ANNE ARUNDEL COUNTY
MARYLAND

DEPARTMENT OF PUBLIC WORKS

CHAPTER 1

REFERENCE PUMPING STATION SPECIFICATIONS

July 2011

TABLE OF CONTENTS

SEWER PUMPING STATION SPECIAL PROVISIONS

Published: 7/11 Revised:

DIVISION 9 – FINISHES

DIVISION 10 – SPECIALTIES

DIVISION 11 – EQUIPMENT

DIVISION 15 – MECHANICAL

DIVISION 16 – ELECTRICAL

Published: 7/11 Revised:

APPENDICES

SECTION 02561

SANITARY SEWERS AND SANITARY HOUSE CONNECTIONS

Add the following to Section 02561.03 of the Anne Arundel County Standard Specifications:

02561.03 EXECUTION

A. Pipe Installation

1. Metallic Detection Tape

   a. Metallic detection tape shall be provided for all buried sewer pipe. The tape shall be located a minimum of 8 inches below the surface to a maximum depth of 18 inches. In paved areas metallic detection tape shall be buried beneath stone pavement base in compacted soil.

   b. Metallic detection tape shall have a total thickness of 5.0 mils, and shall have a minimum 0.5 mil aluminum foil core running the full width and length of the tape. The aluminum foil shall be coated with mylar, polyethylene or other flexible plastic material.

   c. Metallic detection tape shall be safety green in color and 3 inches wide. The following imprint shall appear on the tape: "CAUTION BURIED SEWER LINE BELOW".

   d. Metallic detection tape shall be as manufactured by Allen Systems, Inc., Reef Industries, Inc., or equal.

2. DVD of Sewer

   Contractor shall submit DVD of sewer to Engineer for approval upon completion of the construction.

END OF SECTION

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 Manufacturer's 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, 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:

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

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

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

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

B. Fabric

1. Chain link fabric shall be as follows:

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

3. 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.

4. 2-inch diamond mesh.

5. 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 5.79 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 9.10 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 1.80 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.

E. 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. 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.

F. Pipe Bollards

1. Pipe bollards shall be 4-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. Each pipe bollard shall be fitted with a 1/2-inch diameter stainless steel eyebolt fastened through the Schedule 40 steel pipe. Upon completion of the pipe bollard setting and eyebolt assembly, the Schedule 40 steel pipe shall be filled with concrete. 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.

G. Chain

1. Chain shall be 5/16 inch welded steel links, zinc plated. Chain shall have a minimum rated working load of 2,000 pounds. Chain shall be permanently attached to one of the pipe bollard eyebolts. Provide locks as specified above.

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 02800

LANDSCAPING

Delete Specification Sections 02820 - TURF ESTABLISHMENT, and 02860 - FURNISH AND PLANT TREES, SHRUBS, VINES, GROUNDCOVERS AND SEEDLING STOCK fromthe Anne Arundel County Standard Specifications and replace with the following:

02800.01 GENERAL

A. Description

1. This division includes the requirements for topsoiling, seeding and mulching, sodding, shrubs, trees and miscellaneous other related work.

B. Areas Requiring Seeding or Sodding

1. All areas that have been disturbed or damaged by construction operations, with the exception of areas to be sodded, shall be seeded and mulched to provide a dense, uniform and healthy stand of grass, unless otherwise directed by the Engineer. Tack coat mulch over seeded areas.

2. Surface drainage ditches that have been disturbed or damaged by construction operations shall be re-shaped and sodded to one foot beyond the top of the ditch.

C. Quality Assurance

1. Ship landscape materials with certificates of inspection as required by government authorities. Comply with governing regulations applicable to landscape materials.

2. Do not make substitutions. If specified landscape material is not obtainable, submit to Engineer proof of non-availability and proposal for use of equivalent material. When authorized, adjustment of Contract amount will be made.

3. Package standard products with manufacturer's certified analysis.

4. Seed shall be certified by the Maryland State Board of Agriculture and shall conform to requirements of Maryland Turf Grass Law and Regulations, Publication No. 41.

D. Submittals

1. Submit certificates of compliance for seed material stating mixture percentages of species, purity, germination, weed seed.

2. Submit certificates of compliance for sod.

3. Submit certificates of compliance for shrubs.

4. Submit certificates of compliance for trees.

5. Submit certificates of compliance for soil amendments.

E. Product Delivery, Storage and Handling

1. Deliver packaged materials in containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery, and while stored at the site.

F. Guarantee

1. Guarantee landscaping work through the specified maintenance period until final acceptance.

G. Job Conditions

1. Examine the subgrade, verify the elevations, observe the conditions under which work is to be performed, and notify Engineer of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected.

2. Proceed with and complete the landscape work as rapidly as portions of the site become available, working within the seasonal limitations for each kind of landscape work required.

3. Determine location of underground utilities and perform work in a manner which will avoid possible damage. Hand excavate, as required, to minimize possibility of damage to underground utilities.

4. Plant or install materials during normal planting seasons for each type of landscape work required. Correlate planting with specified maintenance periods to provide maintenance until occupancy by the Owner.

H. Tree and Shrub Replacement

1. Replace trees and shrubs on developed property disturbed by construction activities that are dead, weakened, diseased or damaged.

2. Replacement trees and shrubs shall be the same type and size as those that require replacement due to construction activities.

3. Replacement trees and shrubs shall be at the Contractor's expense.

02800.02 MATERIALS

A. Soil Amendments

1. Lime

a. Lime shall be natural dolomitic limestone containing not less than 85 percent of total carbonates, ground so that not less than 90 percent passes a 10 mesh sieve and not less than 50 percent passes a 100 mesh sieve.

2. Fertilizer

a. Fertilizer shall be a commercial fertilizer, uniform in composition, free flowing, of neutral character with less then 5% phosphorous content. Fertilizer shall be delivered to the site fully labeled according to applicable state fertilizer laws and shall bear the name, trade name or trademark and warranty of the manufacturer. Fertilizer shall be supplied with the percentage of total nitrogen, available phosphoric acid and total potash as indicated for specific applications as specified hereinafter.

3. Peat Moss

a. Peat moss shall be a sphagnum peat moss and shall be free from woody substances.

B. Grass Materials

1. Seed shall be fresh, clean, new crop grass seed complying with the tolerance purity and germination established by the Official Seed Analysts of North America. Provide seed of the grass species, proportions and minimum percentage of purity and germination, and maximum percentage of weed seed, as specified.

2. The following seed mixtures shall be used for all areas to be seeded except as otherwise noted:

a. General Turf Areas (Fertilized and mowed on a regular basis): Home lawns, Commercial sites, Parks, Playgrounds.

i. Kentucky Bluegrass - Full sun mixture - For use in areas that receive intensive management. Irrigation required.

a. Recommended Certified Kentucky Bluegrass Cultivars** 100%

b. Seeding Rate: 1.5 to 2.0 pounds/1,000 square feet

** A minimum of three bluegrass cultivars should be chosen ranging from a minimum of 10% to a maximum of 35% of the mixture by weight.

ii. Kentucky Bluegrass/Perennial Rye - Full sun mixture - For use in full sun areas where rapid establishment is necessary and when turf will receive medium to intensive management.

a. Certified Perennial Ryegrass Cultivars 10-15%

b. Certified Kentucky Bluegrass* 85-90%

c. Seeding Rate: 2 pounds mixture/1,000 square feet.

d. A minimum of 3 Kentucky bluegrass cultivars must be chosen, with each cultivar ranging from a minimum of 10% to a maximum of 35% of the mixture by weight.

iii. Tall fescue/Kentucky Bluegrass - Full sun mixture - For use in drought prone areas and/or for areas receiving low to medium management in full sun to medium shade.

a. Certified Tall Fescue Cultivars** 95-100%

b. Certified Kentucky Bluegrass Cultivars 5-0%

c. Seeding Rate: 5 to 8 lb. mixture/1,000 square feet.

** One or more cultivars may be blended.

iv. Kentucky Bluegrass/Fine Fescue - Shade Mixture - For use in areas with shade in Bluegrass lawns. For establishment of a high quality, intensively managed turf area.

a. Certified Kentucky Bluegrass Cultivars* 3 0-40%

b. Certified Fine Fescue 60-70%

c. Seeding Rate: 1 1/2 to 3 lbs/1 ,000 square feet.

*A minimum of 3 Kentucky bluegrass cultivars must be chosen, with each cultivar ranging from a minimum of 10% to a maximum of 35% of the mixture by weight.

NOTE: Varieties should be selected from those listed in the current University of Maryland publication Agronomy Mimeo #77, "Turfgrass Cultivar Recommendations for Maryland".

b. Rough Areas: Not generally mowed and cannot be prepared with conventional equipment. Hydroseeding will be the normal method of seeding these areas.

i. Level Areas

March 1 to May 15 50-100% Tall Fescue
August 1 to November 15 5-25% perennial Ryegrass
0-15% Canada Bluegrass
0-15% Kentucky Bluegrass (Common Type)
0-15% Fine Fescue
0-10% Red Top

Seeding Rate: 150 lb/Acre
May 16 to July 30 Add Lovegrass at 2 lb/acre or Foxtail Millet at 10 lb/acre
November 16 to February 28 Add Cereal Rye at 56 lb/acre

ii. Sloped Areas - Add 16 lbs per acre of crown vetch or 20 lb per acre of Sericea Lespedeza. Inoculant should be used at 10 times the manufacturers recommended rate when hydroseeding.

C. Sod

1. Sod shall be Certified or Approved grade as graded by the Maryland State Board of Agriculture

and shall conform to Requirements of Maryland Turf Grass Law and Regulations, Publication No. 41. Sod shall be machine cut at a uniform thickness of 3/4- inch ± 1/4-inch, excluding top growth and thatch. Each individual sod piece shall be strong enough to support its own weight when lifted by the ends. Broken pads, irregularly shaped pieces, and torn or uneven ends will be unacceptable.

2. Sod shall be as follows:

a. "Maryland State Approved" Multi-Use Turf Sod

b. Tall Fescue: 100% Certified Kentucky 31

D. Screening

1. Overall Design Objectives

a. Existing vegetation should be utilized whenever possible.

b. A minimum 10-foot planting strip must be maintained on all sides between chain link fence and adjacent property lines or right-of-ways.

c. Overall objective is to provide 75% evergreen screening with 25% deciduous trees to provide color and variety.

d. Provide screening/landscaping that requires minimal maintenance.

2. Design Requirements

a. If 25 feet of dense, existing vegetation can be retained, no additional planting will be required. Existing vegetation and fence will be sufficient for that area. For purposes of these standards, existing vegetation shall include vegetation within the pumping station property lines only.

b. If existing vegetation can be retained but is less than 25 feet in depth, clusters of evergreen and deciduous shrubs and ornamental trees must be planted in accordance with percentages stated in Paragraph A.3 and with size and spacing requirements shown on attached “recommended planting list”. These plant materials are referenced with this symbol: *.

c. For planting strips of 10 feet or less where no existing vegetation remains, a dense evergreen screen must be planted with a mixture of evergreen shrubs and small trees as shown on the attached “recommended planting list”. These plant materials are referenced with this symbol: **.

d. Plant materials must be installed by a qualified nurseryman, and in accordance with the Landscape Specification Guidelines for the Baltimore - Washington Metropolitan Area. Sample planting details are to be as shown on Standard Pump Station Drawings.

e. Soil conditions shall be considered when selecting approximate plantings using the attached list “Recommended Plants for Droughty/Wet Soils”.

f. Landscape plans shall include contour lines, existing vegetation, nearby

houses/structures, proposed plantings, utility locations, and provide a planting list.

Recommended Planting for Pumping Stations:

SHRUBS	COMMON NAME	SIZE	SPACING	SOIL
*Abelia Grandiflora	Glossy Abelia	24-30"	4' o.c.	(D)
*Berberis Julianae	Lulianae Barberry	24-30"	3' o.c.	(D)
**Euonymus Alatus	Winged Euonymus	24-30"	3' o.c.	(D)
**Euonymus Kiautschovicus	Evergreen Euonymus	24-30"	3' o.c.	(D)
*Ilex Glabra, Nellie R. Stevens	Inkberry Nellie R. Stevens	24-30"	4' o.c.	(W)
*Juniperis C. C. Pfitzeriana	Phitzer Juniper	24-30"	4' o.c.	(D)
*Myrica Pennsylvanica	Northern Bayberry	24-30"	4' o.c.	(W)
**Photinia X. Fraseri	Red Top Photinia	24-30"	4' o.c.	(D)
*Prunus Laurocerasus	Cherry Laurel	24-30"	4' o.c.	(D)
ORNAMENTAL TREES	COMMON NAME	SIZE		SOIL
Acer Ginnala	Amur Maple	1 1/2-1 3/4" CAL		(D)
Crataegus Phaenopyrum	Washington Hawthorn	1 1/2-1 3/4" CAL		(D)
Koelruetaria Paniculata	Golden Raintree	1 1/2-1 3/4" CAL		(D)
Prunus Ceracifera "Thunder Cloud"	Purple Leaf Plum	1 1/2-1 3/4" CAL		(D)
Prunus Servlatta Kwanzan	Kwanzan Cherry	1 1/2-1 3/4" CAL		(D)
Pyrus Calleryana "Redspire"	Redspire Pear	1 1/2-1 3/4" CAL		(D)

EVERGREEN TREES	COMMON NAME	SIZE	SPACING	SOIL
** Cupressocyparis X. Leylandi	Leyland Cypress	4-5'	5' o.c.	(W)
*Ilex X. Attenuata "Foster"	Fosters Holly	4-5'	5' o.c.	(D)
Pinus Strobus	Eastern White Pine	4-5'	10' o.c.	(D)
**Pinus Thunbergiana	Japanese Black Pine	4-5'	8' o.c.	(D)
**Thuja Occidentalis "Nigra"	Dark Green Arborvitae	4-5'	4' o.c.	(W)

Droughty Soils (D) - Those that, at the time of construction, exhibit no moisture cohesion, are friable, low in organic content, and do not retain moisture.

Wet Soils (W) - Those which, at the time of construction, exhibit moisture cohesion, highorganic content and due to local topography, are likely to be exposed to seasonal flooding or swampy conditions.

E. Plants & Plant Materials

1. Plants and plant materials shall meet the detailed description as given on the plans and as described herein.

2. All plant material, unless otherwise specified, shall be nursery grown, of good average uniform growth, free from irregularities, typical of the species and variety, well formed, uniformly branched and have a vigorous root system. They shall be healthy, vigorous plants free from defects, decay, disfiguring roots, sunscald injuries, abrasions of the bark, plant disease, insect pest eggs, boxers and all forms of infestations of objectionable disfigurements. Plant materials that are weak or which have been cut back from larger grades to meet certain specified requirements will be rejected. All plants shall be freshly dug: no heeled in plants or plants from cold storage will be acceptable.

3. All plant characteristics including, but not limited to; ball diameter, caliper and height measurements, shall be in accordance with the current edition of the "U.S.A. Standard for Nursery Stock", as recommended by the American Association of Nurserymen, Inc.

4. All trees shall be symmetrically balanced according to their normal habit of growth. No forked leader stock will be accepted.

5. All plants shall be planted within the planting season that shall be defined as September 15 through November 30 and March 1 through May 30.

6. All planting furnished under this contract shall be guaranteed to remain viable and to thrive in a healthy condition for a period of one (1) year. Trees that are not thriving

satisfactorily, as determined by the landscape architect, within said one (1) year period shall be replaced by the Contractor at his sole expense. All plant materials shall be planted in accordance with the plans and specifications for the original plantings. Replacement shall include the cost of tearing up and replacing that portion of sidewalk or paving, if any, required for tree replacement, all at the contractor's sole expense. All replacement plants shall be guaranteed for a minimum period of one (1) year.

7. The contractor shall notify all utility companies five (5) days prior to beginning work.

8. Any damage to the existing utilities, building, paving, curb, walls and vegetation (not so designated for removal on these plans) shall be repaired to previous condition or replaced by the contractor at his expense.

9. All planting beds shall have three inches of medium pine bark mulch placed on top of 4 inches of topsoil.

10. Topsoil shall be free from brush, weeds and other litter; and shall be free from clay lumps, stones, or other objects larger than one inch in diameter, and any other substance that may be harmful to plant growth. Prepared topsoil shall conform to the following specifications:

11. Prepared topsoil for evergreen plants: shall consist of two parts topsoil to one part humus or other approved organic material. Fertilize with 3 lbs. 10-10-10 evergreen (acidic) fertilizer or approved equal per cubic yard of prepared topsoil or as soil test dictates.

12. Prepared topsoil for deciduous plants: shall consist of two parts topsoil, to one part well rotted cow or horse manure. Fertilize with 3 lbs. standard 10- 10-10 fertilizer or approved equal per cubic yard of prepared topsoil or as soil test dictates.

13. After fertilizer application, all plant beds (not individual plant pits) shall be covered with weed barrier fabric installed per manufacturer's specifications. The barrier shall be neatly trimmed at edges to conform to bed configuration. Cut holes to size and location of excavated plant pits.

F. Miscellaneous Landscape Materials

1. Mulch for protection of permanent seeding shall be clean, weed free, unrotted straw.

2. Mulch for tree and shrub planting shall be 100 percent true pine bark ground mulch, with minimum 90 percent organic content, and a white wood content not to exceed 10 percent. Mulch shall be a uniform brown color, with not more than 50 percent capable of passing a 3/4-inch sieve.

3. Soil mix for trees and shrubs shall consist of a mixture of 50 cubic feet of peat moss in 12 cubic yards of topsoil, with no lime added.

4. Binder for straw mulch shall be emulsified asphalt, conforming to the requirements for MSHA Grade SS-1 emulsified asphalt, Table 20.12.11.

5. Soil stabilization netting shall be polyproplyene. Netting shall be "Erosion Control Netting", 1.5 x 1.3 strands/inch, mesh opening 5/8-inch by 3/4-inch as manufactured by American Excelsior Company, or equal. Staples for securing soil stabilization matting shall be No. 11 or heavier steel wire bent to form a U shape. Staples shall be one inch wide and minimum six inches long after bending.

6. Weed barrier in planted landscape areas shall be Biobarrier II fabric by Reemay or approved equal, with ten year guarantee.

02800.03 EXECUTION

A. General

1. All seeded areas not covered with soil stabilization netting shall be covered with straw mulch. Mulched areas shall be coated with binder.

2. All seeded areas with a slope of 4:1 or greater shall be covered with soil stabilization netting. Netting shall extend one foot beyond crown of slopes, one foot beyond limit of disturbed area, or one foot beyond 4:1 grade as applicable.

B. Spreading Topsoil

1. All areas to be seeded or sodded shall be covered with four inches of topsoil.

2. Prior to topsoiling and finish grading operations, all rough graded areas shall be corrected, mounds and ridges shall be cut off, gullies and depressions filled, and other necessary repairs performed to enable all surfaces to be brought to the original grades, or, for areas where grading is indicated, to the grades shown on the Drawings, in an even and properly compacted condition.

3. After the area to be topsoiled has been prepared, the surface shall be loosened and made friable by raking or other approved methods, to a full depth of at least two inches to permit blending of topsoil to the subgrade. All stones and debris one inch or more in any dimension shall be raked up and removed from the site.

4. All stockpiled topsoil shall be spread and compacted to a uniform thickness over the areas to be topsoiled. The Contractor shall verify the amount of topsoil previously stockpiled to determine the thickness of the topsoil layer.

5. Topsoil shall not be placed when either the subgrade or the topsoil is wet or frozen enough to cause clodding.

6. The finished surface shall be free of stones, sticks or other material one inch in any dimension, smooth and true to the required grades.

C. Seeding

1. The areas to be seeded shall be cleaned of any rough grass, weeds and debris, with the ground brought to an even grade and the top four (4) inches of topsoil thoroughly worked into a satisfactory seedbed.

2. Apply dolomitic lime at a rate recommended by USDA for the soil conditions per current soil test.

3. Apply fertilizer of 10-10-10 strength at a rate of 25 pounds per 1,000 square feet, minimum.

4. Thoroughly mix lime and fertilizer into the top four inches of topsoil.

5. Moisten seedbed during periods of high temperature and when directed by the Engineer.

6. Apply seed mixture uniformly with mechanical power driven seeders, mechanical cyclone hand seeders or with hydroseeding equipment. Sow the seed mixture at a rate of 200 pounds per acre, or five pounds per 1,000 square feet, minimum, between March 1 and May 31 and between August 15 and October 31.

7. Rake seed lightly into the top 1/4-inch of topsoil, roll lightly and water using a fine spray.

D. Mulching and Soil Stabilization

1. Immediately after seeding apply mulch to a rate of 70 pounds per 1,000 square feet, minimum, to a loose depth between one and three inches, to all seeded areas not covered with soil stabilization netting.

2. Apply binder over mulch at a rate of 5 gallons per 1,000 square feet on flat areas and slopes no more than 8 feet high. On slopes 8 feet or more in height apply binder at a rate of 8 gallons per 1,000 square feet. Application of binder shall be doubled 4 feet around edges, in valleys and at the crest of slopes to prevent wind from lifting mulch. The remainder of binder application shall be uniform in appearance.

3. The Contractor shall place protective coverings over structures prior to application of binder material. The Contractor shall take every precaution against damaging or disfiguring structures or property on or adjacent to the work. The Contractor shall repair all damage caused by his operations to the satisfaction of the Engineer, at the Contractor's expense.

4. Immediately after seeding, apply soil stabilization netting to all slopes 4:1 and greater that have been seeded. Extend netting to one foot beyond top of slope. Netting shall be rolled in the direction of the flow of water. Strips shall overlap a minimum of four inches. Ends shall overlap a minimum of six inches. The upgrade end of each strip of netting shall be turned down and buried to a depth of six inches, minimum. Overlap with the upgrade section on top. Place staples two feet apart along edges and center of netting strips. At ends of netting, place staples six inches apart. Drive staples vertically into the soil and flush with the surface.

E. Sodding

1. The areas to be sodded shall be cleaned of any rough grass, weeds and debris. Loosen the subsoil to a depth of four inches. Sod shall be placed on all disturbed areas not to be paved which are: slopes steeper than 3:1, drainage ditches, improved lawn areas, and where shown on the Drawings.

2. Remove stones 1-1/2 inches and larger, clods, brush, roots, trash and other objectionable material from the top four inches of soil.

3. Apply dolomitic lime at a rate of 50 pounds per 1,000 square feet, minimum, to areas to be sodded.

4. Apply fertilizer of 10-10-10 analysis at a rate of 25 pounds per 1,000 square feet, minimum.

5. Thoroughly mix lime and fertilizer into the top four inches of topsoil.

6. Moisten sod bed if dry and when directed by the Engineer.

7. Deliver sod to the site and install sod within 48 hours after being cut.

8. Place sod in straight parallel lines. Stagger lateral joints and butt tight.

9. On slopes 2:1 and greater, stake each strip of sod with at least two stakes or with wire staples.

10. After laying sod, roll, tamp and water until the underside of the sod pad and soil surface beneath it are thoroughly wet and in contact with each other. Rolling, tamping and watering shall be completed within an eight-hour period after laying sod.

11. Sod shall not be laid on frozen ground or when the air temperature is below 32 degrees F. Perform sodding before December 1 and after February 15.

F. Maintenance

1. Begin maintenance immediately after planting, seeding or sodding.

2. Maintain seeded, sodded and planted areas for one full year after installation to produce good stands of grass free from eroded or bare areas, and healthy trees and shrubs, acceptable to the Engineer.

3. Maintain grass areas by watering, fertilizing, weeding, mowing, trimming, and other operations such as rolling, regrading, replanting, and resodding as required.

