY:


EXHAUST SMOKE ANALYSIS
CHECK FOR
CHECKS TO BE MADE WITH ENGINE WATER OUTLET TEMPERATURE OF 165° F MINIMUM
BLACK OR GRAY
INCOMPLETELY BURNED FUEL
BLUE
FUEL OR LUBE OIL NOT BURNED IN CYLINDER. BLOWN THROUGH CYLINDER DURING SCAVENGING PERIOD
WHITE
MIS-FIRING CYLINDERS
INSUFFICIENT COMBUSTION AIR
EXCESS FUEL OR IRREGULAR FUEL DISTRIBUTION
IMPROPER GRADE OF FUEL
HIGH EXHAUST BACK PRESSURE.
A. MEASURE WITH MANOMETER.
B. REMOVE MUFFLER.
C. REMOVE MANIFOLD.
RESTRICTED AIR INLET.
A. CYLINDER LINER PORTS CLOGGED.
B. AIR CLEANERS OR SILENCER CLOGGED BY DIRT OR DAMAGED.
C. EMERGENCY STOP NOT COMPLETELY OPEN OR RESTRICTED SCREEN.
D. INSPECT ENGINE ROOM FOR ADEQUATE AIR INLET.
IMPROPER SETTING OF INJECTOR RACKS.
IMPROPER TIMING OF INJECTORS.
FAULTY INJECTORS.
A. POP INDIVIDUAL INJECTORS WITH ENGINE STOPPED.
B. CUT OUT INDIVIDUAL INJECTORS WITH ENGINE RUNNING.
LUGGING ENGINE.
HEAVY FUEL DOES NOT COMPLETELY VAPORIZE
(IF SMOKE IS PRESENT WHILE WARMING UP AND IS OBJECTIONABLE, USE OF LIGHTER FUEL IS INDICATED) RUN ENGINE ON NO. 1 FUEL OIL OR KEROSENE AND OBSERVE EXHAUST.
INTERNAL FUEL OR LUBE OIL LEAKS.
A. FOLLOW CHART ON HIGH OIL CONSUMPTION.
B. AIR HEATER LEAKING FUEL.
PULLOVER OF LUBE OIL FROM AIR CLEANER - CHECK OIL LEVEL IN CLEANER.
FAULTY INJECTORS.
A. POP INDIVIDUAL INJECTORS WITH ENGINE STOPPED.
B. CUT OUT INDIVIDUAL INJECTORS WITH ENGINE RUNNING.
LOW COMPRESSION
LOW OCTANE FUEL RUN ENGINE ON NO. 1 FUEL OR KEROSENE.