G. Cleanup and Protection

1. During landscaping work, store materials and equipment where directed. Keep pavements clean and work area in an orderly condition.

2. Protect landscaping work and materials from damage. Maintain protection during installation and maintenance periods. Treat, repair or replace damaged landscaping work as directed.

3. Fertilizer spilled on impervious surfaces shall be promptly cleaned up.

H. Inspection and Acceptance

1. When the landscaping work is in progress, the Engineer will, upon request, make inspections to determine acceptability.

2. Where inspected landscaping work does not comply with the requirements, replace rejected work and continue specified maintenance until reinspected by the Engineer and found to be acceptable.

I. Objective

1. The objective of all landscapes is to keep construction and maintenance costs at a minimum, and create an aesthetically pleasing site that will blend in with the surrounding neighbor(s).

END OF SECTION

SECTION 03010

FORMS AND FORMWORK

03010.01 GENERAL

A. Description

1. This section specifies formwork for concrete work.
2. Related Work Specified Elsewhere
    a. Concrete Reinforcement; Section 03200.
    b. Cast-in-Place Concrete; Section 03300.
    c. Concrete Finishes; Section 03040.
    d. Precast Structural Concrete; Section 03050.
3. Quality Assurance
4. Reference Codes and Specifications
    a. "Guide to Formwork for Concrete" ACI Standard 347-01.
    b. "Formwork for Concrete" ACI Special Publication No. 4.
    c. Codes and regulations of jurisdictional authorities.

B. General Design Criteria

1. Design formwork for vertical loads and lateral pressures in accordance with ACI 347-01.
2. Design formwork system which is adequately braced and has adequate strength and stability to ensure finished concrete within the specified tolerances.
3. When necessary to maintain the specified tolerances, design camber into the formwork to compensate for anticipated deflection and creep due to the weight and pressure of the fresh concrete and construction loads.
4. Chamfer external corners 3/4-inch.

03010.02 MATERIALS

A. Products

1. Plywood Forms

   a. Grade marked.

   b. B-B Plyform, Exterior Class 1 and 2 and HDO Medium Density Overlaid Plywood concrete Form, B-Matte Formguard or equal, conforming to the requirements of the U.S. Products Standard PS-1.

   c. Steel forms are not required for junction or elbows.

   d. Hardboard

      Tempered, smooth one side, not less than 3/16-inch thick conforming to the requirements of U.S. Commercial Standard CS 251.

2. Form Ties

   a. Factory fabricated, snap off metal type of adequate design to minimize form deflections and preclude concrete spalling upon removal.

   b. Fabricated so that set back in the concrete is such that the portion of the tie remaining after snap-off and removal of the exterior portions is at least 11/2-inches back from the concrete surface.

3. Bond Breaker

   Non-staining liquid product which imparts a waterproof film to prevent adhesion of the concrete and will not leave a paint impeding coating on the face of the concrete of release agents which will transfer to the concrete.

03010.03 EXECUTION

A. Construction and Workmanship

1. Construct adequately braced formwork so that the resulting concrete surfaces will conform to the tolerances specified.

2. Brace forms, falsework, and centering adequately to retain forms in the position as shown on the approved working drawings.

3. Provide mortar tight forms of approved materials to retain forms in position as shown on the approved working drawings.

B. Field Quality Control

Construct elements to meet the allowable tolerances of the dimension, elevations and positions shown and specified in Section 03030, Cast-in-Place Concrete.

C. Coating Forms

1. Coat forms with bond breaker prior to the placement of reinforcing steel.

2. Do not allow excess coating material to stand in puddles in the forms. Coating material shall not come in contact with concrete against which fresh concrete is to be placed.

3. Coat bolts and rods that are to be completely removed or that are to be free to move with bond breaker.

D. Embedded Items

1. Clean items to be embedded in concrete free from oil or foreign matter that would weaken the bond of the concrete to these items.

2. Install in the formwork requisite inserts, anchors, sleeves, and other items specified under other sections of these Specifications. Close ends of conduit, piping, and sleeves embedded in concrete with caps or plugs.

3. Concrete pads, curbs, pedestals, and similar means devised by the Contractor to support the forms will be subject to review by the Engineer.

4. Before depositing concrete, check the location and support of items that are to be wholly or partially embedded.

E. Opening and Recesses in Concrete

Provide openings and recesses and place sleeves in the concrete as may be required and furnished by other sections of these Specifications.

F. Joints

1. Unless otherwise directed, make contraction, expansion, and construction joints only where shown.

2. Form keyways as shown.

3. Continue reinforcing steel and wire fabric across construction joints which are not indicated as being free to move.

G. Removal of Forms, Falsework and Centering

1. Maintain forms, falsework, and centering in place until the concrete has attained the minimum percentage of specified design strength for the structural members to carry their own weight and any loads to which they will be subjected without exceeding the permissible stresses and without deforming.

2. Compute permissible stresses on the basis of 0.6 of the compressive strength attained by the concrete at the time of removal.

3. Maintain forms, falsework, and centering in place until the concrete has attained the minimum percentage of specified design listed in Schedule 1, Table 1.

Table 1

Minimum Percent of Specified Design Strength

Structural Member	Schedule 1	Schedule 2
Footings: Invert, sides of beams, slabs and girders, slabs and beams on grade.	25	20
Open cut structure exterior walls; retaining walls	50	30
Soffits and beams, slabs and girders under 20 feet clear span between supports.	80	60
Cantilevers and intersecting sections	90	70

4. Remove forms, falsework, and centering for values between Schedule 1 and Schedule 2 for listed and non-listed members only after:

   a. The Engineer has approved calculations showing the anticipated concrete strengths at the time of the proposed early removal based on:

      1. ratio of dead load over live load;

      2. span, height and shape;

      3. ratio of rise over span;

      4. reshoring;

      5. loads, resultant stresses, and deformations to which the concrete and reinforcing steel will be subject at the time of removal, subsequent to the removal and until the concrete has attained its design strength; prevailing site conditions.

   b. The concrete strength attained prior to form removal has been determined from tests of cylinders cured adjacent to and under the same conditions as the placed concrete.

   c. Three (3) test cylinders taken by the test laboratory have been tested by an independent testing laboratory retained by the Contractor and approved by the Engineer and the tests performed in accordance with Section 03030, Cast-in-Place Concrete.

   d. Do not alter the loading conditions on the concrete subsequent to the removal of the forms if it results in exceeding the permissible stresses and deformation at the attained concrete strengths.

END OF SECTION

SECTION 03040

CONCRETE FINISHES

03040.01 GENERAL

A. Description

Work performed under this section shall include but is not limited to finishing all concrete surfaces for all concrete work as shown on Contract Drawings and as specified herein.

B. Related work specified elsewhere:

1. Concrete Formwork; Section 03010.
2. Cast-in-Place Concrete; Section 03300.
3. Precast Structural Concrete; Section 03050.

03040.02 MATERIALS

See related Section 03030, Cast-in-Place Concrete and Section 03010, Forms and Formwork.

03040.03 EXECUTION

A. Surface Finishes (Except Floor and Slab on Grade)

1. Repair of Surface Defects

    a. All surface defects including tie holes, minor honeycombing, and otherwise defective concrete shall be repaired with cement mortar. Cement mortar for patching shall be the same composition as that used in the concrete except that for exposed surfaces part of the cement shall be white Portland cement to provide a finish color matching the surrounding concrete. Patching shall be done as soon as the forms are removed; areas of surfaces that are to be cured with a curing compound shall be covered during the application of the compound. All areas to be patched shall be cleaned thoroughly. Minor honeycombed or otherwise defective areas shall be cut out to solid concrete to a depth of not less than one inch. The edges of the cut shall be perpendicular to the surface of the concrete. The areas to be patched and at least six inches adjacent thereto shall be saturated with water before placing the mortar. The mortar shall be mixed approximately one hour before placing and shall be remixed occasionally during this period with a trowel without the addition of water. A grout of cement and water mixed to the consistency of paint shall then be brushed onto the surfaces to which the mortar is to be bonded. The mortar shall be compacted into place and screened slightly higher than the surrounding surface. Patches shall be cured as specified for the concrete. Holes extending through the concrete shall be filled by means of a

plunger type gun or other suitable device from the unexposed face. The excess mortar shall be wiped off the exposed face with a cloth. Finished surfaces shall be protected from stains and abrasions. As cast finish against steel, plywood, forms, and rubbed finish shall be equal in workmanship, texture, and general appearance to that of sample panels specified herein. Concrete with excessive honeycombing, which exposes the reinforcing steel or other defects which affect the structural strength of the member, shall be rejected or the defects corrected as directed by the Engineer, and at the expense of the Contractor.

2. Finishing of Formed Surfaces

Finishing of formed surfaces shall be accomplished as soon as practicable after form removal and repair of surface defects. Finishing shall be accomplished as specified herein where indicated.

a. As Cast Finishes

i. Smooth Form Finish

a. The form facing material shall produce a smooth, hard, uniform texture on the concrete. Tie holes and defects shall be patched. All fins shall be completely removed.

ii. Rough Form Finish

a. No selection from facing materials are required for rough form finish surfaces. Tie holes and defects shall be patched. Fins exceeding 1/4 inch in height shall be chipped off or rubbed off. Otherwise, surfaces shall be left with the texture imparted by the forms.

b. Applied Finishes

i. Floated Finish

a. After concrete has been placed, consolidated, struck off and leveled, do not work further until ready for floating. Begin floating when water sheen has disappeared and when the surface has stiffened sufficiently to permit the operation. During or after first floating, check planeness of surface with a ten foot straightedge applied at not less than two different angles. Cut down high spots and fill low spots during this procedure to produce a surface with true planes within 1/4- inch in ten feet as determined by a ten foot straightedge placed anywhere on the slab in any direction. Following straightedge checking, refloat slab immediately to a uniform sandy texture.

ii. Broom or Bolt Finish

a. Immediately after concrete has received a floated finish, give surface a coarse transverse scored texture by drawing a broom or burlap bag across the surface.

c. Unindicated Finish

Finishes not indicated on the Contract Drawings or otherwise specified shall be as follows:

i. Smooth Form Finish

a. For all concrete surfaces exposed to public view.

ii. Rough Form Finish

a. For all concrete surfaces not exposed to public view.

d. Unformed Surfaces

i. Related Unformed Surfaces: Tops of walls or buttresses, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces shall be struck smooth after concrete is placed and shall be floated to a texture reasonably consistent with that of the adjacent formed surfaces. Final treatment on formed surfaces shall continue uniformly across the unformed surfaces.

B. Floor Finishes

1. General Requirements

a. The finishes specified herein include surface finishes, treatments, and toppings for floors and slabs. For floors in which drains occur, special care shall be exercised to slope the floors uniformly to the drains. All floor slabs where finish is not indicated or specified shall receive a single steel toweling. Dry cement shall not be placed directly upon the new concrete surface to absorb excess moisture.

2. Placing and Screening Normal Concrete Slab or Base Slab

a. Concrete of slump within the limits specified herein shall be placed, consolidated, and immediately struck off to bring the top surface of the slab to proper contour, grade, and elevation. This operation may be followed immediately by a darbying or bull floating on the surface with wooden, aluminum or magnesium tools so as to correct any unevenness. Striking-off and darbying shall be completed before bleed water appears on the surface of the freshly-placed concrete. No further work shall then be performed until the concrete has attained a set sufficient for floating and sufficient to support the weight of the finisher and/or equipment. If the bleed water has not disappeared by the time floating of the surface is to start, the excess water shall be first dragged off the surface using a rubber hose. At no time

shall dry cement be used to absorb bleed water. The finish surface shall be free of troweled marks, uniform in texture, and shall be true to plane 1/8 inch in 10 feet when checked with 10-foot straight edge placed anywhere on the slab in any direction. Walkway and stair surfaces shall be floated with a wood float to produce a uniformly gritty surface free from depressions or high spots.

3. Curing

Finished floor surfaces shall be cured adequately as specified herein.

a. Curing with Water

i. Moist or wet-curing with water or by complete covering with waterproof membrane sheets shall be continuous for seven days at temperatures of 60 degrees F and above, and for longer periods at lower temperature, as necessary.

b. Chemical Floor Hardeners

i. Chemical floor hardeners shall be applied to interior floor slabs of buildings. They shall be applied to a dried concrete surface, only after the concrete has been first adequately moist or wet-cured, or to one that has been cured with nonstaining vapor-proof sheeting or paper. Treatment of new concrete surfaces shall be in accordance with the recommendations of the manufacturer, in the amount used and as to the number of applications.

END OF SECTION

SECTION 03050

PRECAST STRUCTURAL CONCRETE

03050.01 GENERAL

A. Description

This Section specifies the requirements for precast structural concrete noted on drawings, specifically the manufacturer, transportation and erection of precast concrete pump stations and vaults.

B. Related Work Specified Elsewhere

1. Forms and Formwork; Section 03010.
2. Cast-In-Place Concrete; Section 03300.
3. Concrete Finishes; Section 03040.
4. Precast Concrete Utility Structures; Section 03400.

C. Quality Assurance

1. Acceptable Manufacturers
    a. Manufacturing plant shall be certified by the Precast Concrete Institute.
    b. Manufacturers of precast structural concrete products used in the work for this project shall have a minimum of 5 years experience in the manufacture of the type of elements used in the work or shall post a bond or deposit in the amount of 100% of the value of precast structural concrete items supplied for this project. Manufacturers without 5 years acceptable experience shall post the specified bond or deposit for a period of 5 years after conditional acceptance of the work. Bond or deposit shall be returned to precast structural concrete manufacturer upon expiration of the 5 year period and satisfaction of the Owner of adequate precast structural concrete products performance.
2. Allowable Tolerance
    a. Width or thickness (Cross Section Dimension) ± 1/4 inch.
    b. L e n g t h ±1/2 inch.
    c. Inserts, bolts and pipe sleeves: Maximum ±3/8 inch (9.5mm) deviation from

drawing location.

d. Horizontal Alignment :Deviation from straight line parallel to theoretical centerline of member: 1/4 inch.

D. Submittals

1. Shop Drawings

a. Content

i. Dimensions and finishes.

ii. Reinforcing and connection details.

iii. Anchors.

iv. Lifting and erection inserts.

v. Other items cast into members.

vi. Show location of unit by same identification mark placed on member.

vii. Include design calculations bearing the seal of a Professional Engineer licensed in the State of Maryland. Shop drawings shall have seal of Professional Engineer registered in State of Maryland.

b. Test Reports: Reports of tests on concrete.

c. Manufacturers' certifications of material conformance with specifications, and PCImanual for Quality Control, (MNL-1 17-70).

E. Product Delivery, Storage and Handling

1. Delivery and Handling

a. Transport and handle precast concrete units with equipment to protect from dirt and damage. Minor damage, such as spalls or chips shall be repaired using an epoxy bonding agent and grout.

b. Do not place units in position which will cause overstress, warp, or twist.

c. Handle by means of lifting inserts.

d. Major damage to units during transit or handling, as determined by the field engineer, will be cause for rejection.

2. Storage

    a. Store units off ground to protect from contact with soil and from physical damage.

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

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

    d. Stack so that lifting devices are accessible and undamaged.

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

    f. Store units in a position consistent with their shape and design in order to avoid excessive stresses.

03050.02 MATERIALS

A. Materials

1. Portland Cement

    a. ASTM C 150, Type II

    b. Use same brand, type, and source of supply throughout.

        i. Air-Entraining Agent: ASTM C 260

        ii. Aggregates: ASTM C 33

2. Water: Potable or free from foreign materials in amounts harmful to concrete.

3. Reinforcing Steel

    a. Deformed billet steel: ASTM A 615 Grade 60.

    b. Wire fabric: Welded Steel, ASTM A 185.

4. Anchors and Inserts

    a. Materials: Type 304 Stainless Steel.

5. Grouts for repair of units.

    a. One part Portland cement to two parts sand by volume.

    b. Keep water to a minimum.

    c. The sand and cement shall be as specified for concrete.

6. Bonding Agent

    a. Moisture insensitive, epoxy-resin bonding agent as manufactured by one of the following or an equal:

        i. Epoxitite; W.R. Grace.

        ii. Euco Epoxy; Euclid Chemical Company.

        iii. Sikastix 370; Sika Chemical Company.

    b. Use of specified for repair of units.

    c. Use in conformance with manufacturer's printed instructions.

7. Precast Reinforced Concrete Wet Well Risers

    a. Wet wells less than 10 feet diameter shall consist of manhole riser sections conforming to ASTM C478.

    b. Wet wells 10 feet in diameter and larger shall consist of reinforced concrete pipe riser sections conforming to AWWA C-302.

8. All penetrations shall be link-seal type penetrations except for incoming gravity sewer lines.

    a. Valve vaults: All pipe penetrations to be link-seal type.

B. Mixes

1. Mixing Procedures: Same as for cast-in-place concrete, Section 03030.

2. Concrete Properties

    a. Water-cement ratio: maximum 40 lbs. (18 kg.) of water to 100 lbs. (45 kg.) of cement.

    b. Air-entrainment: Minimum 3%; maximum 6%.

    c. 28 day compressive strength: Minimum of 5,000 psi.

    d. Do not use calcium chloride or other salts.

3. Fabrication

    a. Formwork

        i. Construct forms to maintain units within their specified tolerances.

        ii. Securely attach anchorage devices to formwork in locations not affecting position of main reinforcement or placing of concrete.

    b. Place concrete in continuous operation to prevent formation of seams.

    c. Consolidate placed concrete by vibration without dislocation or damage to reinforcement and built-in items.

    d. Provide permanent markings on precast unit to identify pick-up points and location in structure.

    e. Cure precast units until 70 percent of the minimum 28 day compressive strength has developed before removing the units from the forms.

03050.03 EXECUTION

A. Inspection

Before starting to erect precast concrete units, verify that structure and anchorage inserts are within required tolerances.

B. Erection

1. Set units into position by means of hoist or crane. Vertical alignment must be instrument checked with plumbness approved by the Engineer.

2. Repair all minor damage, such as spalls and chips, using an epoxy bonding agent and grout. Major damage occurring during erection, as determined by the field engineer, will be cause for rejection.

C. Patching

1. Patch damaged units to match adjacent area.

2. Add patch to concrete with bonding agent.

3. Cut off lifting device and grout.

D. Waterproofing

Waterproofing the exterior of buried precast concrete construction in accordance with Section 07110, except for manholes which shall be waterproofed as specified in Section 02570.

END OF SECTION

SECTION 03200

CONCRETE REINFORCEMENT

Delete Specifications Section 03200 – CONCRETE REINFORCEMENT from the Anne Arundel County Standard Specifications and replace with the following:

03200.01 GENERAL

A. Description

This section specifies reinforcement for concrete and other facilities.

B. Related Work Specified Elsewhere

1. Cast-in-Place Concrete, Section 03300

2. Precast Structural Concrete, Section 03050

C. Quality Assurance

1. Allowable Tolerances

a. Cut and bend reinforcing steel to conform to the dimensions shown and within the following tolerances:

i. Sheared length	+/- 1 inch
ii. Stirrups, ties and spirals	+/- 1/2 inch
iii. All other bends	+/- 1 inch

D. Submittals

1. Shop Drawings

a. Detail reinforcing in accordance with the requirements of ACI 315-99 Details and Detailing of Concrete Reinforcement.

b. Submit with the shop drawings, bar lists and bending diagrams showing the individual weight of each bar, the total weight of each bar size, and the total weight of bars on the list. Base the calculated weights on the theoretical unit weights shown in Table 1, ASTM A615.

2. Certificates

a. Submit certified copies of reinforcing mill tests showing chemical and physical analyses.

b. Have testing performed in accordance with ASTM A615 as modified by ACI 318 building code requirements for reinforced concrete.

c. Submit certificates of compliance for all reinforcing materials.

E. Product Delivery, Storage and Handling

1. Shop reinforcing steel in bundles.

2. Tag each bundle at the mill with a waterproof tag showing the name of the mill and heat number, the grade and size of the bars, and identifying number.

3. Protect reinforcing steel and wire fabric from damage and dirt, oil, grease, other foreign matter, and rust causing conditions.

03200.02 MATERIALS

A. Reinforcing

1. Reinforcing Steel Bars: ASTM A615, Grade 60, modified in accordance with ACI 350.

2. Welded Steel Wire Fabric: ASTM A185.

3. Metal Accessories: As recommended by CRSI Manual of Standard Practice. Where concrete surfaces will be exposed to public view in the finish structure, use supports with plastic protected or stainless steel legs.

03200.03 EXECUTION

A. Cutting and Bending

1. Perform cutting and bending in the shop. Bend steel cold. Do not bend or straighten bars in a manner that will injure the material.

2. Do not bend bars in the field except to correct minor errors or damage in shipment or handling, or to make shipment of certain bars practicable.

B. Bar Support and Spacers

1. Support bars by means of bolsters or chairs with no less than the minimum required by ACI 315-99, Details and Detailing of Concrete Reinforcement.

2. Reinforcing steel in the bottom of slabs resting on earth may be supported by concrete, brick, or mortar blocks.

3. Hold reinforcing steel in position in walls, columns, piers, and abutments by means of mortar blocks, bar supports, or spacers wired to reinforcing steel.

4. Do not use stones, clay bricks, wood blocks, or pieces of broken concrete to support reinforcing steel.

5. Do not place bars or fabricated mats on layers of fresh concrete as the work progresses.

C. Placing and Fastening

1. Arrange and place reinforcing steel as shown on the Contract Drawings.

2. Secure reinforcement positively against displacement during placing of concrete.

3. Wire or clip bars together as recommended in Concrete Reinforcing Steel Institute Recommended Practice for Placing Reinforcing Bars.

4. Place steel which is free from dirt, mill and rust scale, oil, grease, and other foreign matter.

5. Placing Reinforcing Steel

i. Variation of protective coating 2-inch cover	1/4 inch
ii. Variation of protective coating 3-inch cover	1/2 inch
iii. Variation from indicating space	1 inch

D. Splicing

1. Furnish reinforcing bars in full lengths as shown on the Contract and Shop Drawings.

2. Do not splice bars unless approved by the Engineer in writing.

E. Inspection

Deposit concrete only when the placement of the reinforcement has been checked and approved by the Engineer. The Contractor shall provide notice to the Engineer at least 24 hours in advance of any contemplated concrete pour.

F. Embedment

Place reinforcement so that there will be a clear distance of at least 2 inches between the reinforcement and any anchor bolts or other embedded metal work.

G. Concrete Protection for Reinforcement

Reinforcement shall be protected by the thickness of concrete indicated in the Contract Drawings. Where not otherwise shown, the thickness of concrete over the reinforcement shall be as follows:

1. Where concrete is deposited against the ground without the use of forms - not less than 3 inches.

2. Where concrete is exposed to weather, ground, sewage, or sewage gases, but placed in forms - not less than 2 inches for bars larger than No. 5 and 1-1/2-inches for No. 5 bars or smaller.

3. In slabs and walls not exposed to ground, weather, sewage or sewage gases - not less than 3/4 inch.

4. In beams, girders, and columns not exposed to ground, weather, sewage, or sewage gases - not less than 1-1/2 inches.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

Delete Specification Section 03300 - CAST-IN-PLACE CONCRETE from the Anne Arundel County Standard specifications and replace with the following:

03300.01 GENERAL

A. Description

1. This section specifies the requirements for Portland Cement cast-in-place concrete.

2. Related Work Specified Elsewhere

   a. Forms and Formwork; Section 03010.

   b. Concrete Reinforcement; Section 03200.

   c. Concrete Finishes; Section 03040.

   d. Precast Structural Concrete; Section 03050.

B. Quality Assurance

1. Properties of Concrete

   a. General Requirements

      i. Design mixes to produce concrete of proper workability, durability, compressive strength, maximum density, and minimum shrinkage and permeability.

      ii. Design mixes to have a minimum water-cement ratio, the largest permissible maximum size specified coarse aggregate, and an optimum percentage of fine aggregate.

      iii. Use maximum size of coarse aggregate in accordance with ACI Committee 613 Report, Recommended Practice for Selecting Proportions for Concrete.

   b. Durability

      For durability purposes, use a water-cement ratio in accordance with either ACI Committee Report 613, Table 4 as determined by the type of structure and exposure conditions, or 0.50 by weight whichever is the lesser.

   c. Workability

Use approved chemical or air-entraining admixtures, or suitable combinations thereof to improve workability, as well as to reduce water and cement contents, and minimize shrinkage and permeability of concrete, provided that these admixtures do not adversely affect other required properties of concrete.

d. Strength

i. Design the mix for each class and type of concrete of a specified compressive strength based on the required overdesign factor according to ASTM C94, and assuming a coefficient of variation equal to 15. Unless otherwise shown, working stress method of design will apply to structures.

ii. For working stress method of design, each class of concrete shall be designed so that not more than 20 percent of the compressive strength tests will have values less than the specified compressive strength, and the average of six consecutive strength test will be equal to or greater than the specified compressive strength.

e. Method of Proportioning

i. For proportioning mixes use methods as described in ACI Report 613.

ii. Vary mixing water content as specified in ACI Report 613, Table 3.

iii. Do not vary the proportions of the ingredients of the approved mixes without the written approval of the Engineer.

C. Submittals

1. Samples

Membrane-forming curing compound: Two one-pint samples, each type.

2. Design Mixes

a. At least 30 days prior to start of placing concrete, submit design mixes for each class and type of concrete, indicating that the concrete ingredients and proportions will result in a concrete mix meeting the requirements specified.

b. Include for each class and type of concrete as many mix designs as there are combinations of different ingredients, or type of ingredients, anticipated to cover the requirements of the contract work.

c. Compression test cylinders from all footings, walls and slabs shall be made at the Contractor's expense by an independent testing laboratory approved by the Engineer and tested in accordance with the ACI Code and "Method of Test for Compressive Strength of Molded Concrete Cylinders (ASTM C39)". One set of cylinders will

be required for the first 5 cubic yards and one set for each 25 cubic yards thereafter for each day's pour.

d. Furnish two (2) copies of each report to the Engineer and one copy to local government building department and structural engineer. Concrete which does not meet the Specifications will be required to be removed and replaced at the Contractor's expense or may be subjected to a load test, also at Contractor's expense.

e. Establish the mix designs and have them tested through the laboratory.

f. Submit cylinder test results for the various mix designs showing compressive strength at 2, 7, and 28 days.

D. Proposed methods for controlling concrete temperature.

E. Certificates of Compliance

1. Ingredients

a. Submit with the mix design, laboratory test reports and mill or manufacturer's certificates attesting to the conformance of ingredients with these specifications. Use ingredients in the design mix which are representative samples of the materials to be used in the contract work.

b. In case the source, brand or characteristic properties of the ingredients need to be varied during the term of the contract, submit revised laboratory mix report, in conformance with the above procedures.

2. Batch Tickets

Submit a delivery ticket from the concrete supplier with each batch delivered to the site setting forth the following information. Submit certificate to the Engineer before unloading at the site.

a. Name of Supplier

b. Name of batching plant and location

c. Serial number of ticket

d. D a t e

e. Truck Number

f. Specific job designation (contract number and location)

g. The volume of concrete (cubic yards)

h. Specific class and type of concrete (in conformance with the specification requirements)

i. Time loaded

j. Type and brand of cement

k. Weight of cement

l. Maximum size of aggregates

m. Weights of coarse and fine aggregates, respectively

n. Maximum amount of water to be added and amount of water added at the site, if any.

o. Kind and amount of admixtures

F. Product Delivery, Storage And Handling

1. Aggregates

a. Transport and stockpile aggregates according to their sources and gradations. Handle in a manner which will prevent segregation and loss of fines or contamination with earth or foreign materials.

b. If aggregates show segregation or the different grades become mixed, rescreen before placing in the proportioning bins.

c. Do not use aggregates from different sources or of different gradations alternatively. Mix only to obtain different gradations.

d. Do not transfer aggregates directly from trucks, railroad cars or barges to the proportioning bins when the moisture content is such that it will affect the accuracy of the proportioning of the concrete mixture. In such case, stockpile aggregate until the excess moisture drains off.

2. Packaged Cement

a. Deliver to the project site in original sealed packages labeled with the weight, name of the manufacturer, brand, and type specified.

b. Store packages in a water-tight building.

c. Do not use cement which has been reclaimed by cleaning bags.

d. Do not use cement which has been damaged by exposure or overstocking.

e. Do not deliver packages varying more than three percent from the specified weight.

f. Packaged cement will be subject to test at any time.

3. Bulk Cement

a. Store bulk cement separately from other cement and protect from deterioration from exposure to moisture and intrusion of foreign matter.

4. Provide facilities to maintain separation of cement meeting the requirements of these specifications from other cement.

5. Provide in cement manufacturer's plant, facilities for sampling of cement at the weighing hopper or in the feed line immediately before entering the hopper.

6. Do not use different brands of cement, or the same brand of cement from different sources without approval.

03300.02 MATERIALS

A. Materials

1. Portland Cement: ASTM C150 Type I or II

2. Admixtures

a. Admixtures to be used in concrete shall be subject to prior approval by the Engineer.

b. Calcium chloride or admixtures containing chloride other than impurities in admixture ingrediants shall not be used.

3. Membrane Forming Curing Compound shall comply with provisions of ASTM C309, Type I (100 resin) with fugitive dye, and Type 2.

4. Waterproof Curing Sheet shall comply with provisions of ASTM C171, Type 1.1.1 and 1.1.2.

5. Burlap Sheet shall comply with provisions of AASHTO M182, Class 3 and 4.

6. Tarpaulins shall comply with provisions of FS K-P-146.

7. Water requirements

a. Containing no impurities, suspended particles, algae, or dissolved natural salts in quantities that will cause:

i. Corrosion of reinforcing steel.

ii. Volume change that will increase shrinkage cracking.

iii. Efflorescence.

iv. Excessive air entraining.

b. The pH to be not less than 6.5 nor greater than 7.5.

c. When tested in accordance with ASHTO T26, standard mortar briquette tests to show no indication of unsoundness, change in time-of-setting not in excess of 30 minutes, or reduction in strength not more than ten percent.

8. Concrete Aggregate shall comply with the provisions of ASTM C33, with the following additional requirements:

a. Coarse aggregate:

Deleterious Substance	**Maximum Allowable Percent by Weight**
Coat and lignite particles	0.5
Friable particles	0.25
Material passing No. 200 sieve (for crushed aggregates if the material finer than the No. 200 sieve consists of dust of fracture essentially free from clay or shale the percentage may be increased to 1.5)	1.0
Thin or elongated pieces (length may be greater than five times the smallest dimensions of a circumscribing rectangular prism)	5.0
Other deleterious substances	1.0

b. Percentage of wear not exceeding 45 when tested in accordance with ASTM C131 and C535.

c. Weighted percentage of loss not more than 15 percent by weight when subjected to five cycles of the magnesium sulphate soundness test in accordance with ASTM C88.

d. Gradation in accordance with Table 2 of ASTM C33 and represented by a smooth gradation curve with the required limits.

9. Fine Aggregate

a. Washed natural and or washed manufactured sand. Manufactured sand may be subject to special gradation requirements as directed by the Engineer.

b. Gradation in accordance with ASTM C33 and represented by a smooth gradation curve within required limits. The minimum percentages of the material passing the Number 50 and Number 100 sieves may be reduced to five and zero respectively if the aggregate is to be used in concrete with three percent minimum air- entrainment, or concrete containing more than 5.5 bags of cement per cubic yard.

c. Weighted percentage of loss not more than 12 percent by weight when subjected to five cycles of the magnesium sulphate soundness test in accordance with ASTM C88.

d. Deleterious Substance

Deleterious Substance	**Maximum Allowable Percent by Weight**
Coat and lignite particles	0.5
Friable particles	1.0
Material passing No. 200 sieve, other deleterious substances such as shale, alkali, mica, coated grain, soft and flaky particles.	5.0

e. Free from injurious amounts of organic impurities as determined by ASTM C40. Should material fail to pass test for organic impurities in sand for concrete, retest in accordance with ASTM C87. If the fine aggregate shows by the calorimetric test a darker color than that of the sample originally approved for work, stop using the aggregate until tests satisfactory to the Engineer have been made to determine whether the change in color is indicative of an injurious amount of deleterious substances.

10. Reinforcement

a. All reinforcing steel except No. 2 bars shall be deformed. Reinforcement not specified or indicated otherwise shall have minimum yield strength of 60,000 psi, and shall conform to one of the following ASTM specifications:

b. Reinforcing Bars

i. A 615 Deformed billet-steel bars for concrete reinforcement Grade 60

ii. Welded Wire Fabric

Welded wire fabric shall be electrically-welded fabric of cold-drawn wire of gauge and mesh size indicated or specified herein, and shall conform to ASTM A 185. Where the size mesh and weight of the fabric are not indicated or specified otherwise, fabric shall be 6-inch by 6-inch mesh, No. 6 gauge of 0.192-inch nominal diameter wire weighing approximately 42 pounds per 100 square feet.

11. Elastomer Waterstops

Elastomer waterstops shall be made of polyvinyl chloride, shall be dense, homogeneous, free from porosity and other imperfections, and symmetrical in shape. Materials shall be resistant to chemical action with Portland cement, acids and alkalis, and not affected by fungi. They shall show no effect when immersed for 10 days at room temperature in 10 percent solutions of sulfuric acid, hydrochloric acid, and sodium chloride, and a saturated lime solution. Resistance to fungi shall be determined by ASTM G 21. Material shall not be adversely affected when subjected to tests for low temperature brittleness (-35 degrees F), in accordance with ASTM D 1329, and for water absorption (maximum 5 percent by weight). Waterstops not indicated otherwise shall be 6-inches by 3/8 inch.

12. Materials for Curing Concrete

a. Cotton Mats: Cotton mats shall be free from any substance which may have a deleterious effect on fresh concrete.

b. Waterproof Paper Waterproof paper shall conform to Federal Specifications UU-B-790.

c. Polyethylene Sheeting: Polyethylene sheeting shall be natural color and shall have a nominal thickness of 0.004-inch. The loss of moisture when determined in accordance with ASTM C 156 shall not exceed 0.055 gram per square centimeter of surface.

d. Polyethylene - Coated Burlap: Polyethylene-coated burlap shall be 4 mils thick white opaque polyethylene film impregnated or extruded into one side of the burlap. Burlap shall weigh not less than 9 ounces per square yard and shall conform to Federal Specifications CCC-C-467. The loss of moisture when determined in accordance with ASTM C 156 shall not exceed 0.055 gram per square centimeter of surface.

e. Liquid Membrane-Forming Compound: Liquid membrane-forming compound shall conform to ASTM C309, white-pigmented Type 2, and be free of paraffin or petroleum.

f. Liquid Chemical Compound Curing: Liquid chemical compound curing shall be accomplished by the application of a suitable sealer-hardener designed for sealing and hardening in addition to curing of the concrete, applied by the method and at the rate recommended by the manufacturer. It shall not reduce the adhesion of paint, waterproofing or other material to be applied to the concrete. The chemical compound shall be free of petroleum resins or waxes. The loss of moisture when determined in accordance with ASTM C 156 shall not exceed 0.055 gram per square centimeter of surface or, if determined by Federal specifications TT-C-800, the loss of moisture shall not exceed 0.037 gram per square centimeter of surface. The abrasion loss shall not exceed 80 percent of that of the same concrete, untreated, when tested in accordance with ASTM C 418 at age 28 days. The

adhesion to the treated concrete shall be at least 90 percent of the adhesion to the same concrete, untreated. The test for adhesion will consist of forming mortar or concrete slabs, three moisture cured and three liquid chemical cured for each type of covering to be applied. After curing for 28 days, the slabs shall be permitted to dry in air. The covering shall be adhered to the troweled face of the slabs with the adhesive to be used in the work. After the adhesive has set, cuts one inch apart and 6 to 10 inches long shall be made through the adhered covering, forming strips to one end of which a calibrated spring type balance or other device shall be attached. The strips shall be peeled off at a rate of 2 to 100 inches per minute. The pull required to peel the covering from the slabs shall be the average of three specimens.

13. Chemical Floor Hardener: Chemical floor hardener shall be a liquid concrete hardener applied in accordance with the manufacturer's recommendations.

    a. Sonneborn — Lapidolith

    b. Chem-Masters — Sciolith

    c. W. R. Meadows — Pena-lith

    d. Protex — Lithoplate

14. Joint-Sealing Materials: Joint-sealing materials shall conform to ASTM D 1850 or Federal Specifications SS-S-1401, except that all joints exposed to the weather shall be sealed with material conforming to Federal Specifications SS-S-140 1.

15. Expansion Joint Filler: Expansion joint filler shall be preformed type conforming to ASTM D 1751.

16. Slots and Inserts for Masonry Anchors

    a. Dovetail Anchor Slots: Dovetail anchor slots shall be formed of zinc-coated sheet steel, U.S. 24 minimum gauge, provided in concrete faced with or abutting masonry.

    b. Inserts: Shall be formed of minimum 9 gauge zinc-coated steel wire, engaged between a two-piece half-round wood core, and having loops for embedding in concrete.

17. Epoxy Bonding Compound: Epoxy bonding compound shall conform to ASTM C881.

18. Vapor Barrier: Vapor barrier shall be polyethylene sheet .006 inch (6 mil) thickness of widest practicable widths. See Architectural drawings for locations.

03300.03 EXECUTION

A. Field Quality Control

1. Air Entrainment: Determine the air content of concrete in accordance with the recommendations of ASTM C231.

2. Testing of Concrete

   a. General Requirements

      i. Furnish molds and concrete required for casting specimens and testing. In addition, furnish to the Engineer the necessary standard testing equipment and tools to perform sampling, slump tests, air- entrainment tests, yield tests, and boxes for shipping samples.

      ii. Compressive strength tests will be performed by the Contractor by making not less than one set of standard cylindrical test specimens for the first 5 cubic yards and every 25 cubic yards of concrete or any portion thereafter for each structure.

      iii. For each work shift, when concrete is delivered, at least one set of specimens will be made. A set of test specimens will consist of at least six standard cylinders from a batch. At least two specimens of the set will be tested for 2-day, 7-day, and 28-day compressive strength. The tests for 2-day compressive strength, approximately 25 percent of the 28-day compressive strength, will be used to aid in the determination of form, falsework and centering removal. The tests for 7-day compressive strength, approximately 60 percent of the 28-day compressive strength, will be likewise used.

      iv. Slump tests, yield tests, and air content tests will be performed by the Contractor with no less frequency than that of casting strength specimen sets.

   b. Concrete Strengths

      i. Determine compressive strengths from standard test specimens taken according to ASTM C31 and ASTM C172, and cured and tested in accordance with ASTM C39 by the Laboratory. Core drilling and testing will be in accordance with ASTM C94.

      ii. Compute and evaluate in accordance with ASTM C94.

   c. Air content: Determine in accordance with ASTM C231.

   d. Cement Factor: Determine in accordance with ASTM C138.

   e. Modulus of elasticity: Determine the modulus of elasticity and Poisson's Ratio in accordance with ASTM C469 as directed by the Engineer.

f. Slump: Determine in accordance with ASTM C 143.

g. Unit Weight: Determine the unit weight in accordance with ASTM C138 as directed by the Engineer.

3. Design Mix

a. Specified 28 days compressive strength of concrete shall be as follows:

i. f ' c = 3000 psi for all structurally reinforced concrete work.

ii. f ' c = 3000 psi concrete for exterior work and all flatwork underfoot, such as walks, steps, ramps, drives, porch floors, all work vulnerable to the use of "de-icers". Also use for pipe thrust blocking and masonry cell fill.

iii. f ' c = 2000 psi concrete for mud mats, limited site voids, soil boring voids, and for under foundations where excavated to excessive depth.

iv. f ' c = 2000 psi concrete for grout with maximum size coarse aggregate not exceeding 3/8 inch.

b. Mix Proportioning

i. Mix proportioning for wastewater treatment structures shall produce watertight concrete resistant to naturally occurring or commonly used chemicals, with a 28-day compressive strength of 3500 psi in accordance with Method I (ACI 301) and the following:

a. Maintain a minimum water to cement ratio consistent with the point of placement.

b. Provide the following minimum cement content:

ASTM C33 Coarse Aggregate No.	Lbs. per cu. yd.
467	517
57 or 67	564

c. Provide air entrainment as follows:

5% +/- 1% coarse aggregate No. 467

6% +/- 1% coarse aggregate No. 57 or 67

c. Classes for Concrete

i. Classes of concrete are designated by numerals corresponding to their specified 28-day compressive strengths in pounds per square inch as determined by

ASTM C94

ii. When class is not indicated use 3,000.

iii. Each class of concrete may comprise one or more mixes determined by the maximum size of aggregate, cement factor and types of admixtures used.

d. Minimum Cement Factor

i. Observe the minimum cement factor for the various classes of concrete as follows:

Class of Concrete	Mimimum Cement Factor Bags per cu. yd. of Concrete
4,500	6.5
3,500 - 4,000	6.0
3,500 - 3,000	5.0
Less than 3,000	4.5

B. Material Preparation

1. Mixing Concrete

a. Operations

i. Provide concrete mixers that discharge the concrete from the mixer uniform in composition and consistency throughout the mixed batch.

ii. Do not use fine aggregates from different sources of supply alternatively in the same class of construction mix.

iii. Combine coarse aggregates of different gradation and identical sources, providing the corresponding concrete mix has been approved by the Engineer. The use of alternate batches of gravel, crushed gravel, or crushed stone of any one size will not be permitted.

iv. The adequacy of mixing will be determined by the Engineer by mixer performance tests according to the Bureau of Reclamation Designation 26 Variability of Constituents in Concrete in the appendix of Concrete Manual of U.S. Bureau of Reclamation, Seventh edition.

v. The Engineer reserves the right to reduce the size of the batch to be mixed or to increase the mixing time when the charging and mixing operations fail to produce a concrete batch which conforms to the above criteria.

vi. Add water prior to, during, and following the mixer charging operations. Do not use concrete which is retained in mixers so long as to require additional

water in excess of design mix water to permit satisfactory placing.

b. Central-mixed concrete

i. Arrange mixers in centralized mixing plant so that the mixing action in the mixers can be observed by the Engineer and plant operator from a location convenient to the mixing plant operator's station.

ii. Do not load mixers in excess of their rated capacity. Mix the concrete ingredients in a batch mixer for not less than the period of time herein specified for various mixer capacities after all of the ingredients except the full amount of water are in the mixer. Reduce the mixing time if thorough mixing as herein defined can be obtained in less time, as determined by the Engineer.

Capacity of Mixer	Mixing Time
2 cu. yd. or less	1-1/2 minutes
3 cu. yd	2 minutes
4 cu. yd.	2-1/2 minutes
Larger than 4 cu. yd.	*

*To be determined by mixer performance tests by Engineer. Equip each mixer with a mechanically operated batch counter, and a timing and signaling device which will indicate completion of the required mixing period.

iii. Truck-mixed concrete: Use equipment and procedures that conform to the requirements of ASTM C94.

iv. Temperature control:

a. Use preparation methods capable of producing concrete with a temperature not more than 90 degrees F. and not less than 45 degrees F. at the time of placement.

b. Do not heat concrete ingredients to a temperature higher than that necessary to keep the temperature of the mixed concrete as placed, within the specified temperatures.

c. Do not allow cement to contact water or aggregate in excess of 120 degrees F.

c. Admixtures

i. Air entraining admixture: Use for concrete exposed to weathering or in contact with rock or moist soil.

ii. Chemical admixtures:

a. Use water reducing admixtures in concrete areas below grade in contact with

rock, earth, or fill.

b. Employ admixtures without interfering with the specified air content dosage of air-entrained concrete.

c. Except as specified, use water reducing, set retarding or set accelerating admixtures only with the Engineer's approval.

d. If the introduction of certain admixtures to improve concrete strength is permitted by the Engineer, do not reduce the cement content below the minimum amounts specified.

iii. Use calcium chloride only as specifically authorized in writing by the Engineer. Do not use calcium chloride in prestressed concrete, underground structures, reinforced concrete, or in concrete used to encase or in contact with structural steel or cast iron.

d. Consistency

Slump shall not exceed 2-inches above design mix slump as approved by the Engineer, and shall be kept at a practical minimum for the point of placement.

e. Construction Joints

Joints not shown on the drawings shall be made and located so as to not impair the strength of the structure and shall be subject to approval of the Engineer. In general, construction joints must be placed such that no vertical pour may exceed 10 to 15 feet and no horizontal pour may exceed 20 to 30 feet. Horizontal joints in walls and columns shall be at the underside of floors, slabs, beams, or girders and at the top of footing of grade slabs. Joints shall be perpendicular to the main reinforcement.

i. Reinforcement in Construction Joints.

All reinforcing steel and welded wire fabric shall be continued across joints. Keys and inclined dowels shall be provided as indicated. Longitudinal keys at least 11/2-inches deep shall be provided in all joints in walls and between walls and slabs or footings.

ii. Preparation of Surface

The surface of the concrete at all joints shall be thoroughly cleaned and all laitance removed.

iii. Bonding: When a bonded construction joint is required, bond shall be obtained by one of the following methods.

a. The use of a bonding compound for concrete, conforming to Mil.

Spec. MIL-B-19235.

b. The use of suitable chemical retardant which delays but does not prevent setting of the surface mortar. Retarded mortar shall be removed within 24 hours after placing to produce a clean exposed aggregate bonding surface.

c. By roughening the surface of the concrete in proper manner which will expose the aggregate uniformly and completely expose fresh concrete at the surface.

f. Expansion Joints, Cleavage Joints, Waterstops and Embedded Items.

i. Expansion Joints and Cleavage Joints

a. Expansion joints shall be provided in any structure having a dimension of 120 feet in any principal direction. Desirable maximum spacing is 50 to 60 feet. Reinforcement shall stop 2 inches from the face of an expansion joint.

b. Expansion joints and cleavage joints shall not be less than 1/2-inch wide except as indicated otherwise. Expansion joints not exposed to weather shall be filled completely with preformed joint material conforming to ASTM D 1751. Expansion joints exposed to weather and cleavage joints between vertical masonry surfaces and floor slabs laid on earth shall be filled to a depth of one-inch from the surface or face of the concrete width deep space above the preformed material conforming to ASTM D 1751. The one-inch deep space above the preformed material shall be cleaned after the concrete has been cured, and when dry, filled flush with joint sealing material. Reinforcement or other embedded metal items bonded to the concrete, except dowels in floors bonded on only one side of joint, shall not be permitted to extend continuously through any expansion joints.

ii. Waterstops

a. All horizontal and vertical construction and expansion joints providing for fluid containment in a wet space as well as joints located in exterior walls below grade shall have placed in the joint a waterstop to develop effective watertightness. Wet space shall include tanks, channels, chambers, etc. used to store, convey or contain fluids or solids containing fluids.

b. The material, design, and location of waterstops in construction joints and expansion joints shall be as indicated or as specified herein. Each piece of premolded waterstop shall be maximum practicable length in order the number of end joints will be held to a minimum. Joints at intersections and at ends of pieces shall be made in the manner most appropriate to the material being used. Joints shall develop effective watertightness fully

equal to that of the continuous waterstop material and shall permanently develop not less than 50 percent of the mechanical strength of the parent section and shall permanently retain its flexibility.

iii. Embedded Items

All sleeves, inserts, anchors, and embedded items required for adjoining work or for its support shall be placed prior to concreting. All subcontractors, whose work is related to the concrete or must be supported by it, shall be given ample notice and opportunity to introduce or furnish embedded items before the concrete is placed. All ferrous metal sleeves, inserts, anchors, and other embedded ferrous items exposed to the weather or where rust would impair the appearance or finish of the structure shall be galvanized.

iv. Placing Embedded Items

Expansion joint material, waterstops, and embedded items shall be positioned accurately and supported against displacement. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable material to prevent the entry of concrete into the voids. Aluminum shall not be embedded in concrete except where aluminum is protected from direct contact with the concrete.

v. Reinforcing Bars

Bars may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items, but not so as to impair design strengths of the members. If bars are moved more than one bar diameter, the resulting arrangement of bars shall be subject to the approval of the Engineer.

C. Conveying

1. General Requirements:

   a. Convey concrete from the point of delivery with a continuous flow of concrete to the point of placement without segregation.

   b. Provide an arrangement at the discharge end of a conveyor to prevent segregation.

2. Chutes and Troughs:

   a. Use only ferrous metal or approved plastic or rubber lined chutes and open troughs. Where steep slopes are required, discharge the concrete into a hopper. Keep chutes or open troughs clean of hardened concrete by thoroughly flushing with water after each use.

   b. Discharge the water used for cleaning outside the lines of the structure.

3. Adjustable Length Pipes (Elephant Trunks):Use flexible pipes only of ferrous metal, rubber or plastic, six inches minimum diameter and use in a manner that will not cause segregation of the concrete.

    a. Locate chute or flexible pipes so that concrete is delivered in a continuous flow to points not more than five feet horizontally and five feet vertically from its final location.

    b. Thoroughly clean flexible pipes or elephant trucks after each use.

4. Buggies: Construct runways on which buggies will operate such that they will not come in contact with or be supported by the reinforcing steel of the structure.

5. Pumping Equipment:

    a. Use pumping equipment, designed to handle the types, classes and volumes of concrete to be conveyed without segregation.

    b. Operate the pump equipment so that a continuous stream of concrete without air pockets is conveyed. Position the discharge end of the line as near the final position of the concrete as possible.

D. Preparation For Placement

1. Do not place concrete until all formwork, steel reinforcement, installation of embedded parts, preparations for finishing unformed areas, scaffolding, lighting, power and methods and procedures for placing concrete have been accepted and an instrument check of vertical alignment and bracing sufficient to insure plumbness during pour has been approved by the Engineer. All surfaces of forms and embedded materials shall be cleaned of dried mortar or grout from previous pours. Poorly consolidated concrete at construction joints and all loose material shall be removed. Surfaces of concrete and embedded materials shall be cleaned of laitance, or oil and other bond destroying agents.

2. Surfaces against which concrete is to be placed shall be clean and free of running water, mud, loose material, oil debris, frost and ice. Rock surfaces shall be free of semi-detached and unsound fragments. Absorptive foundation surfaces shall be moistened thoroughly or otherwise treated so that moisture will not be drawn from freshly placed concrete.

3. Coat faces of removable concrete forms with form oil acceptable to the Engineer.

E. Placement

1. General Requirements

    a. Place concrete continuously and as soon as possible after mixing. Do not use vibrators for shifting the mass of fresh concrete.

b. Place concrete in layers of such thickness that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. Cover each layer of concrete with fresh concrete within 45 minutes.

c. Do not place concrete which has attained its initial set or concrete which has contained its mix water for more than 90 minutes.

d. Notify the Engineer at least 24 hours in advance of the start of concrete placing.

e. Placing will not be permitted when, in the opinion of the Engineer, the sun, heat, wind or limitations of facilities furnished prevent proper finishing and curing.

f. Control concrete temperature at time of placement:

i. To be not less than 45 degrees F.

ii. To be not more than 90 degrees F.

g. Unless approved by the Engineer, do not start concreting when descending natural air temperature falls lower than 40 degrees F.

h. Start placement of structural concrete on/or next to a construction joint with a 3-inch thick layer of oversanded mix with 3/4-inch maximum aggregate, an extra sack of cement per cubic yard, and a five inch slump.

i. Deposit concrete as nearly as practicable directly in its final position so that the lateral movement will not result in segregation of the coarse aggregate, mortar, or water from the concrete mass. Do not use methods and equipment in depositing concrete in forms which result in clusters or groups of coarse aggregate being separated from the concrete mass. When concrete is placed through a dropchute, use one or more vibrators where concrete is falling to prevent stacking and separation.

j. Place formed concrete, in continuous, approximate horizontal layers, the depth of which generally shall not exceed 24-inches. Lesser depths may be required where necessary to ensure that each new layer can be made monolithic with the previous layer by penetration of the vibrators.

2. Compaction

a. Consolidate all concrete by vibration to the maximum practicable density, so that it is free from pockets of coarse aggregate and entrapped air, and filled tightly against the subgrade of previously placed concrete, all formed surfaces and embedded materials. In consolidating each layer of concrete operate the vibrator at regular and frequent intervals, and in a near vertical position. Allow the vibrating head to penetrate and revibrate concrete in the upper zone of the underlying layers.

b. Revibrate the top layer of each placement systematically at the latest time the

concrete can be made plastic by means of vibration. Do not place layers of concrete until the layers previously placed have been vibrated thoroughly as specified.

c. Consolidate concrete by electric or pneumatic drive vibrators of sufficient power and capacity to consolidate the concrete effectively and quickly. Operate concrete vibrators at speeds of at least 7,000 rpm when immersed in the concrete. Have standby vibrators in good condition readily available if needed during concrete placement. Use equipment capable of obtaining results and operating reliably and effectively with a concrete mix that is not excessively oversanded or high in slump and may occasionally be of lower slump than intended.

F. Curing And Protecting

1. General Requirements

a. Protect freshly placed concrete from excessive hot or cold temperatures. Maintain concrete surfaces without drying for the period of time necessary for the hydration of the cement and the proper hardening of the concrete.

b. Cure newly placed concrete for a cumulative period of seven days at an air temperature in excess of 55 degrees F.

c. During the curing period keep steel and wood forms set. If forms are removed during curing use one of the following methods of curing immediately and continue for the remainder of the curing period.

2. Normal Curing And Protection - Use any one of the methods specified below:

a. Use ponding on horizontal surfaces providing the surface is submerged at all times for the required curing period.

b. Apply continuous sprinkling with nozzle or nozzles which, during the first 24 hours, atomizes the flow of water providing a mist and not a spray. Do not apply the moisture under pressure directly upon the concrete and avoid flowing or washing on the surfaces while susceptible to erosion.

c. Cover the entire surface of the concrete with double thickness burlap sheet, laid directly on the concrete and kept wet at all times. Maintain in good condition.

d. Sprinkle, as specified above, for at least 18 hours and then immediately cover the concrete surface with waterproof curing sheets, free from holes or tears. Hold in position in such manner that the entire surface of the concrete being cured is fully covered at all times.

e. Do not damage burlap or waterproof sheet or concrete surfaces.

3. Membrane-Forming Curing Compound

a. Use a curing compound when authorized for circumstances where the application of moisture is impracticable and where such compounds will not jeopardize the appearance of the concrete. Except as otherwise specified, use Type 1 compound, uniformly applied over the surface at the thickness recommended by the manufacturer. Thoroughly mix compound and apply within one hour after mixing.

b. Where the surfaces are subject to sunlight, apply Type 2 White compounds.

c. Do not apply wax-resin type curing compounds to a surface where bond is required for additional concrete or where a bonded surface coating such as paint, tile, dampproofing, waterproofing, or roofing is to be applied.

d. Warm the curing compound if required for satisfactory application in accordance with the manufacturer's recommendations. If the film of the compound is damaged before the expiration of the curing period, repair immediately with additional compound.

e. Give surfaces the required surface finish prior to the application of the curing compound. Do not use curing compound on construction joints.

f. Apply curing compound in two coats, apply the first coat immediately after stripping of forms and acceptance of the concrete finish.

g. If the surface is dry, thoroughly wet the concrete with water and apply the curing compound just as the surface film of water disappears. Apply the second coat after the first coat has set.

h. Protect the coating against damage for a period of at least 10 days after application. Apply an additional coating to coatings which are damaged.

G. Cold Weather Protection

1. Take the protective measures as are necessary to protect the concrete when the official weather forecast for the vicinity may be expected to reach 32 degrees F. Use one of the following methods:

a. Heating:

i. Enclose the forms or structures and heat to maintain the concrete and air within the enclosure at a temperature of not less than 38 degrees F. for a period of seven days after placement.

ii. Maintain the relative humidity at not less than 40 percent during the curing period where heat is applied to enclosures. Arrange the stoves, salamanders or heaters so as to provide a uniform distribution of heat. Vent combustion gasses to the outside air.

iii. After the seven days curing period, reduce the temperature within

the enclosure gradually at a rate not to exceed 20 degrees F. per day until the outside temperature has been reached.

iv. Provide adequate fire protection and watchmen when heating units are in continuous operation.

b. Insulation of forms:

i. Completely insulate the forms with blanket insulation of sufficient thickness to maintain the concrete of a temperature of not less than 55 degrees F. for a period of seven days.

ii. Have the type and thickness of the insulation approved prior to use.

iii. Protect the top of placed concrete by tarpaulins or other approved waterproofing material over the insulation.

c. Place concrete during the cold weather at a temperature of not less than 55 degrees or more than 90 degrees F.

d. Heat and mix materials for concrete as specified.

H. Hot Weather Requirements

1. Hot weather conditions are deemed to exist when the temperature in the forms is 75 degrees F. or above.

2. After placement, protect the concrete from direct sunlight and keep the forms moist by means of cool water sprinkling, or the application of wet burlap or cotton mats.

I. Defective Concrete

Concrete will be considered defective if it is structurally unsound, not watertight, improperly finished, or not within the tolerances specified herein.

1. Concrete will be considered defective if the concrete cylinder tests fail to meet the specified strength requirements at any location of the work. In such cases, take drilled cores at locations specified by the Engineer. Core specimens will be tested by the Engineer in accordance with the requirements of ACI 301. If cored specimens do not indicate compliance with the compressive strength requirements, replace the defective portion of the structure.

2. Cold joints are not permissible. Upon form stripping and inspection by the Engineer, indications of cold joints may be cause for rejection of pour.

3. Windsor probe tests conducted in conformance with ASTM C-803-75T may be conducted by the Engineer in lieu of taking and testing core specimens.

4. The Engineer, at his discretion, will require replacement of the defective portion of the

structure in accordance with the provision of ACI 201, Chapter 7. All strengthening or correction of defective concrete will be at no additional cost to the Owner.

J. Damaged Work

1. Before final acceptance of the work, damage to surfaces, corners of concrete and concrete finish, whether such damage shall have resulted from the action of the elements or damage from any cause whatsoever, shall be neatly repaired, as approved by the Engineer at no additional cost to the Owner.

2. At damaged place where surface repairs are permitted, the concrete shall be chipped out and a concrete patch installed. The patch shall have a minimum thickness of two inches, shall be dense and watertight to meet specifications requirements, and shall have a smooth exposed surface matching the neat line of adjacent concrete.

K. Tolerance For Concrete Construction

1. Permissible surface irregularities are defined as "finishes", and are to be distinguished from tolerances as described herein.

2. Allowable tolerances are:

a. Structures

Departure from established alignment ..... 1 inch

Departure from established grade ..... 1 inch

Variation from the plumb in the lines and surfaces of

columns, piers, and walls exposed, in 10 ft ..... ½ inch

Backfilled, in 10 ft ..... 1 inch

Variation in the level or from grades specified in slabs

and beams exposed, in 10 ft ..... ½ inch

Backfilled, in 10 ft ..... 1 inch

Variation in cross-sectional dimensions of columns, piers, slabs, walls and beams

Minus ..... 1/4 inch

Plus ..... 1/2 inch

Variation in sizes and locations of slab and wall openings.... 1/2 inch

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 insure 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 insure 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, insure 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 thumb-print 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

   B21 1-90 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.

5200.02 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 300 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 304 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 color of 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-20-70 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-1-74 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 ICBO 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 the State where trusses are fabricated.

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 A 446, 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 304, 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 07110

ELASTOMERIC MEMBRANE WATERPROOFING

Delete all references to membrane waterproofing in Specification Section 07100 of the Anne Arundel County Standard Specifications and replace with the following:

07110.01 GENERAL

A. Description of Work

The work to be included under this section includes everything necessary for and incidental to execution and completion of elastomeric membrane waterproofing work for pump station structure(s) and valve vault(s).

B. Quality Assurance

1. The manufacturer of the material shall have successful experience in supplying the principal materials for the required waterproofing work, or have a successful record of supplying materials for waterproofing.

2. The installer shall be a firm specializing in waterproofing work and either experienced in the use of the types of work required, or licensed by the manufacturer of the materials being installed. Include the following items for undivided responsibility:

   a. Waterproofing accessories

   b. Flashings in connection with waterproofing

   c. Expansion joints in the membrane

   d. Fluid-applied membrane materials

   e. Protection course over membrane, where required.

3. Project Working Conditions

   a. Proceed with the installation of waterproofing only after the substrate construction has been completed, and after penetrating components have been installed, so that the membrane will not be penetrated or damaged by subsequent work.

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

c. Weather Conditions: Proceed with work only when weather conditions comply with manufacturer's recommendations, and will permit the materials to be applied and cured in accordance with those recommendations.

4. Submittals

a. Manufacturer's Data, Elastomeric Membrane Waterproofing: Submit specifications by the manufacturer of materials. Include manufacturer's certified test data showing compliance with the requirements of this Section. Products of W.R. Grace Construction Products Division - "Bituthene system" or equal shall be used.

b. Samples: Submit one pint can of primer, two (2) sections of membrane 36 inches x 18 inches, one section of protection board 12 inches x 12 inches, and one pint can of liquid membrane flashing.

5. Precautions

a. Storage: All materials should be protected from rain and physical damage. Store all materials away from sparks or flames. Store membrane where it will not exceed 90 degrees F., for extended periods. Outdoors, place cartons on raised pallets and cover completely. Protection board shall be protected from the wind.

b. Safety: Membrane, primer, mastic adhesive and protection board are flammable products. Follow instructions on product labels. Protection board is a combustible, cellular product. Do not expose to flames, sparks or temperatures above 150 degrees F.

07110.02 MATERIALS

A. Materials

1. Primer: Bituthene Primer WP-3000 (500 to 600 square feet per gallon) for 40 degrees F or greater; use Bituthene Primer B2 LVC (low VOC) if temperatures are 25 degrees F or greater.

2. Membrane: Shall be a self-adhering membrane of rubberized asphalt integrally bonded to polyethylene sheeting, 0.0625-inch minimum thickness, either Bituthene 3000, or Bituthene Low Temperature for work on vertical surfaces at temperatures between 25 and 60 degrees F.

3. Liquid Membrane: Bituthene Liquid Membrane shall be used for flashing of the base membrane at minimum 0.09 inch thickness. In corner flashing applications, the Liquid Membrane should extend 6-inches in either direction from the corner.

4. Elastomeric Mastic: Bituthene Mastic shall be used for terminations of base membrane over other sheets.

5. Protection Board: 1-inch (25mm) expanded polystyrene protection board.

B. Total System

As the basic components are designed to work as a total system, no substitute components of the system will be permitted. If the Contractor wishes to substitute a total system, other than that which is specified, the Contractor shall request permission in accordance with the Anne Arundel County Standard Specifications, GP-5.04.2 Submittals.

07110.03 EXECUTION

A. Surface Preparation

1. Surfaces must be free of voids, spalled areas, loose aggregate and sharp protrusions with no coarse aggregate visible. Broom finishes must not be used. Allow concrete to be cured (minimum of seven (7) days) and dry before application of Bituthene waterproofing systems. Remove forms as soon as possible from below horizontal slabs to prevent entrapment of excess moisture. Do not apply Bituthene while forms are in place without proper drying and venting. Allow concrete to thoroughly dry following rain.

2. Repair defects such as spalled or poorly consolidated areas before applying Bituthene primer. Remove sharp protrusions and form match lines. Strike masonry joints off flush. A masonry wall should have a well-adhered parge coat applied to achieve a smooth monolithic surface. Remove grease, oil or other contaminants. Clean surface (broom, vacuum cleaner or compressed air) to remove dust, loose stones and debris.

B. Priming

Apply primer, Primer WP-3000, to all concrete or masonry by spray or by roller (500 to 600 square feet per gallon). See temperature requirements in Paragraph 3.03, below. Allow primer to dry one hour or until tack free. Prime only the area which will be covered with membrane in a working day. Areas not covered with membrane in 24 hours must be reprimed. Dry primed surfaces should be covered immediately where contaminants from the air are accumulating on the surface as directed by the Engineer. Metal or other dense surfaces do not require priming but must be clean, dry, free of loose paint, rust or other contaminants. Follow manufacturer's recommendations closely for surface preparation.

C. Temperature

Apply waterproofing membrane, Bituthene 3000, only in fair weather when air and surface temperatures are above 40 degrees F. Between 25 and 40 degrees F., use waterproofing membrane, Bituthene 3100. Primer, Bituthene P-3100, must be used on vertical surfaces at temperatures between 25 and 40 degrees F.

D. Sealing Edges

1. For vertical applications, Bituthene membranes should be applied over the edge of the slab or over the top of the foundation or parapet wall. If the membranes are terminated on the vertical surface, a reglet or counter flashing shall be used or the membrane may be

terminated on the concrete by pressing firmly to the wall. Press edges with a metal or hardwood tool such as a hammer or knife handle. Failure to use heavy pressure at terminations can result in a poor seal. Nailing of the membrane is not required, but if nails are used, large head nails at 12-inch intervals must be covered with an 8-inch wide strip of Bituthene membrane. At the base of the foundation wall, Bituthene membrane must be drawn down the base of the wall and over the edge of the footing, rolled or pressed firmly.

2. Apply a troweled bead of Bituthene EM-3000 to all vertical and horizontal terminations.

E. Sealing Seams

All edge and end seams must be overlapped at least 2-1/2 inches. Apply succeeding sheet with a minimum 2-1/2 inch overlap and stagger end laps. Roll the entire membrane firmly and completely as soon as possible to minimize bubbles caused by "outgassing" of air or water vapor from the concrete. For horizontal applications, use a standard water-filled garden roller less than 30 inches wide. Cover the face of the roller with a resilient material such as 1/2-inch of a plastic foam or two wraps of indoor/outdoor carpet to allow the membrane to fully contact the substrate. For vertical applications, use heavy hand pressure. Patch misaligned or inadequately lapped seams with Bituthene membrane. All "fishmouths" must be slit and the flaps overlapped, repaired with a patch, pressed or rolled to make the seal, and the edges sealed with a mastic sealant. Laps within 12 inches at all corner details shall be sealed with a troweling of EM-3000.

F. Corner Details

Double cover all inside and outside corners with an initial strip a minimum of 11 inches wide centered on the axis of the corner. This strip shall be completely covered by the regular application of Bituthene membrane. Outside corners shall be free of sharp edges. Inspect surfaces adjacent to all corners and repair if necessary to provide a smooth dense surface. Inside corners should receive a fillet formed with epoxy mortar or latex modified cement mortar (such as Darawled-C mixed in with cement mortar) and a double coverage of membrane. Do not use fiber or wood cants.

G. Drains and Protrusions

Apply a double layer of Bituthene membrane around posts or projections to a length of at least 6 inches in all directions. At drains, apply a bead of Bituthene EM-3000 over a double layer of membrane under clamping rings. Apply Bituthene EM-3 000 at all terminations. Liquid membrane, Bituthene LM-3 000 may be used as an alternative method.

H. Protection of Membrane

1. The Bituthene membrane system shall be protected to avoid damage from other trades, construction materials or backfill. The Bituthene protection system shall be used on foundation walls and horizontal walls with light traffic, and consists of protection board, Bituthene PB-3000, adhered with protection board adhesive, Bituthene PBA-3000,

applied at a rate of 250 to 300 square feet per gallon. Protection board shall be one inch lightweight cellular plastic which provides excellent cushioning to resist damage. Protect horizontal decks subject to heavy construction traffic with 1-inch asphalt headboard. Cover any Bituthene left exposed on parapets or the top of a foundation wall with weather-resistant neoprene flashing.

2. The entire Bituthene protection system shall be installed the same day the membrane is applied.

I. Exposed Edges

Seal all daily terminations with a troweled bead of Bituthene EM-3000.

J. Compatibility

The Bituthene membrane protection system is incompatible with fresh tars, pitches and certain liquid waterproofing products and sealants containing tar or polysulfide polymers. Always avoid direct contact of the adhesive layer of Bituthene membrane of Bituthene EM-3000 or substitutes with such products.

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, 3-tab 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 & Son, Inc.

Fiberglass Asphalt/25; The Celotex Corp.

Glassguard 25; Certainteed Corp.

Brigade; Flintkote/Genstar Building Materials Co.

Fireglass III; Manvill Building Materials Corp.

Classic Plus; Owens-Corning Fiberglass Corp.

Or Equal

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

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 Vent-A-System by Alcoa Aluminum Vent-A-Ridge, or equal. 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 one layer felt horizontally over 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, vent flashing and edge protection as shown and in compliance with details and recommendations of the NRCA Steep Roofing Manual.

5. Extra Stock:

   Provide 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. 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.

6. 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".

C. Submittals

1. Shop drawings shall be submitted for Engineer's acceptance on all flashing details. No work shall proceed without accepted drawings.

2. Manufacturer's Data: Submit manufacturer's specifications, installation instructions and general recommendations for flashing and trim applications.

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

4. 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, arrises, 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 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

Published: 4/11 Revised:

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 304 or 316.

B. Finish

Finish shall be Dark Duronodic Bronze meeting finish designation AA-M10622 A41 of the NAAMM Metal Finishes Manual.

C. Anchors

1. Stainless steel, Type 304 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. 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 premachined 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 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 thegreatest 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 latchsets (BHMA Series 4000, Grade 1):

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

   b. Locks and latchsets shall conform to ANSI 156.2, Series 4000, Grade 1 and be UL listed. Locks and latchsets with knobs shall meet ANSI 156.2 door preparation. Locks and latchsets 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 22-inch x 22-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.

4. 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.

C. 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 not 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. Carboline

   b. PPG Coatings

   c. Tnemec Company, Inc.

   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. Under this standard industrial maintenance coating volatile organic compounds are limited to 340 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 & Servere Exposure Services: Abrasive Blast Cleaning per SSPC SP13/NACE 6, ICRI CSP 3-7. 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

F. Exterior Painting Schedule

1. Metals (Except Aluminum and Stainless Steel)

a. Semi-Gloss finish/Epoxy Polyamid oamine- Polyfunctional 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 750 UVX (Tn.) @ 3.0 mil minimum dry film thickness.

G. Interior Painting Schedule

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

a. Semi-Gloss Finish/Alkyd Enamel

b. First Coat: 10-99 Tnemec Primer (Tn.) @ 3.0 mil minimum dry film thickness or Tnemec Series 27 W. B.Typoxy for galvanized or non-ferrous surfaces @ 2.5 mil minimum dry film thickness.

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

H. 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. (Tnemec Series 435 Perma-Shield (H2S & other corrosive exposures) Series 436 (H2S, Corrosive chemicals and Impact and Abrasion Exposures) or equal).

b. Surface preparation - Provide brush-off abrasive blast cleaning to remove loose surface concrete and contaminants and provide "tooth" for good coating adhesion. 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 – (Corrosive Exposure Only) 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: Red Bitumastic No. 300-M (Kp.) @ 8 mil minimum dry film thickness per coat.

5. Dry Well and Valve Vault Sewage Piping and Valves

a. Semi-Gloss Finish/Epoxy Polyamine:

i. First Coat: Tnemec Series N69 Epoxoline II Primer (Tn.) @ 3.0 mil minimum dry film thickness.

ii. Second and Third Coats: Series N69 Hi-Build Epoxoline II (Tn.) @ 4.0 mil minimum dry film thickness per coat.

I. 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.

J. 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.

K. 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.

L. 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
3/4 to 1 1/4 inches	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 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 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.

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.

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

B. Dry Well Hatch and Frame

1. Hatch cover shall be 11-gauge aluminum mill finish with 3-inch beaded flange. Insulation shall be glass fiber 1-inch thickness, fully covered and protected by an interior metal liner of 18-gauge aluminum.

2. Hatch frame curb shall be 12 inches in height with a 3Y2-inch flange with holes provided for securing to the roof deck. Curb shall be equipped with an integral metal cap flashing of the same gauge and material as the curb, full welded at the corners for weather

tightness. Insulation on the exterior of the curb shall be rigid fiberboard 1-inch thickness.

3. Hatch shall be completely assembled with heavy pintle hinges, compression spring operators enclosed in telescopic tubes, positive snap latch with turn handles, padlock hasp outside, and neoprene draft seal. Compression spring operators enclosed in 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. Cover shall be equipped with an automatic hold open arm complete with vinyl grip handle to permit easy, one hand release. All hardware shall be cadmium plated.

4. The hatch shall be Bilco roof scuttle, type "SS".

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 11/2-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 approved equal. Ladders shall have 2 1/2" x 3/8" stringers with 15/16" square non slip, serrated rungs spaced 12" on center. Ladders shall be aluminum alloy 6061-T6.

2. All necessary anchor bolts will be stainless steel and furnished with ladder. All material will have a standard mill finish. The portion of the ladder in contact with concrete shall have a heavy shop coat of bituminous paint.

B. Safety extension poles shall be aluminum alloy 6061-T6 and castings shall be aluminum, alloy 356-T6. All necessary hardware shall be stainless steel and furnished with safety extension for mounting to ladder. All material will have a standard mill finish.

C. Safety extension poles shall be spring loaded. Extension poles shall lock in the extended position.

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 Owner’s Representative.

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 or lead 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 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, TM-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.

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, 5 feet to top of bracket.

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.

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 job site as complete units, ready for installation or erection, with all anchors, hangers, fasteners and miscellaneous metal items required for installation.

D. 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 defect 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.

6. Grab bar per detail.

10600.03 EXECUTION

A. Installation

1. Ladder Climbing Safety Device (when required by safety regulations)

2. 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.

3. First aid kit shall be wall mounted, square and plumb a distance of 40 inches from bottom of kit to floor.

B. Testing

1. Ladder Climbing Safety Device (when required by safety regulations)

2. 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.

3. Replacement of safety devices not fulfilling test requirements shall be at no cost to the Owner.

4. The Contractor shall furnish the Engineer certification that all safety equipment has been tested as described hereinbefore.

END OF SECTION

SECTION 11230

SOIL ODOR FILTER BLOWER

11230.01 GENERAL

A. General

1. Description

   Soil odor filter blower installation shall include, but not be limited to furnishing and installing the blower, flexible connections, discharge control valve and vibration insulation rails of the size and type shown on the Plans and in accordance with the Contract Documents.

2. Related Work Included Elsewhere

   a. Cast-in-Place Concrete Structures; Section 03300.

   b. Insulated Fiberglass Enclosures; Section 10100.

   c. General Mechanical Requirements; Section 15010.

   d. Supports, Sleeves and Seals; Section 15140.

   e. Electrical; Sections 16100, 16200 and 16700.

3. Quality Assurance

   a. Materials

      The Engineer will inspect all materials before and after installation to ensure compliance with the Contract Documents. When specific material tests 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

      The Contractor shall furnish the services of the manufacturer's field service representative to inspect the final installation and supervise initial operation of the unit at each location. The field representative shall confirm that the installation is correct and shall test the blowers to verify that the varying design conditions have been met. Upon completion of the installation inspection and testing sequence the Contractor shall provide a final report/letter of certification that the system has been installed properly and functions as designed.

4. Submittals

    a. Shop Drawings

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

        ii. Odor Filter Blower: product information, technical specification, manufacturer's certification, installation recommendations, certified performance curves, and wiring diagrams.

        iii. Flexible Connections: product information, technical specifications, and installation recommendations.

        iv. Discharge Control Valve: product information, technical specifications, and installation recommendations.

        v. Vibration Isolators: product information, technical specifications, and installation recommendations.

        vi. Bypass Drain Curb Valve and Riser: product information, installation, recommendations, and technical information.

        vii. Operation and Maintenance Information

    b. Submittals for the odor filter blowers shall include the information outlining the operation and maintenance requirements. This includes instructions for lubrication, motor and drive replacement, and a spare parts list.

5. Supplemental References

    a. Load Ratings and Fatigue Life for Ball Bearings AFBMA 9.

    b. Standards Handbook AMCA 99.

    c. Laboratory Methods of Testing Fans for Rating Purposes AMCA 210.

    d. Test Code for Sound Rating Air Moving Devices AMCA 300.

    e. Method of Calculating Fan Sound Ratings from Laboratory Test Date AMCA 301.

    f. Motor and Generators NEMA MG1.

    g. National Electric Code NFPA 70.

11230.02 MATERIALS

A. Materials Furnished By The County

The County will not furnish any materials for the soil odor filter blower system.

B. Contractor's Options

None this section.

C. Detailed Material Requirements

1. Soil Odor Filter Blower

   a. General: The blowers shall be direct drive centrifugal type with a non-corrosive, non-metal support base carrying the drive motor which directly supports the fan. The blowers shall be Rotron CP808, which includes the “Chem-Tough” process, as manufactured by EG&G ROTRON, Saugerties, New York, or equal. Size and model shall be as listed in the fan/blower schedules in the Contract Drawings.

   b. Performance: The basis of performance shall be sea level conditions at ambient temperature. Ratings shall conform to AMCA 210. Fan operating parameters shall be as follows:

   c. Bearings: Provide AFBMA 9, L-10 life at 50,000 hours minimum, sealed for life permanently, self-aligning, grease-lubricated ball bearings.

   d. Sound Ratings: The fan shall be statically and dynamically balanced to eliminate vibration or noise transmission to surrounding areas. Ratings shall conform to AMCA 301 and test shall be in accordance with AMCA 300.

   e. Motor: The motor shall be TEFC and shall supply the required torque at any point on the fan-operating curve without overloading. The motor shall have a 1.15 service factor, Class F insulation and conform with NEMA MG1. Motor shall be rated for Class I, Division I, Group D Hazardous location.

   f. Vibration Isolating Rails

      i. The fan vibration isolating rails shall be cadmium plated aluminum with cadmium plated steel springs and hardware. Alternative materials and coatings are acceptable provided the statement of corrosion inhibiting quality is approved by the Engineer. The rails shall be approximately 3- 3/4" high and shall be of the length required to match the fan base plate. The rails shall be manufactured by Vibration Eliminator Co., Inc., Long Island, New York, or approved equal.

g. Discharge Control Valve

   i. Construction: Four-inch (4") diameter fully lugged butterfly valve with gear operator.

   ii. Service: 150 psi and 250ºF rated, throttling application.

   iii. Materials: EPDM moisture seal, stainless steel stem, thirty percent (30%) glass reinforced polypropylene bearings; single-piece PVC body, EPDM O-rings, PVC seal retainers; PVC disc; EPDM liner; 316 stainless steel retaining ring; PVC end plug.

h. Gear Operator: Weatherproof operator of worm gear design, integral position indicator, adjustable travel stops.

   i. Manufacturer: Hayward Industrial Products, Inc., or approved equal.

i. Bypass Drain Curb Valve

   i. Curb valves used for bypass drain shall be iron pipe (I.P.) threaded ends. The valve shall have a tee handle with drain. The curb valve for the bypass drain shall be Model H-10284 manufactured by Mueller Company, Decatur, Illinois, or equal.

   ii. Arch pattern base, improved extension type curb box shall be cast iron, complete with lid and pentagon brass plug, and be compatible in size and design with the specific curb valve. The curb box shall be Model H-10336 manufactured by Mueller Company, Decatur, Illinois, or equal.

j. Shut-off rod shall be of steel, 6 feet long, with one flattened and one pointed end of crossbar, and compatible in size and design with the specific curb box. The shut-off rod shall be Model H-10321 manufactured by Mueller Company, Decatur, Illinois, or equal.

k. Pentagon key shall be provided for operating the screws of curb box. The key shall be of steel and plated with a corrosion-resistant coating with one pointed and one hammerhead end. The Pentagon key shall be Model H10325 manufactured by Mueller Company, Decatur, Illinois, or equal.

l. Compatible foot piece shall be provided. The foot piece shall be Model H103 95 manufactured by Mueller Company, Decatur, Illinois, or equal.

11230.03 EXECUTION

A. Installation

1. General: Install the equipment in accordance with the manufacturer's instruction.

2. Thoroughly review all shop drawing submittals, equipment specifications and dimension of the materials to be installed with clearance and dimension of existing equipment.

3. Coordinate rough in of all work and installation of sleeves, anchors and supports for piping and equipment installed under related sections.

4. Coordinate electrical work required under Section 11230 with that required under Sections 16100, 16200 and 16700.

B. Blowers: Install the blowers as indicated and as specified, with vibration isolating mountings, flexible connectors and flexible electrical leads. Adjust the vibration isolators to prevent tension in flexible connectors when fan is operating. Strictly follow the flexible connector and flexible lead manufacturer's installation instructions.

END OF SECTION

SECTION 11231

SOIL ODOR FILTER

11231.01 GENERAL

A. Description

1. The Work of This Section Includes, but is not limited to:

   One complete soil odor filter system shown on the Drawings and as specified herein.

2. Related Work Specified Elsewhere:

   a. Structure Excavation; Section 02200.

   b. Trench Excavation, Backfill and Compaction; Section 02250.

   c. Insulated Fiberglass Enclosures; Section 10100.

   d. Soil Odor Filter Blower; Section 11230.

3. The soil odor control filter shall be designed according to the following criteria.

   a. Blower Fan: Continuous duty EG&G Rotron regenerative blower with fiberglass enclosure.

   b. Media Volume: 1 cubic foot of media per CFM of exhaust air.

   c. Surface Area: 0.5 square foot per CFM of exhaust air.

   d. Bed Cross Section: 2 feet minimum depth of media over 0.6 feet depth of gravel bed.

   e. Air Flow: 2 to 4 air changes per hour based on volume of wet well above pump down (shut off) level.

   f. Air Back Pressure: Designed to 3.5 inches of water pressure.

   g. The interior dimensions of the soil odor filter shall be Y feet wide by X feet long.

   h. The perforated portion of piping shall have a length of Y feet.

   i. The compost media depth shall be 3.0 feet.

B. Submittals

1. Shop Drawings:

    a. Submit detailed certified dimensional shop drawings for materials and equipment, including wiring and control diagrams.

    b. Show complete information concerning materials of construction, fabrication, protective coatings, installation and anchoring requirements, fasteners and other details.

    c. Equipment Certification: At the time of submitting shop drawings, submit on the form provided the equipment manufacturer's warranty and certification attesting that the manufacturer has examined the Contract Drawings and specifications and that the equipment provided will meet the performance criteria and conforms to specification requirements.

2. Maintenance Data and Operating Instructions:

    a. Submit an Operation and Maintenance Manual for the equipment furnished, including a detailed description of the function of each principal component, procedures for operation, and instructions for overhaul and maintenance, and one (1) complete set of approved Shop Drawings. Number of sets and format per the General Requirements and as identified in Special Provisions.

    b. Include lubrication schedule, safety precautions, test procedures, electrical schematics, and parts lists.

    c. The Operation and Maintenance Manual submitted must meet the standards outlined in the General Provisions, GP-5.04 of Anne Arundel County Standard Specifications.

11231.02 MATERIALS

A. Description of Operation

At the pumping station wet well as shown on the Drawings, air will be collected and forced by the odor control fan to exhaust air piping and then distributed to a biofilter through perforated pipes. Optimum moisture content (45%) in the biofilter shall be maintained in the filter bed by an automatic sprinkler system that will operate on a timed sequence.

B. Control Valve

1. Pressure: 20 psi min., 150 psi max.

2. Opening Time: Five seconds max.

3. Closing Time: 60 seconds max.

4. Manual Flow Control: Adjustable down to zero flow.

5. Manual Bleed Control: Downstream, internal bleed operation within one half turn of solenoid from closed position.

6. Operating Voltage: 24 Vac nom., 19 Vac min., 50/60 Hz.

7. Features:

   a. Engineered plastic and stainless steel construction.

   b. Thermoplastic diaphragm.

   c. Corrosion-resistant PVC body on slip model.

   d. Manual operation with internal, downstream bleed.

   e. Model 260-06-04, 24 V, 1" control valve as manufactured by Toro or equal.

C. Automatic Drain Valve

1. Automatic drain valve shall open when internal pressure drops below 2.5 psi and shall close when the pressure is about 5.5 psi.

2. Automatic drain valve shall be installed to allow free draining of the sprinkler piping system.

3. Automatic drain valve shall be Model 1 6A-FDV as manufactured by Rain Bird Sprinkler Manufacturing Corporation or equal.

D. Sprinklers

1. The soil odor filter sprinklers shall be 6" high pop-up type with stainless steel springs. The spray head shall have a UV resistant seal and a screw-on type cap. The sprinkler head and nozzle shall have an operating range of 20 psi - 50 psi.

2. The sprinkler head inlet connections shall be 1/2" NPT.

3. The sprinkler head assembly shall consist of a sprinkler head, nozzle with screw, stainless steel screen and plastic mesh filter.

4. The spray pattern of the sprinkler shall be either flat or low angle with trajectories less than or equal to ___ degrees.

5. All pieces of the sprinkler assembly shall be supplied by the same manufacturer. The sprinkler, Model 570Z, and nozzle, 570 series, shall be as manufactured by Toro of Riverside, California or equal, located where shown on the Drawings.

6. Provide number and series as indicated on the Drawings.

E. Curb Valves

1. Curb valves used for the sprinkler system shall be bronze curb valves with drain. The valve shall have a tee handle and female connections. The curb valve shall be Model H-10284 as manufactured by Mueller Company, Decatur, Illinois or equal.

2. The curb valve riser shall be of PVC construction and be compatible in size and design with the specific curb valve. The upper part of the valve box shall screw onto the lower part for adjusting to grade. The curb valve riser shall be manufactured by Bingham and Taylor, Culpeper, Virginia or equal.

3. The valve box caps shall be cast iron and should be lettered "WATER". Curb valve box caps shall be manufactured by Opelika Foundry, Opelika, Alabama or equal.

F. Air Pressure Gauge

1. Air pressure gauge shall be 3-1/2 inch diameter face capable of measuring 10 inches of water full scale and shall be as manufactured by Marsh Instrument Co. or equal.

G. Geotextile Material

1. Geotextile material shall be nonwoven pervious fabric of polyester, nylon or polypropylene; shall have average openings of 0.4 mm, permeability of $2x10^{-4}$ cm/sec; and shall be Grade 140 N MIRAFI, manufactured by Mirafi, Inc., or equal.

2. Rubber-butyl sealant shall be 3/8" thick by 3" wide.

H. Gravel: AASHTO M43, No. 57.

I. Compost

1. Soil odor filter compost shall be a free draining, loosely compacted mixture of decomposed sewage sludge and hardwood chips (ComPRO) and shredded hardwood bark. The mixture shall be 50/50 by volume.

2. The ComPRO shall have an organic content of 70% by dry weight. It shall have 1% total nitrogen and a 2% phosphoric acid content. The material shall be free of nitrate, ammoniacal nitrogen and soluble potash. The ComPRO shall be as marketed by ComPRO Marketing, Annapolis, Maryland.

3. Shredded hardwood bark shall be free from clay, stone or any plant parts of foreign substances. The mulch shall be as provided by Pioneer Southern, Inc., Virginia and distributed by Homestead Gardens, Davidsonville, Maryland or equal.

4. Hardwood chips for installation on the upper surface of the odor filter structure shall be of hardwood and produced by a chipping machine. The chips shall be one to one and a half square inch in size and free of all foreign materials. Hardwood chips shall be as distributed by Homestead Gardens, Davidsonville, Maryland or equal.

J. Piping

1. Intake and Exhaust and Sprinkler Piping: PVC, ASTM D1785 Schedule 80 with fittings conforming to ASTM D2467.

2. Perforated Piping: Polyvinyl Chloride (PVC): ASTM D2729 Perforated.

3. Insulated Sprinkler Piping:

   The insulated sprinkler pipe system shown on the Drawings shall be suitable for buried applications. The system shall be a pre-insulated piping system with a directional filament wound fiberglass reinforced resin jacket. The minimum insulation thickness shall be 1.5". The minimum jacket thickness shall be 0.055". The pipe insulation system shall be as manufactured by Perma-Pipe or equal.

K. Pipe Supports for Sprinkler Piping:

Pipe supports shall be a combination of 1" PVC Type E channel and interlocking thermoplastic pipe clamp as manufactured by Aickinstrut, Inc. or equal.

L. Timbers

1. Pressure treated timber shall be yellow pine or Douglas fir and meet the requirements of AASHTO M168. The timber shall be marine grade and treated with 100% pure oxide form of chromated copper arsenate (CCA) at a rate of 2.6 lbs. CCA per cubic foot of wood and shall conform to AASHTO M133. Timber treated with inferior oxides or salts will not be acceptable.

2. Pressure treated timbers shall be as manufactured by Osmose Wood Products, Griffin, California and disturbed by Mid-Atlantic Wood Preservers, Inc., Harmans, Maryland or equal.

M. Lag Bold Assemblies

All hardware including nails, spikes, bolts and washers shall be hot-dip galvanized in accordance with ASTM 153.

N. Controller

1. Electrical:

   a. Input Power:

      i. 117 Vac, 60 Hz (plug in transformer).

      ii. 0.20 amp (24 W) max.

   b. Station Output Power

i. 24 Vac.

ii. 0.35 amp (8 VA) per station max.

iii. 0.35 amp (8 VA) pump/master valve.

iv. 0.70 amp (17 VA) total load.

2. Features:

   a. Four to eight stations, expandable with 2-station modules.

   b. Three fully independent irrigation programs; any station can be assigned to any program.

   c. Integrated pump start/master valve output.

   d. Custom wall mounting plate with 1/4" conduit inlet.

   e. Screwless wire terminals for easy installation.

   f. Advanced, solid-state design with easy-to-use hybrid interface.

   g. Large, clear LCD display for easy programming and operation.

   h. Station run times from one minute to four hours in one minute steps.

   i. Seven-day calendar or interval watering cycle, independent by program.

   j. Independent OFF setting by program.

   k. Master OFF function for extended shutdowns.

   l. Independent season adjust setting by program from 10% to 200% in 10% steps.

   m. Automatic split-cycle mode when season adjust is greater than 100% prevents runoff.

   n. Runs standard or modified (select stations) manual programs.

   o. 9 V battery (included) backup for time and program memory.

   p. Low battery indicator.

   q. Built-in trickle charger for NiCad battery use.

   r. Spare fuse (0.75 amp) included.

3. The controller shall be the GreenKeeper as manufactured by Toro or equal.

11231.03 EXECUTION

A. General

1. Structure excavation, backfill and compaction shall be as specified in Section 02200.

2. Trench excavation, backfill, compaction and pipe bedding shall be as specified in Section 02250.

B. Timber Structure Installation

1. Supporting Foundation/Base: The timber structure shall be installed at the locations and elevations shown in the Contract Documents. The first row of timbers shall be placed on a sound base. Should during installation over excavation take place, the base shall be reconstructed and compacted using soil material. In no case should gravel be used to prepare the foundation base for the timber structure.

2. The timbers shall be fitted closely, set accurately to the required lines and levels, and shall be secured in place in a rigid and substantial manner.

3. The treated lumber shall be handled, bored, framed and field treated in complete accordance with AWPA Sec. M4, "Standard Instructions for the Care of Pressure Treated Wood After Treatment".

4. The corners of the structure shall be assembled in an alternating overlapping method. No variance from this corner or joining method will be permitted.

5. The pressure treated timber shall be marine grade and be treated with 100% pure oxide form of chromated copper arsenate (CCA) at a rate of 2.6 lbs. CCA per cubic foot of wood. Common grade, ground contact, pressure treated timbers will not be approved for use in constructing the filter structure.

6. During construction of the timber filter structure, individual timbers shall be placed such that the "best side" is facing out.

7. For the specific location of the soil odor filter with respect to grade, see the main profile shown on Site Plan and, if applicable, the cross-section shown on the Contract Drawings.

8. All sprinkler piping shall maintain positive slope and drain to either the automatic drain valve or the curb valve. Piping between the solenoid valve and the sprinklers shall drain to the auto drain. Piping between the curb valve and the solenoid valve shall drain to the curb valve.

9. The sprinkler control box shall be installed 2" below the top of the hardwood chips.

10. The rubber-butyl sealant shall be placed between the timber courses in one

continuous strip. Where it is necessary to join multiple strips of sealant, the ends shall be overlapped sufficiently so, during compressing, the sealant material will form a single continuous bond.

11. The rubber-butyl sealant shall be placed such that, during compression, any excess sealant is pushed towards the side of the filter structure. Any material pushed past the outside face of the filter structure shall be neatly removed. During removal of any excess sealant, the individual timbers shall be protected from damage. Damaged timbers shall not be approved and will be removed from the project.

12. The rubber-butyl sealant and lag screw assemblies shall be used to fasten all timber courses except the top course. The top course of timbers shall be fastened using galvanized spikes and will not require the rubber-butyl sealant.

13. During installation of the timbers, all necessary precautions shall be made to ensure that individual timbers are not split. This includes drilling all pilot and countersink holes. All split timbers shall be removed from the project.

14. There shall be one lag screw assembly or spike located at the end of each timber. Lag screw assemblies shall be spaced a minimum of 2' on center.

15. All lag screw assemblies shall be tightened to ensure full compression of the rubber-butyl seal.

16. Aggregate/Gravel

    a. Storage of Material: The gravel material shall be stored in such a manner to shed water and prevent contamination. The materials shall be protected from weather by suitable covering. During removal from a stockpile, should any gravel be contaminated with foreign materials such as dirt, sand or organic material, the material shall not be used. Only clean, uncontaminated materials will be approved for installation and authorized for payment.

    b. Material Transport: All vehicles used to transport the gravel material shall be thoroughly cleaned before loading. Cleaning shall include any scraping or hosing required. Materials delivered to the site in an uncleaned or contaminated truck will not be approved for use or authorized for payment.

    c. Installation:

        i. Gravel material and air piping shall be installed to the dimensions shown on the Contract Drawings. This includes installation of the gravel up to but no closer than 2' from all interior walls of the timber structure. Gravel installation cannot violate the 2' separation requirement.

        ii. Should the Contractor wish to use plywood sheeting to contain the gravel while installing the compost, it shall be permitted. Use of a sheeting type arrangement will not be cause for extra payment and must be removed after the

filter has been backfilled to the upper limit of the gravel.

C. Compost and Wood Chip

1. Storage of Material: The prepared compost material or raw materials shall be stored in such a manner to shed water and prevent contamination. The materials shall be protected from weather by suitable covering. During removal from a stockpile, should any material be contaminated with foreign materials such as dirt, sand, gravel or grass, the material shall not be used. Only clean, uncontaminated materials will be approved for installation and authorized for payment.

2. Material Transport: All vehicles used to transport the compost material or raw materials shall be thoroughly cleaned before loading. Cleaning shall include scraping and hosing of any foreign materials. Materials delivered to the site in an uncleaned or contaminated truck will not be approved for use or authorized for payment.

3. Installation: Compost shall be installed in such a manner as to avoid excessive compaction. No equipment or personnel will be allowed inside the filter during compost installation. Movement and spreading of the material shall be accomplished from around the outside perimeter of the timber structure.

D. Polyvinyl Chloride (PVC) Pipe Installation

1. Polyvinyl chloride (PVC) shall be installed in accordance with Section 15210.

2. Sprinkler Piping Installation

3. In general, sprinkler piping shall be installed in accordance with Section 15210.

4. All sprinkler piping shall be installed to ensure location below the frost line. The frost line depth used for the project will be 3'. Where sprinkler piping is installed at a depth less than 3' and on the supply side of the control valve as shown on the Contract Drawings, the piping shall be insulated as specified.

5. All sprinkler piping installed between the curb valve and the control valve shall be sloped to a point draining back to the curb valve. All sprinkler piping installed between the control valve and the sprinklers shall be sloped to permit drainage to the auto drain valve.

E. Automatic Drain Valve Installation

1. The automatic drain valve shall be installed at the location and grade shown in the Contract Documents. The valve shall be located as such to permit free draining of all sprinkler piping between the solenoid valve and sprinkler head.

2. When installed, the drain valve shall be located within the gravel drain bedding. The gravel shall be placed around the valve to protect the valve from the surrounding soil. Gravel contaminated with materials such as sand or loam will not be permitted for use around the drain valve.

3. During installation, the drain valve shall be installed to ensure that any fines or soil material do not enter the valve prior to gravel bedding installation.

F. Control Valve Assembly Installation

1. The control valve assembly shall be installed in the Control/Generator Building or within a plastic valve box as indicated on the Drawings. The installed assembly shall include a true union fitting on each end to allow the entire assembly to be easily removed from the building or piping.

2. The assembly shall be located within the box in such a manner to provide adequate space to allow access to remove and reinstall the unioned equipment.

G. Curb Valve Installation

1. The curb valve shall be installed following the specifications as outlined in Section 15210 and as shown on the drawings.

2. The curb valve shall be located at an elevation so the sprinkler piping between the curb valve and the control valve maintains positive slope to the curb valve.

H. Valve Box Installation

When indicated, the plastic valve box housing the control valve shall be located as shown on the Drawings. The box shall be installed outside the hazardous area envelope as defined in the latest NFPA 820 standards.

I. Sprinkler Installation

Sprinklers shall be installed in the configurations and at the grades and locations shown on the Drawings.

J. Field Test for Soil Odor Filter

1. Upon installing the soil odor filter structure and installing and testing the air handling pipe and the soil odor filter blower, a system leak test will be conducted. The test shall be completed as follows:

2. A smoke bomb will be ignited in the wet well and allowed to fill the tank. The Contractor shall insure that no portion of the bomb falls or remains in the wet well.

3. The soil odor filter blower will be turned on and allowed to vent smoke to the soil odor filter.

4. As the smoke is conveyed to the filter structure, the entire odor control system will be inspected for leaks. This includes the air handling pipes, pipe connections, odor filter blower and odor filter structure.

5. After the system is inspected in operation and no leakage of smoke is

observed, the system will be approved. Should, at any time during the test, smoke leakage be observed or detected, the Contractor shall be required to make the repairs necessary to stop the leak. This may include any excavation, disassembly/reassembly or repair work necessary. Prior to making any repairs, the Contractor shall submit the proposed method and/or material to the Engineer for review and approval.

6. Polyvinyl chloride (PVC) piping shall be tested as specified in Section 15210.

7. The centrifugal blower shall be tested as specified in Section 15100.3.06.

8. Field Test for Sprinklers

   The sprinkler system will be tested to ensure its proper operation. The system will be run through two irrigation cycles by manually manipulating the timer control. During this test, the control valve and sprinkler spray shall be adjusted to ensure adequate irrigation of the odor filter structure.

9. Equipment Acceptance

   Adjust, repair, modify or replace any components which fail to perform as specified and rerun the test. Make final adjustments to the equipment under the direction and to the satisfaction of the Engineer.

END OF SECTION

SECTION 11310

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.

6. Certified factory pump performance curves shall be provided and approved by the Engineer before the pumps are shipped.

7. 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.

8. 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 30 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 guide bars or stainless steel guide cables and 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 30 (minimum), the smooth surfaces devoid of blow holes and other irregularities. All exposed nuts and bolts shall be of 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 30, 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 ____KW 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 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 30 (minimum) cast iron. Anchor bolts shall be 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 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 stainless steel.

d. Guide rail brackets and fasteners shall be stainless steel.

4. Manufacturer

Submersible wastewater pumps shall be Model ____, with Code ____ impeller as manufactured by ITT Flygt Corporation, KSB, or EMU.

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 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

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.

1. 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)

2. Pump Construction

    a. Major pump components shall be of gray cast iron, ASTM A-48, Class 30 (minimum) with smooth surfaces devoid of blow holes and other irregularities. All exposed nuts and bolts shall be of 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 30(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 30 (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 30 (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.

3. 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.

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.

4. Manufacturer

Sewage pumps shall be Model ____ with impeller ____ as manufactured by Smith and Loveless.

5. 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

6. Spare Parts

    a. The following spare parts shall be supplied for the wastewater pumps:

        i. (1) Impeller (dynamically balanced), 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 accordance with Section 15990 and the Appendices of these specifications.

8. Any drywell-mounted motor or pump that becomes submerged or damaged before final acceptance shall be replaced at no cost to the Owner.

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.

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, horse power 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) tape 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 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, 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, gas-tight aluminum wet well access cover fabricated of ¼" treadplate, located exterior to the fiberglass pump chamber shall be provided, complete with stainless steel hinges and hardware padlocking provisions. The manway shall be integral part of the station floor plate and provide access to the wet-well. The minimum open area of the manway access into the wet-wellshall be at least 4.3 square feet.

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 these specifications.

    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 PolyPhenylSulfone, 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 pump performance testing shall be done in accordance with Appendices of these specifications.

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 guiderail/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 Model No. (DESIGN) twin shaft grinder complete with stainless steel guide rail system, overflow chute and frame, submersible TEFC motor and a automatic jam sensing and reversing controller, all as manufactured by JWC Environmental Muffin Monster, Franklin Miller Taskmaster, or equal.

B. Mechanical

1. Mechanism

   a. Shafts – The shafts shall be minimum 2-inch hexagonal 17-4 ph stainless steel.

   b. Cutters – Single piece cutter cartridges shall be made of 17-4 ph stainless steel comprising a plurality of 7 tooth cam shaped cutter elements. This one piece element shall be designed for heavy duty cutting. It shall provide easy assembly with no more than 4 elements for a 8-inch chamber. The monolithic cutter cartridge design shall avoid catastrophic cutter stack collapse due to the cracking of one or more cutters. It shall further be designed to reinforce adjacent cutters as well as shafting and shall help prevent shaft scoring. Units using multitudes of individual cutters and spacers shall not be accepted.

   c. 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.

2. Housing: The housing shall be cast from grade 65-45-12 ductile iron.

3. 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 insuring 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.

4. 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.

5. Wet Well Frame and Guide Rail System

    The unit will be supported by a channel box and frame integral overflow bar screen in 304 stainless steel. Channel frame and Guide Rail System will be mounted to 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 grinder for easy removal for inspection or maintenance.

6. Drive and Motor

    a. The grinder shall be driven by 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.

    b. Two counter rotating shafts shall be driven by two heavy duty spur gears hardened to a Rockwell C of 40-45.

7. Electrical Controls

    a. An Automatic Reversing Controller shall be supplied with 30.5 mm 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.

8. 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 guidrail 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 Final 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.

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 forcemains;

c. List of pump sizes, valves, piping, fittings and other appurtenances;

d. Method of noise control for each pump and/or generator;

e. Method for controlling and monitoring the pumps.

11400.02 MATERIALS

A. Equipment

1. All pumps used shall be automatic self-priming units that do not require the use of footvalves in the priming system. The pumps must be diesel powered. 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., (856) 467-3636 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 as manufactured by Phillips Driscopipe, Inc. or equal.

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 providing 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.

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 bypass pumping system every two hours to ensure that the system is working correctly.

3. Maintenance Service:

The Contractor shall insure that the temporary pumping system is properly maintained and a responsible operator shall be on-site when 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.

B. Preparation

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 operation, 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 device. 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 11600

PACKAGE PUMPING STATION

11600.01 GENERAL

A. Description

Work performed under this section shall include, but is not limited to, furnishing and installing a complete package pump station, including dry well, wet well and appurtenances.

B. Related Work Specified Elsewhere

1. Related items specified elsewhere are as follows:

   a. Sewage pumps are specified in Section 11310 - Sewage Pumps.

   b. Piping, valves, fittings and specialties are specified in Section 15210 - Piping, Valves, Fittings and Specialties.

   c. Air blowers, ductwork, unit heater, sump pump, dehumidifier and appurtenances are specified in Division 15600 - Heating and Ventilating.

   d. The hatches are specified in Section 10027 - Hatches.

   e. Pump station controls and alarms are specified in Sections 16946 - Bubbler System and 16010 - Electrical.

   f. Electrical requirements are specified in Section 16010.

   g. Mechanical requirements are specified in Sections 15210, 15400 and 15600.

   h. Precast concrete requirements are specified in Section 03050.

   i. Elastomeric Membrane waterproofing requirements are specified in Section 07110.

   j. Special coating requirements are specified in Section 09800.

   k. Painting requirements are specified in Section 09900.

   l. Vibration design and installation requirements are specified in Section 15990 and the Appendices.

C. Submittals

1. Certificate of Compliance

Submit a certificate of compliance for package pump station.

2. Manufacturer's Installation Instructions

Submit manufacturer's installation instructions for the package pump station.

3. Manufacturer's Certification

Submit manufacturer’s certification for package pump station.

4. Operation and Maintenance Data

Submit operation and maintenance data for all pump station equipment. The operation and maintenance data shall address related items specified elsewhere in these specifications, such as sewage pumps, valves, blowers, unit heater, sump pump controls, as they relate to the package station as a complete operating system.

5. Shop Drawings

a. In addition to requirements hereinbefore specified for shop drawings, the following items shall be included with shop drawings for dry well package pump stations.

b. Details for securing package pump station dry well to concrete top and base slab.

c. Drawings for any changes to the sewage pumping station base slab necessary to accommodate the package pump station dry well proposed to be supplied, shall be designed and sealed by a registered professional engineer, licensed in the State of Maryland, and submitted.

6. Manufacturer’s Instruction

Provide a minimum of two eight-hour days of manufacturer's instructions for package pump station operation and maintenance.

D. Single Source Responsibility

1. The manufacturer/supplier of the package pump station shall bear the responsibility of providing all items required by this section. The Contractor shall guarantee the overall performance of the package pump station and all equipment for one year after the date of final acceptance.

2. The Contractor shall be responsible for coordinating the pump station equipment and other related equipment so that all elements are compatible and form a complete working system. Shop drawings submittals shall include sufficient information regarding component compatibility to demonstrate compliance with this requirement.

3. Critical items requiring special coordination effort are the sewage pumps and controls, odor control equipment, flowmeter, power supply, transfer switch and generator set, bypass piping and remote monitoring system.

4. All sewage pump controls and alarms shall be furnished by the pump station manufacturer/supplier and installed where shown in the Contract Documents.

E. Manufacturer/Supplier Experience

The manufacturer of the package pump station shall have supplied a minimum of five similar package pump stations during the two year period prior to bid opening. The Contractor shall submit, with the shop drawings, a list of installation of similar pump stations supplied by the manufacturer of the proposed pump station. The list shall include the location of the installation, a brief description of the station, and the name, address, and telephone number of the Owner or Owner's representative. In lieu of experience, a performance bond for 100 percent of the value of the package pump station work shall be furnished by the Contractor. If a performance bond is offered in lieu of experience, the Owner will hold such bond for a period of five years.

11600.02 MATERIALS

A. Submersible Package Sewage Pump Station

1. The package sewage pump station shall consist of sewage pumps, discharge elbows, stainless steel guiderails, pump controls and liquid level controls.

2. Package pump station components shall be delivered preassembled, pretested and pre-wired to the extent possible.

B. Dry Well/Wet Well Package Sewage Pump Station

1. The package sewage pump stations shall be a completely factory built, pretested, precast concrete dry well pump station, suitable for below grade installation on a reinforced concrete pump station base slab.

2. The package pump station, consisting of the precast concrete dry well shall include sewage pumping units with suction and discharge piping and valves; ventilation; heater; dehumidifier; sump pump; electrical control and alarm systems; lighting; ladders; hatches; and all other incidental items and appurtenances required for a complete pumping station as shown on the Contract Drawings and as specified.

3. The pump station shall be completely factory assembled, painted and wired, requiring only placement, piping connections to the wet well, and water piping, electrical power, signal, and control connections.

4. Controls for heating, ventilation and lighting shall be the responsibility of the manufacturer of the package sewage pump station. Design of controls shall be coordinated with equipment.

5. The package sewage pump station shall be modified from the manufacturer's standard design as necessary to comply with the requirements of the Contract Drawings and Specifications. Adequate space for all equipment plus space for routine maintenance shall be furnished.

6. The package pump station shall be factory built as manufactured by Rotondo/Carlgen Inc. or equal.

7. Dry Well Structure

    a. The structure shall be precast concrete, suitable to withstand applied earth, groundwater, surface and internal loads, plus loads imposed by shipping and placing the dry well.

    b. The structure shall include base module, dry well riser section(s), dry well top slab, access tube riser section(s), access tube top slab and hatch. Precast concrete design shall be the manufacturer's responsibility.

    c. Lifting eyes shall be furnished in the bottom side of the dry well top slab. Lifting eyes shall be provided for centered directly over each sewage pump and discharge check valve. Lifting eyes shall be designed to accommodate a pulley or hoist for pump/motor removal and be capable of supporting the entire weight of the unit. A minimum of three feet of clearance shall be provided between the top of the pumps and ceiling.

    d. Precast concrete shall be in accordance with Section 03050 - Precast Structural Concrete.

    e. General painting shall be in accordance with Section 09900.

    f. Special Coating shall be in accordance with Section 09800.

    g. Exterior precast dry well waterproofing shall be in accordance with Section 07110.

11600.03 EXECUTION

A. General

Each package sewage pump station shall be installed as shown on the Contract Drawings and in strict conformance with the recommendations of the manufacturer.

B. The pump station excavation shall be maintained continuously in a completely dry condition until the excavation is completely backfilled in order to prevent structure floatation.

C. Pre-Delivery Test

The dry well/wet well package pump station shall be completely assembled, tested and inspected at the factory. The test shall consist of a complete operational performance test. All pump station components and controls shall be tested and inspected. The Owner and/or the Engineer shall be allowed to witness all tests. The tests shall be arranged to be completed within one (1) eight hour workday. The Owner shall be notified a minimum of seven (7) calendar days prior to the scheduled test date. The manufacturer/supplier shall prepare and submit a test and inspection report to the Owner and Engineer.

D. Demonstration Operation

1. After installation, the Contractor shall demonstrate that pumps, equipment, controls, and alarms are operating in a satisfactory manner. All rotating equipment shall be lubricated according to recommendations of the manufacturer and all adjustments shall be made to suit anticipated operating conditions.

2. Each pump shall be tested in accordance with Performance/Acceptance Testing in Appendices B, E, and F of these specifications to show that it operates quietly without excessive vibration, overheating or signs of distress at specified capacity. Vibration shall not exceed the tolerances specified therein while pumping under the full range of possible conditions but not necessarily at the design point. The Contractor shall submit to the Engineer vibration analysis signatures and report for each pump and motor installed.

3. Each alarm function shall be induced, in a manner that will avoid any damage, to demonstrate that alarms function properly.

E. Defects that cannot be eliminated by installation adjustments shall be sufficient cause for rejection. No claim or charge or any suit shall be made against the Owner or Engineer for any remedial measures required to replace or to put the pumping station in satisfactory and acceptable operation. The Engineer shall be notified in advance of all field tests and all tests shall be conducted to his entire satisfaction.

F. Performance testing of equipment after installation shall be in accordance with the Performance Testing/Acceptance Booklet in the Appendix section of these specifications.

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 coasts 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
BOCA	- Building Officials and Code Administrators
IEEE	- Institute of Electrical and Electronics Engineers
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 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 that 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; chamber 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 finish to match equipment. Provide openings for tachometers. Guards shall meet OSHA and MOSHA 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, include controls. Use plaques, stencils, nameplates, tags, marker, 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.

4. Identification system shall be as manufactured by W.H. Brady Co., or equal.

5. Embossed Plastic Tape: Prohibited, except where specifically approved in writing.

6. 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 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 manufactures 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 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, 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 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 Owner with complete written lubricating instructions, together with 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. 104

iii. Clevis 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. Floor Supports, steel or cast iron:

a. 6" and smaller pipe Grinnell Fig. 259, Fee & Mason Fig 295, or Standon Model 2589.

b. 8" through 24" pipe Grinnell Fig. 258, 264 Fee & Mason, or Standon Model 2589

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 Joint, Loop, Bend, ft.	Expansion Joint Max Spacing, ft.	Type of Expansion Joints
Ductile Iron	15	80	80	Mechanical Couplings
Steel				
1-1/4" and Smaller	7	30	100	None required
1-1/2 to 4"	10	30	100	Mechanical
Over 4"	15	80	80	Couplings

Copper 1" and smaller	5	--	--	None required
Over	7	50	100	None required
PVC Continuous Support	(Note 1)			
1/8 and ¼"		20	80	None required
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 C1 10. 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 polyvinylchloride (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 304, schedule 40 seamless, unless otherwise noted. Joints shall be screwed type unless otherwise noted.

3. Fittings shall be screwed, stainless steel, conforming to ASTM A182, Grade F304 or barstock to ASTM A276 Type 304 with dimensions conforming to ANSI B16.3 for 150 lb SWP malleable iron screwed fittings.

F. 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.

G. 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.

H. 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 standard weight galvanized steel, conforming to ASTM Specification A-120. 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 method 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.

I. 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.

J. 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.

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.

4. Plug valves shall be installed so that the plug isolates the valve body from flow in normally closed service or 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 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 and 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.

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 Unit of General Signal Corp., 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 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.

K. 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. Resilent 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.

L. 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.

6. Check valves 3-inches and larger shall be manufactured by GA Industries, Clow, M&H, or equal.

7. 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.

M. 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. 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.

4. The valve shall be APCO Model 104P3 Rubber Flapper Check Valve, as manufactured by Valve & Primer Corp., Schaumburg, Illinois.

N. 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.

O. 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 S.S. 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.

5. A 2-1/2 inch dial, glycerine-filled pressure gauge shall be provided at each bubbler system compressor air receiver tank and shall have a pressure range of 0 to 160 psig.

P. 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 insure 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 a an alloy bronze or stainless steel retaining ring and stainless steel screws. The body seat shall be alloy bronze or stainless steel.

7. The valve shall be APCO Series 3000 Angle surge relief as manufactured by the Valve & Primer Corporation.

Q. Mud Valves

1. Non-rising stem; to be cast stainless steel as manufactured by Trumbull or equal.

R. Quick Connect Couplers (Valve Vault)

1. Quick connect couplers 4-inches and larger shall be 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.

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.

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 a mild 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.

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:

13. Mating flanges shall be concentric to within 1/16-inch tolerance unbolted.

14. Mating flange faces shall be parallel to within a tolerance of no greater than Y2 the gasket thickness unbolted.

15. Flange face separation shall be no more than 1/8-inch beyond the normal gasket thickness unbolted.

16. Pipe supports must be adjustable.

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 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 M 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 compression pattern.

2. Soil pipe joints shall be rubber gasket.

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.

3. Hose bibs shall be 3/4-inch bronze gate valves with hose outlet male threads conforming to ANSI B2.4. Hose bibs shall be Jenkins Brothers, Figure 372, or equal. NOTE: Do not install hose bibs on interior walls of control room or generator room.

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 JOSAM Series 71450, Zurn Model Z-1385, or equal, equipped with vacuum breaker and four foot burial depth.

G. Wall Hydrant

Wall hydrants shall be a non-freeze wall hydrant, cast bronze with stain finish Nikalloy face with ¾-inch H.P.T. outlet, backflow preventer, pressure-relief valve and bronze operating parts. 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 rising stems, flanged ends. Provide an extension stem with 2-inch square operating nut and extension stem support as required.

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 dovetailed 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 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 oil 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. 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" .

   b. The tank shall be constructed of a minimum of 7- gauge (3/16") carbon steel of all welded construction with factory applied exterior rust preventative.

   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 A120, 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.

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 aluminized 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 watertight. 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 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 where 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 to 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 corroded 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

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 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 F.R.P., 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 steelframes and provided with 6063T5 heavy guage, 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 counter-balance 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 radial vane or backwardly 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 and 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 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.

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 guage 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 as manufactured by PennBarry Type P Breezeway, Loren Cook SWD, Greenheck, or equal.

F. Unit Heaters – Electric

1. Propeller type unit heaters equal, with heating and air delivery capacities and electrical characteristics as indicated on the drawings. Heating coil shall consist of metal sheath fintube electric heating elements. The rust resistant fin tube elements shall be attached to 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 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 heating thermostat has been satisfied to maximize transfer of generated heat to space being heated and extend operating life of heating element.

11. All hardware shall be stainless steel.

12. Unit shall be provided with 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 heavy-gage 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 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. Provide and install dehumidifiers where indicated, Westinghouse ED203D, Dayton, or equal, having a capacity of 20 pints per 24 hours, 115 volts, 60 Hertz, 1 phase with cord and plug, complete with humidistat and discharge pipe or tubing to sump pump pit.

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 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 maximum size recommended by 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 sidepieces 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 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 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 un-insulated 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 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 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 F 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 sub-base in a manner that is level in both directions according to the machined surfaces on the base. If 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. 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 a 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 perimeter. Center distance between these holes shall not be more than 30 inches

3. Hollow Bases: Holes sufficiently large in top of base for filling and venting grout, throughout the entire base. If cross-members are provided in the base, provide grout vent holes for each base segment.

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. 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.

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 blocks and stainless steel precision cut and shims.

    c. Blocks and shims shall be generously sized to provide solid support at each anchor bolt location.

    d. Provide blocks and shims at each anchor bolt. Blocks and shims shall be square shape with "U" cut out to allow blocks and shims to be centered on anchor bolts.

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. The transducer system, which houses the Class 1 laser diode and a position detector, and the prism shall be installed on the respective shafts, then adjusted such that the laser beam is reflected back into the position detector. As the shafts are rotated through 180 degrees, any parallel offset or angularity shall deflect the reflected beam from its original point of incidence in the position detector. The position detector measurements shall automatically enter the computer, which shall calculate misalignment from the beam deflection, and then display shaft misalignment at the coupling and corrective measures to the nearest 0.0005 inches at the machine feet.

    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. 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 factory precut 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 herein 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.

e. Machinery supports and baseplate pads shall be free of burrs, rust, scale and other obstructions.

f. Stainless steel 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 SPS Appendices.)

h. All jackbolts shall be backed-off (1) turn after the alignment procedure is complete.

B. Shaft Alignment Tolerances

Alignment Tolerances (in inches)

RPM		Offset		(Inches per Inch)
100-1000	+/-	0.0040	+/-	0.001000
1001-2000	+/-	0.0030	+/-	0.000500

C. After erection 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, E, and F 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 rotors 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 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 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 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 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 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 820-2003 or latest version thereof.

   e. Underwriter's 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. The County will make application for electric and telephone service. The County will pay utility company fees, cable charges, and added facilities charges.

2. The Contractor shall provide all coordination for service with the utility company.

3. 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. Provide 1 pint of the equipment manufacturer's touchup paint per 500 square feet of painted surface for repair of damaged enamel topcoats.

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 820-2003 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 hangars 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 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 back fill 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 bottom of box or nearest course-line in masonry wall.

   a. Switches 4' - 0" AFF

   b. Receptacle 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 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 assure that the work is complete and ready for final test.

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 the 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 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 switch on inside doorframe 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 9006, Type C switch 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 series number 17 for generators above 250 KW. 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”, “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 304 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 pushbutton 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.

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 Permecote 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 304 stainless steel. Install cover with neoprene gaskets and Type 304 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 precaset individual raceway openings may be sued. 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 Parmagum, 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 304 stainless steel, preformed channel. Anchor with 304 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 304 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 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 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 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 noninsulated-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 day's 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. Preliminary Inspection/Test

5. 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.

6. 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 Underwriter's Laboratories, Inc.

B. Receptacles

1. Corrosion-Resistant Receptacles: Provide corrosion-resistant receptacles. Provide gray melamine, duplex receptacle, Hubbell 53CM62GY 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 stain stainless 302 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 PLC's 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 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 or Allen Bradley Centerline 2100 Series.

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: D178-24 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, push-buttons, 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 RR3, SquareD 8501 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 322, G&W Eagle Signal BRI 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. Elapse 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 form 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 60-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	-4degrees 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 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. Auxilliary 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 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 over current 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 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, Cummins-Onan 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 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.

H. Warranty

The complete generator set, controls, accessories, and assembly shall be warranted as a whole by the manufacturer for one year 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 on 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°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 TEXACO engine coolant, or equal. 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 as 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 nonasbestos 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 line voltage rated and powered through a contactor with 277-volt control. Provide an exterior tank type heater, Kim-Start, or equal.

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 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 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 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 10% for any step loading, which includes one sewage pump motor.

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 Electric 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 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.

j. Dry contacts for remote alarms wired to terminal strips.

k. Automatic starting controls.

l. Panel illumination lights and switch.

m. Generator "Running", 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 calcium 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 on 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 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 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 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 radiator adapter duct shall be provided with aluminum, gasketed inspection door to allow complete inspection and adjustment of gravity dampers and inspection of 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 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 corner 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 attached 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 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 shed.

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 pad lock 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 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 manufacturers 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 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 75 dBA at 21 feet for Level II enclosures and 69 dBA at 21 feet for Level III enclosures.

10. Warrantee: All materials shall be guaranteed against failure of workmanship for 1-year.

11. Enclosure shall be as manufactured by Onan, Model Quiet Site, Tramont, or approved equal.

12. Enclosures for 250 KW and larger shall contain incandescent 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 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. 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 form 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.

      i. 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.

      ii. 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.

iii. Contractor shall demonstrate to the county that the generator engine control microprocessor diagnostic interface will communicate with a laptop computer utilizing the diagnostic software provided as part of this contract.

4. 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 including piping, generator, enclosure (if provided) and frame.

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.

2. Accessories

a. Provide a solid-state sensing and control logic panel. 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 pilot lights to indicate source to which the load is connected.

e. Provide pilot light to indicate presence of 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 for the load, plus 25% spare capacity.

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.

3. Manufacturers

a. The transfer switch shall be as manufactured by Zenith with ENTELLI-SWITCH 250 Microprocessor Control or equivalent product of ASCO.

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. Provide dry contact closures for primary source active and secondary source active 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

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 wetwell. 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.

3. 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.

B. 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 indicted 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 embed in a resin and filler system to attenuate the sound level.

5. Transformer shall be suitable for installation in motor control center or wall mounting.

6. Transformers shall be Sorgel Electric Division, 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 re-strike, unless otherwise noted.

3. Incandescent:

    a. Ceiling or wall-mounted vapor proof w/guard and globe as noted on the drawings.

4. Manufacturers:

a. Fluorescents: General Electric, Sylvania, Westinghouse, or equal.

b. Incandescent: Crouse Hinds, or equal.

c. High Pressure Sodium: Lithonia, 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 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 equip 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 Engineer at least three days in

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 manufacturer 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 fails 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 surge suppressor to 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/ bubbler control panel, 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 drawings in AutoCAD format on CD, version 2006 or higher.

b. Submit all configuration software logic on CD in applicable PLC language.

c. 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.

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.

3. 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.

4. 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. A Programming Engineer representing the County will provide the final system programming of the control strategy logic after successful configuration of the system is demonstrated by the Contractor. All system configuration application software will be provided to the Programming Engineering prior to the Preliminary testing for implementation in the control logic.

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.

3. 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.

D. 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.

E. 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 and the programming engineer 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, and approval of the test results by the Owner, the County's Programming Engineer will load the control logic software in the PLC.

4. The programming engineer will debug their software for a total time of 10 (ten) working days, with the assistance of the Contractor verifying the hardware, prior to the start of the Conditional Acceptance Test.

5. Upon completion 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.

F. 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.

G. 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 "Siemens S7-200, Programming I Course," course # S7200 P1B or "Rockwell Automation Developing an RSLogix5000 Project Course," course #CCP-143.

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. Gauge Pressure Indicating Transmitter.

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	Bubbler System Pressure/Wetwell Level
Quantity	2
Tag No.	PIT1 and PIT2
Mounting	Bubbler Panel
Diaphragm Material	316 S.S.
Output Signal	4-20 mA D-C
Output Signal to	PLC
Range	0-20 ft. H_20, Field Verify
Calibrated Range	0-160 inches. H2O
Enclosure	NEMA 4X
Loop Power	24 VDC
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 Bubbler 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 phase monitor shall be ATC, Diversified Electronics Series PBD; 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 PLC
Under Voltage	Adjustable

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 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.V6, or equal.

3. GENERAL

Service	Dry Well Supply and Exhaust Fans
Quantity	2
Tag No.	AFSI-1, AFSI-2
Wetted Material	303 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	5 A @ 120 VAC
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.
	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

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. 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%

2. Sensor

a. Gas sensor shall sample and monitor the atmosphere without the aid of pumps or other mechanical devices. 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. Sensor cable shall be provided with sufficient length to allow mounting of the sensor assembly 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% too 95% relative humidity. The system shall have measurement ranges or 0 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 de-mounting 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/A1 (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, 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 91W.

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 charts 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	Pump Station Flow
Quality	1
Tag No.	FIT
INSTRUMENT	
Location	Pump Station
Mounting	Panel
Scale	Configurable
Channels	2
Input	4-20 mA d-c
Input From	Transmitter
Accuracy	+/-0.1%
Enclosure Class	NEMA 12
Power	120 VAC, 60 Hz
Integrator (Totalizer)	Yes, Microprocessor Based
Flow Range	_____ 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 PLC's shall be Siemens S7-200 or equivalent Allen Bradley 1400 series Micro Logix. However, contractor shall note that county standard PLC drawings are designed around the Siemens product addressing and I/O. If Allen Bradley Micro Logix is submitted, the contractor's Control System Integrator shall be responsible for submitting revised drawings/schematics and component list to the Engineer and county for review and approval. Contract drawings and As-builts shall be updated accordingly.

2. Programmable Logic Controllers

a. The PLC's 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. Siemens PLC components shall be S7-200:

2. Processor: Model CPU 224 XP.

3. Digital Input Module: 24VDC, 16pt. Model EM 221-16DI.

4. Digital Output Module: 24-volt, relay Model EM 222-4DO-Relay.

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.

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 phosphotized 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 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.

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 in accordance with 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 duct.

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 with in 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. Bubbler System

1. The bubbler system shall be installed in a separate enclosure as shown on the drawings. It is the intent of this specification that the bubbler system be supplied with all associated peripheral equipment wired and mounted inside the enclosure.

2. The bubbler system shall consist of two redundant systems each including an air compressor, a pressure reducer with a rotometer, constant differential pressure regulator,

electronic gauge pressure transmitters, power supplies, digital displays, panel front-mounted manual purge valves, and all necessary connection tubing and peripheral equipment to make a working system. The following components shall be mounted in a neat and workmanlike manner within the bubbler panel:

3. The combination filter-regulator unit shall be Norgren miniature series B07 or equal. Unit shall have 0-125 psig pressure range set at 10 psi, 1/4-inch inlet and outlet five-micron filter, piston type pressure regulator, and threaded polycarbonate filter bowl.

4. Air flow rotameter shall be Dwyer Model Visi-float model VFA-2-BV, or equal. Rotameter shall have acrylic body, needle valve flow control, 0.2 to 2 SCFH set at 1.5 SCFH, 1/4-inch inlet and outlet and + 5 percent full-scale accuracy.

5. Panel mounted and interior valves shall be Norgren, Anderson Brass or equal. Valves shall have 1/4-inch inlet and outlet, brass body with tapered bronze body.

6. Gauge Pressure transmitters shall be Endress + Hauser. Refer to Specification 16920 for transmitter specification.

7. All internal system tubing shall be 1/4” diameter polyethylene suitable for use with compression fittings. Tubing between the air compressors and bubbler panel shall be 3/8”

8. Power supply is 24-volt DC to bubbler system pressure transmitters and digital displays in the bubbler panel as indicated. Power supply to bubbler system air compressors is 120-volt single phase as indicated.

9. The air compressor units shall be a standard catalogued product by a manufacturer of air compressor equipment and shall not be a special or one of a kind device. Each compressor system shall be inclusive as a standalone unit with a 3-gallon receiver tank and extended condensate drains with ball valve. Compressor shall be of the oil-less design, capable of delivering a minimum of 1.0 SCFM at a 100- psig-discharge pressure. The compressor shall be air cooled, single stage reciprocating type and shall be complete with suction muffler-filters, check valves, automatic on-off pressure switch, pressure gauge, safety valve, outlet needle valve. The compressor gauge shall be liquid-filled 2-1/2 inch diameter dial, phenol case, black epoxy stainless steel snap ring, bronze movement and stainless steel bourdon tube with overpressure stops. The air compressor will start and stop after a power cycle with no physical intervention, based solely on system pressure. Provide two compressor systems from Ralph A. Miller Company, Model THMS-LGH310/260484. It shall have the capability of restarting after power loss in the middle of a run cycle.

10. Three-eighths inch (3/8”) NPT female bulkhead fitting shall be mounted on the side of the enclosure for connection to the bubbler tubes to the wet well. Bubbler tubes shall transition to ½-inch stainless steel pipe inside the wet well. Buried bubbler tubing shall be 3/8-inch polyethylene tubing inside 3/4-inch PVC-coated galvanized steel conduit. Bubbler tube shall be sloped at a minimum of 1-inch per 1 foot to drain into wet well. The bubbler tube shall be provided and installed as shown on the drawings.

11. Digital displays shall be 3-½ inch LED type, with input from 4-20mA loop with 24-volt DC power supply in bubbler panel. Refer to Specification 16920.

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.

C. Bubbler Panel

A bubbler panel will be provided in the pump station to send analog 4-20 ma signals, proportional to wet well level, to the Pump Control Panel. The bubbler panel is designed to house two redundant systems each including a pressure reducer with a rotometer, constant differential pressure regulator, electronic gauge pressure transmitters, power supplies, digital displays, panel front-mounted manual purge valves, and all necessary connection tubing and peripheral equipment to make a working system.

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 bubbler tubes 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:

   i. Control Circuit Breakers and Fuses.

   ii. Transient Voltage Surge Suppressor.

   iii. Redundant Programmable Logic Controllers (PLC's).

   iv. Two 24 VDC Power Supplies.

   v. Control Relays.

2. The selector switches and push buttons shall be wired as shown on the drawings.

D. Wet Well Bubbler System (Typical 2)

1. Two independent bubbler systems will be provided for the wet well to sense the sewage level in that well. The bubbler systems will be located in Bubbler Panel in the Pump Station control room. Air will be supplied to each bubbler system from an air compressor (Typical 2) located adjacent to Bubbler Panel.

2. The bubbler system gauge pressure transmitters will monitor the backpressure in the wet well bubbler tube which is equivalent to the wet well level. The pressure transmitters will

3. Each Bubbler System (Typical 2) will include the following:

    a. Air Filter.

    b. Regulator.

    c. Rotometer.

    d. Pressure Transmitters.

    e. Three Isolation Valves (In Door).

    f. Wet Well Level Digital Meters (Inches of Water).

4. The PLC will monitor both wet well level transmitters and control off the higher of the two signals. If the difference between the two signals is larger then six inches then the PLC will output a pressure transmitter 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 alteration 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 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. The PLC program shall include a level setpoint at the same elevation as the high float, which provides a local visual alarm indication to the Pump Control Panel when the wetwell is reaches the high level float.

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.

    ii. The odor blower will be controlled by the H/O/A selector switch located on the motor control center. 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 blower starts. When the odor blower H/O/A switch is in the "auto" position, the blower will be automatically controlled by a 24-hour cycle timer. The blower will be called to start at a preset time every cycle (0 – 24 hours). The blower will run for a preset time and then stop.

iii. The odor control sprinkler system will be automatically controlled by the sprinkler manufacturer controller via a 24-cycle timer. The valve will be called to open at a preset time every cycle (0 – 24 hours). The valve will open for a preset time and then close.

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 Ventilation Monitor Panel
k. Generator Running	Generator Control Panel Contacts
l. Grinder Fail	From Terminal blocks in Grinder Panel

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 Transmitter Fail alarm shall be generated when the PLC detects one of the bubbler pressure transmitters fails and transmits a signal to the RTU, after a preset time period.

7. The Drywell Flood Alarm shall be generated when the drywell 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 Wetwell Alarm shall be generated when the high wetwell float is activated. The signal is connected directly to the 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 switch 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

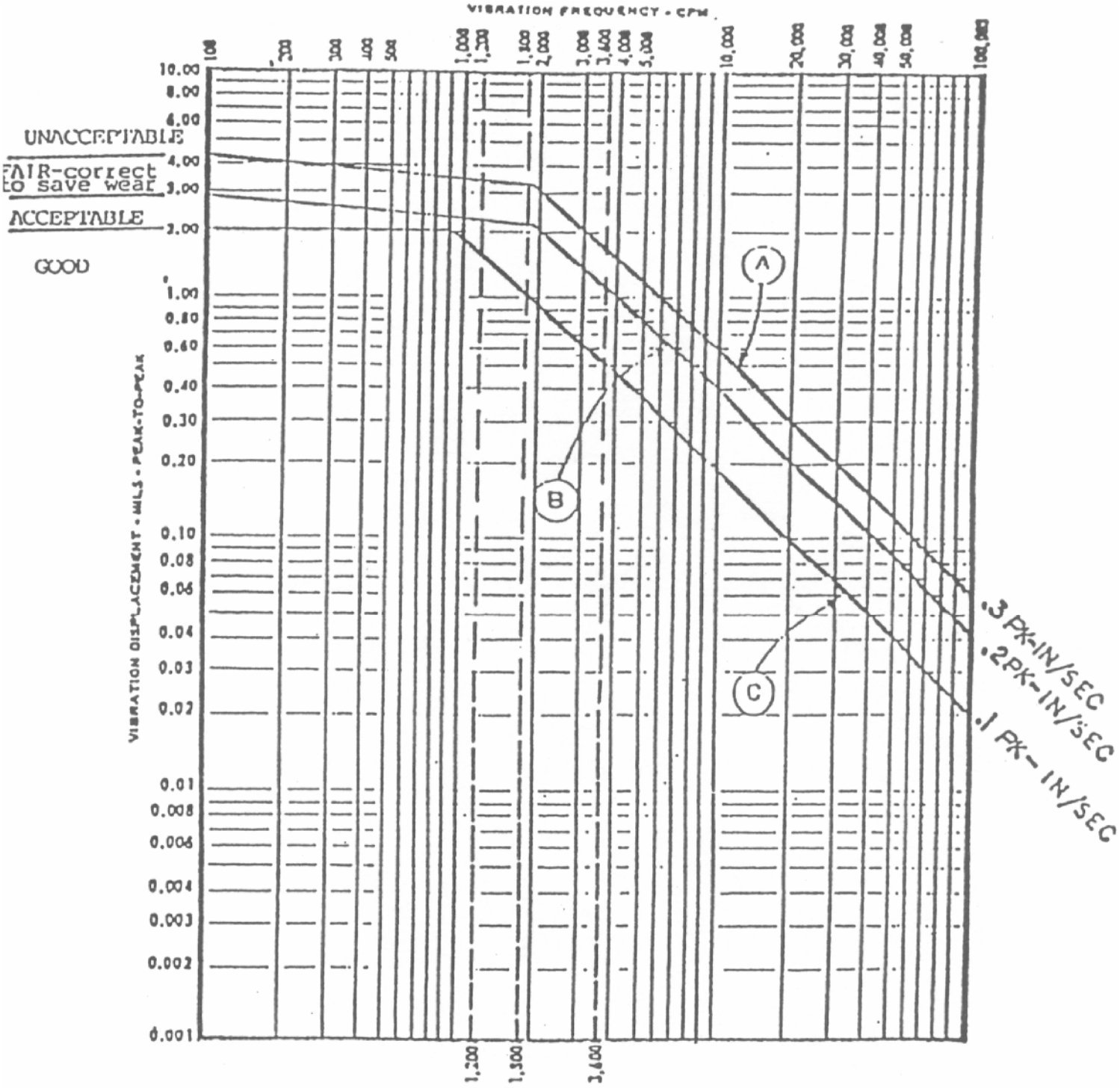
Refer to Sections 16900, 16920 and 16946.

END OF SECTION

APPENDIX A

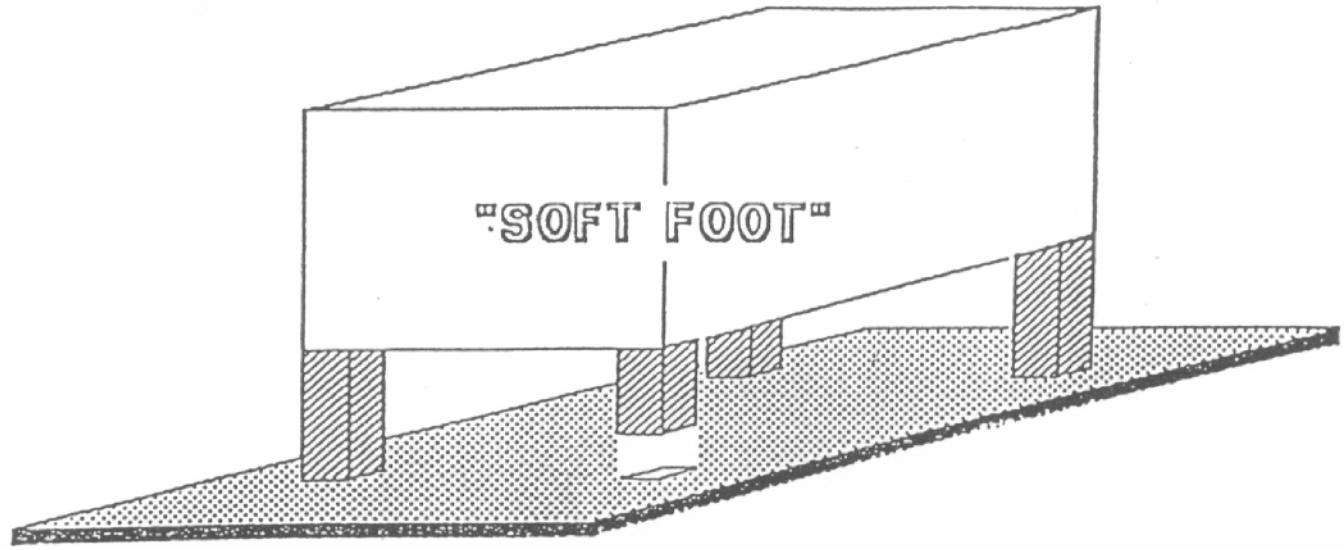
DRAWING NO. 1	VIBRATION SEVERITY – CHART NO. 1
DRAWING NO. 2	SOFT FOOT (DESCRIPTION)
DRAWING NO. 3	SOFT FOOT TEST
FORM NO. 1	MACHINERY ALIGNMENT REPORT

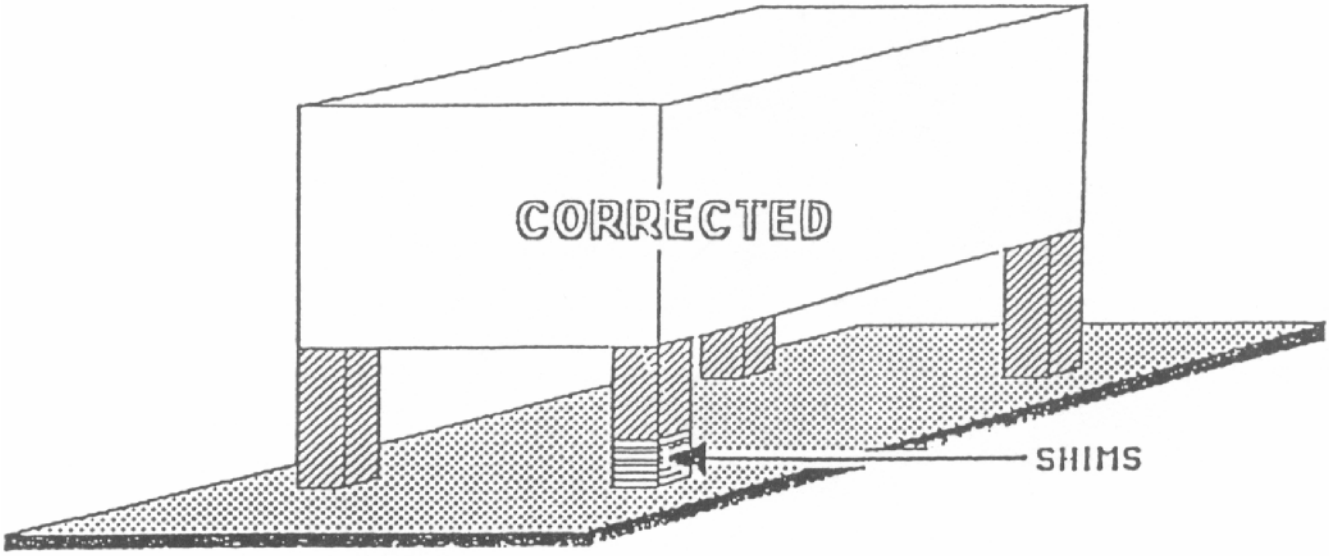
Published: 7/11 Revised:



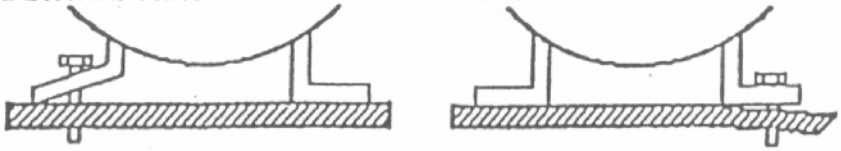
VIBRATION SEVERITY CHART NO. 1

(VIBRATION ACCEPTANCE CURVES)

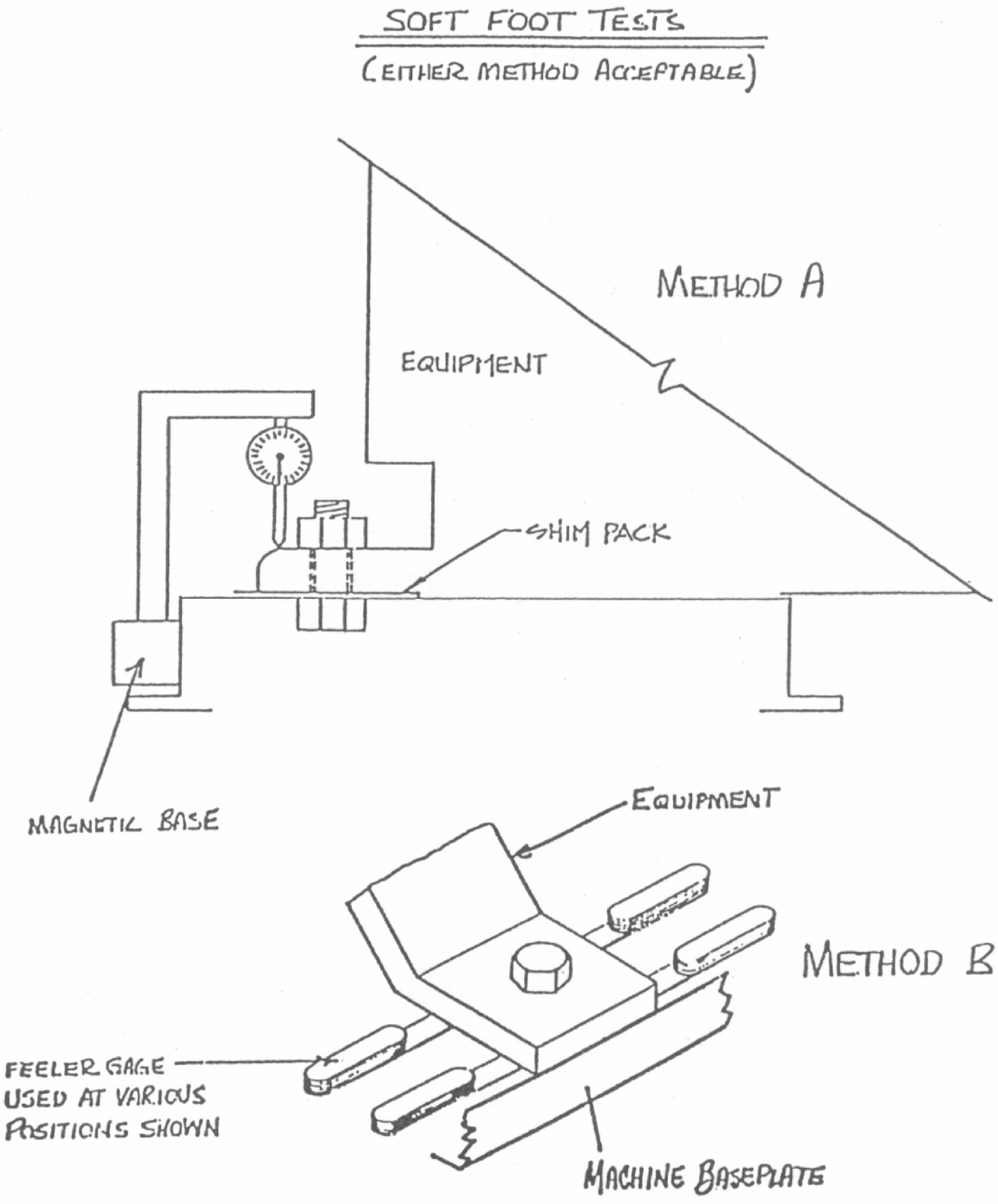




NOTE: "SOFT FOOT" IS SOMETIMES A RESULT OF A BENT "FOOT" OR A BENT BASEPLATE. IN SUCH CASES, IT MAY BE NECESSARY TO INSTALL A TAPERED SHIM OR "JURY RIG" BY "SANDWICHING" A STRIP OF SHIM STOCK BETWEEN TWO NORMAL SHIMS. ALSO, BEWARE THAT WARPED OR BENT SHIMS CAN CAUSE "SOFT FOOT".



"SOFT FOOT"


SOFT FOOT TESTS
(EITHER METHOD ACCEPTABLE)
METHOD A
EQUIPMENT
SHIM PACK
MAGNETIC BASE
EQUIPMENT
METHOD B
FEELER GAGE
USED AT VARIOUS
POSITIONS SHOWN
MACHINE BASEPLATE

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 June 2010

Published: 7/11 Revised:

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

_____ Odor control system

_____ Motor control center

_____ Bubbler and PLC controls

_____ VFD's (if applicable)

_____ Sewage grinder (if applicable)

_____ Generator and transfer switch

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

FORCE MAIN AIR RELEASE VALVES AND BLOWOFF VAULTS

____ All force main isolation valves operational, valve line-up.

____ Force main hydrostatically tested and full of water

____ Vaults pumped out, no signs of leakage at pipe penetrations/ link seals

____ ARV isolation valves operational and opened

____ All ARV fittings/ appurtenances installed: body drains w/ball valves, street ell

____ Blowoff isolation valves operational, then shut, blow-off connection caps in place

____ Valve extensions working and properly supported

Hatches (where installed)*:*

____ Corrosion resistant hardware and fasteners

____ Automatic hold open device(s).

____ Slam latch with removable key, spare keys furnished

____ Flush handle

____ Hatch drain to grade

PUMP STATION EQUIPMENT

____ Manufacturer's installation certificates completed and signed.

____ Load bank testing completed by generator supplier.

____ Pump control panel: PLC and control hardware installed, wired and configured by contractor.

____ PLC program loaded, tested and 'debugged' by County.

____ Minimum speed, ramp-up and ramp-down times set in VFD's (If applicable).

_____ Water supply established and/ or temporary recirculation set-up by contractor for Pump station testing

SCADA

_____ RTU Cabinet in place, labeling, wired to field devices.

_____ Antenna/ pole installed.

_____ Communications and station alarms established with Millersville.

NOTE: Items 1 thru 5 to be completed prior to walk through, conditional acceptance.

6. BUILDING

ELECTRICAL ROOM

_____ Room painted as specified

_____ All floors broom clean, all equipment clean, construction debris removed

_____ Lighting working

_____ Check all receptacles working

_____ Incoming electrical service surge protection device in place and operational

_____ Automatic transfer switch operable and programmed as specified. Exerciser set for Weds. 9:00A

_____ 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.

_____ VFD's (if applicable): General condition, breakers on, indicator lights working, enclosure clean of dust and wiring debris, cooling fans working, filters in place.

_____ Grinder Control Panel (if applicable): General condition, breakers on, indicator lights working, panel interior clear of debris.

_____ Check condition and operation of all louvers, ventilation fans and damper controls

_____ Check unit heater and thermostat operations

_____ Ventilation fan guard/motor support. No 'bump' hazards

BUBBLER SYSTEM/ PANEL

_____ Compressors (as specified)

_____ Properly sized air receivers, ASME rated(as specified), pressure gauge

_____ Receiver condensate bleed valve accessible

_____ Pressure relief valves working

_____ On/off pressure switch operation and settings -

_____ Digital displays operating/reading correctly

_____ Pressure transmitters mounted properly, tagged and calibrated

_____ Manual, panel mounted bubbler purge valves are correct and labeled

_____ Air flow rotameter and pressure regulator adjusted properly

_____ No air leaks in panel internal pneumatic tubing or fittings

FLOWMETER (If specified)

_____ Totalizer installed

_____ Chart installed, operational and calibration certification

_____ Spare charts and pens (as specified)

GAS DETECTOR

_____ Detector installed, operational and calibration certification

_____ Wet well gas detection alarm panel tested and operating

LIGHTING PANEL

_____ Breaker legend neatly typed, not handwritten

_____ Surge protection installed as specified

GENERATOR ROOM

_____ Lighting working

_____ Room painted as specified

_____ All floors broom clean, all equipment clean, all construction debris removed

_____ Check all receptacles are working

_____ Fire extinguisher securely mounted to walls at location identified by Ops

_____ Building water service gives full pressure. No leaks.

_____ Soil odor filter sprinkler control system/ valve line-ups (if applicable)

_____ Backflow preventer, no leaks, test/inspection tag

_____ Fuel tank filled with #2 diesel. Check tank gauge operation. Check for leaks.

_____ Fuel vent and fill pipes installed to the correct heights.

_____ Fuel trench: Pipes properly supported, diamond plate cover in place

_____ Check fuel tank, valves, fuel piping to engine, paint

_____ Anchor bolts/ vibration isolators in place and properly secured

_____ Engine block heater working.

_____ Fluid levels (coolant and oil).

_____ Coolant drains and extended oil drains with valves

_____ Check exhaust piping: Muffler/silencer insulated, no signs of exhaust leaks.

_____ Battery charger operation and battery cable installation.

_____ Generator air intake and air exhaust damper operation.

_____ Load bank test safety switch: Check wiring, operation and enclosure labeling

_____ Check load bank test connection box for wiring, proper size/ color plugs, labeling door gaskets.

Architectural/ Structural

_____ Good appearance/quality workmanship

_____ Doors keyed to A.A. County System (10 Keys)

_____ Combination door closures, hold open device, panic bar operation.

_____ Check door entry alarm switch. Alarm received at Millersville?

_____ Weather stripping in place on exterior door(s)

_____ Aluminum fascia, drip edges, guttering : Secured in place, no damage

_____ Roofing condition: No buckled or loose shingles

_____ Louvers: Color, condition, bird screens installed

_____ Check doors, lock, closures

_____ Generator exhaust thimble. Aluminum hi temp paint

_____ Wall hydrants working.

_____ Exterior lighting working.

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)

HATCHES:

____ Corrosion resistant hardware and fasteners

____ Automatic hold open device(s).

____ Slam latch with removable key, spare keys furnished

____ Flush handle

____ Fall protection D-ring installed, removable handrails

____ Hatch drain to grade

LADDER:

____ Aluminum 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 or grab bars on hatches as specified

____ Joints sealed/ good workmanship. No infiltration or inflow observed

____ Interior epoxy coating per specification

____ Check pipe and conduit penetrations and seals for leaks

_____ Aluminum grating: Sections easily removable and aluminum supports

_____ S.S. Bubbler tubes, properly secured and easily accessible from ladder for Maintenance.

_____ High Well Level Float mast and float properly located, easily accessible from ladder, proper type, elevation, will not foul.

_____ Sewage Grinder (if applicable): Pull and reset. Check guide rails, power cord and seating. Check operation and Grinder Fail alarm to Millersville.

_____ Combustible Gas Detection sensor easily accessible from ladder for maintenance. Calibrated?

_____ Soil odor filter intake pipe properly supported (if specified)

_____ Wet well ventilation pipe properly supported and proper distance above grating.

_____ Surge valve pipe properly supported and proper distance above grating (if applicable).

SUBMERSIBLE PUMPS (IF APPLICABLE)

_____ Pull and reset each pump. Clears openings in grate and hatch opening

_____ Check guide rails & pump connection seats

_____ Check electrical connections for adequacy and seals for gas tightness

_____ Pump power cable condition, in place and secure, conduit entries installed correctly

_____ Pump lifting cables in place and secure

8. VALVE VAULT

HATCHES:

_____ Corrosion resistant hardware and fasteners

_____ Automatic hold open device(s).

_____ Slam latch with removable key, spare keys furnished

____ Flush handle

____ Fall protection D-ring installed

____ Hatch drain to grade

LADDERS:

____ Aluminum construction

____ Rungs 1-inch square

____ Maximum run spacing 12 inches on center

____ Non-skid grooves in rungs

____ Minimum dimension from wall to centerline of rung 7- inches

____ No toe interference behind rungs at any location (no pipes, conduits, etc.)

____ Ladder properly secured to structure

____ Locking extension poles or grab bars as specified

____ Joints sealed/ good workmanship. No infiltration observed.

____ Check pipe and conduit penetrations for leaks.

____ Interior coatings as specified

____ Aluminum grating (Sectional to be easily removable) and aluminum supports (bituminous coated in contact with concrete)

____ Pump around connections and valving as specified

____ Male couplers with dust caps on brass chain in place

____ Sump pits with floor sloped to drain (test with water). Mud valve operational.

____ Exercise all valves from full open to full closed (control flow to prevent spills)

____ Valve operator extensions positioned and supported properly, accessible aligned with openings

____ Personnel Emergency push button mounted correctly and tested for operation

9. ODOR CONTROL

CHEMICAL (if applicable)

____ Check operation of odor control system, including dosing pumps, controls and Alarm panel

____ Chemical storage tank full with specified chemical

____ Check pump suction piping and level sensor hook-ups in tank manway. Replace lid.

____ Check fill station connection and piping.

SOIL ODOR FILTER (if applicable)

____ Check installation and operation of soil odor filter blower.

____ Proper discharge pressure, butterfly valve adjusted.

____ Check condition of enclosure and hardware. Sound insulation in place and secure

____ Check operation of soil odor filter blower blower ¼-turn by-pass valve (open then close and leave closed).

____ At filter box, check for operation and air flow from soil odor filter blower by removing inspection/cleanout cap.

____ Check installation and operation of soil odor filter sprinkler system/ timers.

BIO FILTER (if applicable)

____ Check installation and operation of filter blower.

____ Proper discharge pressure, valves / dampers adjusted.

____ Proper media temperature and pressure drop.

____ Check condition of Control enclosure and hardware. Indicator lights working.

____ Check line-up and operation of water supply/ moisture control. Heat trace operational?

____ At filter outlet stack, check for operation and air flow.

10. EMERGENCY STORAGE TANK (if applicable)

HATCHES:

_____ Corrosion resistant hardware and fasteners

____ Automatic hold open device(s).

____ Slam latch with removable key, spare keys furnished

____ Flush handle

____ Fall protection D-ring installed

____ Hatch drain to grade

LADDERS:

____ Aluminum construction

____ Rungs 1-inch square

____ Maximum run spacing 12 inches on center

____ Non-skid grooves in rungs

____ Minimum dimension from wall to centerline of rung 7- inches

____ No toe interference behind rungs at any location (no pipes, conduits, etc.)

____ Ladder properly secured to structure

____ Locking extension poles or grab bars as specified

TANK:

____ Joints sealed/ good workmanship. No infiltration observed.

____ Interior coatings as specified

____ Sump pits with floor sloped to drain (test with water).

____ Exercise drain valve from full open to full closed (control flow to prevent spills)

____ Valve operator extensions positioned and supported properly, accessible aligned with openings

11. SITE

____ Fence, gate, lock as specified (Black vinyl with mowing strip and correct expansion joints at 10 foot maximum)

____ Paving as specified, no birdbaths

____ Storm drain grates clean and open

____ Site graded to prevent ponding and flooding

____ All grass areas growing and as specified; four inches of topsoil required

____ All shrubbery alive and as specified

____ Fire hydrant as specified and operating (if applicable)

____ Yard hydrant as specified and operating

____ Stone provided over vinyl cloth weed barrier as specified

____ Metal edging installed as specified.

____ Bollards in place with safety yellow vinyl sleeves

____ Check operation of swing gates and slide gates

12. DRY WELL

HATCH:

_____ Corrosion resistant hardware and fasteners

____ Automatic hold open device(s).

____ Slam latch with removable key, spare keys furnished

____ Flush handle

____ Fall protection D-ring and safety/ retracting device installed

____ Automatic light limit switch working

____ Entry alarm limit switch working (alarm received at Millersville)

LADDERS

____ Aluminum construction

____ Rungs 1-inch square

____ Maximum run spacing 12 inches on center

____ Non-skid grooves in rungs

____ Minimum dimension from wall to centerline of rung 7- inches

____ No toe interference behind rungs at any location (no pipes, conduits, etc.)

____ Ladder properly secured to structure

____ Locking extension poles, grab bars or equal on hatches as specified

____ Ladder and grab bar

_____ 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.

_____ Intermediate Landing aluminum grating: Sections easily removable and aluminum supports

_____ Joints sealed / good workmanship. No infiltration observed.

_____ Check pipe and conduit penetrations, pump hand hole covers and flanges for leaks.

_____ Interior coatings as specified

_____ Sump pump with double check valves and isolation valve. Pump operational

_____ Local pump disconnects operational and as specified

_____ Dehumidifier operational and as specified

_____ Exercise pump valves from full open to full closed (control flow to prevent spill)

_____ Pumps and mechanical seals primed and ready for testing. Pressure gauges in place

_____ Pump rotation checked under Normal and Emergency power

_____ Pump power cable, seal tight, conduit installed correctly

_____ 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

_____ Flowmeter transducers mounted properly (if applicable)

_____ Lighting operational and as specified

_____ Lifting eyes for moving pumps, valves provided as specified

_____ Dry well flood float properly located, easily accessible, proper type, will not foul.

_____ Surge valve isolation valve open and ready for operation

____ Personnel Emergency push button mounted correctly and tested for operation

13. 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

14. FORCE MAIN AIR RELEASE VALVES AND BLOWOFFS

_____ Recheck that all ARV valves operational. No leaks from testing

_____ Recheck all blow-off vaults. No leaks from testing

15. 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 Appendix B thru G of 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.

16. ____ **ALL PUNCHLIST ITEMS COMPLETED BY CONTRACTOR**

17. **AS-BUILT DRAWINGS**

____ Red-lined copies provided to county for processing

18. ____ **CONDITIONAL ACCEPTANCE SIGN-OFF**

cc: (When completed:)

Contractor Construction Management
Design Engineer State OEP
Project Engineer

PUMP PERFORMANCE TESTING

PART 1 - General

All 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, Section 15990).

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:

Pumps
Pump motors

PART 3 - Testing Prerequisites:

PART 4 - 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.

Flow path established for pump tests (i.e. recirculation to wet well or pumping through force main).

PART 5 - All measuring devices and instrumentation should be calibrated and adjusted prior to testing. Calibrated pressure test gauges shall be used for head measurements.

PART 6 - On coupled motor/pump arrangements shafts shall be checked and verified for proper alignment, coupling gap settings and lubricated if necessary.

PART 7 - 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.

PART 8 - Prior to testing, pump bearings, motor bearings, and splines and steady bearings shall be checked for proper lubrication.

PART 9 - 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.

PART 10 - On satisfactory completion of preliminary inspections the pumps can be lined-up, primed and seal water made available, 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 11 - Test Parameters

As a minimum, the following values are to be measured on-site and compared against design conditions/values:

PART 12 - 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.

PART 13 - 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.

PART 14 - Pump speed (not required on submersible style pumps).

PART 15 - 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%.

PART 16 - Motor and pump bearing temperature rise. Note any deficiencies and actions to be taken to correct.

PART 17 - 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:

1. Each pump and power cable shall be meggered dry (each phase) before they have been submerged for the first time on-site.

2. 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.

PART 18 - Pump and motor vibration (see section on vibration testing, Section 15990 and Appendix F).

PART 19 - Documentation

PART 20 - Factory certification that pumps will perform at each design condition.

1. Motor certifications.
2. Pump installation certificates.
3. Pump service card submitted.
4. Shaft alignment certification.
5. Shop drawings with performance curves.
6. A final performance and inspection report shall be submitted containingcomplete 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.

END OF SECTION

RECORD OF PUMP PERFORMANCE TEST

STATION NAME

MOTOR/PUMP #_____

GPM _____ RPM_____ VAR/CONST.

MOTOR HP_____ MGFR _____

DESCRIPTION/CONDITION:

_____

_____

SHAFT ASSEMBLY
DESCRIPTION/CONDITION

_____

_____

PUMP SIZE _____CAPACITY _____ MANUFACTURER

IMPELLER ROTATION

PACKING/SEALS _____INSPECTION PLUG _____

BASE & FOUNDATION:

DESCRIPTION_____

CONDITION_____

OBSERVE OPERATION

VIBRATION_____

CAVITATION _____

NOISE_____

HEAT _____

VIBRATION DATA AVAILABLE (yes) (no)

APPENDIX C

ELECTRICAL INFRARED TESTING PROCEDURES

Published:7/11 Revised:

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

I. 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 Builtogether Sewage Pumps Rigid Mount with Concrete Base

Published: 7/11 Revised:

APPENDIX D.1
VIBRATION PERFORMANCE TESTING
DRY PIT SUBMERSIBLE PUMPS

A. General

1. Perform a vibration analysis on all dry pit submersible pumps after they are installed and ready to run. All final vibration readings used for acceptance will be taken with the machinery under normal full load operating conditions. The analysis is to be performed by qualified technicians 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 in inches/second. 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. (4) copies of a vibration report on tested machinery shall be provided to the Engineer for distribution;

   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. 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
At impeller blade pass frequency	Not to exceed .25 inches/sec RMS velocity

Frequency Range	Tolerance
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.

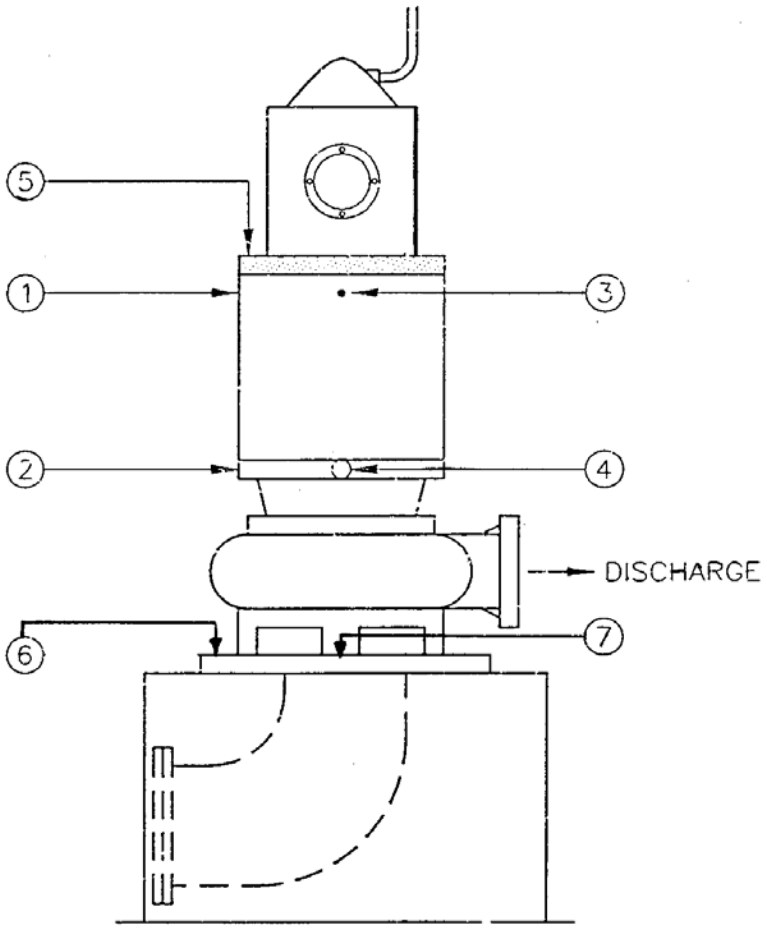
    c) The equipment speed shall then be manually reduced at the VFD in 1 Hertz increments from full speed to designated minimum speed (or flow) while observing or storing (vibration analyst option) the vibration data.

    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. Equipment to be tested under this standard:

VIBRATION TEST POINTS
DRY–PIT SUBMERSIBLE
PUMPS

NOTE: POSITIONS 1, 2 & 6 ARE IN LINE WITH DISCHARGE PIPING
POSITIONS 3, 4, 5 & 7 ARE 90° FROM DISCHARGE PIPING



PREPARED BY A.A. COUNTY BUREAU OF UTILITIES OPERATIONS TECHNICAL SUPPORT SERVICES	MASTER GUIDE SPECIFICATIONS FOR MACHINERY VIBRATION	DATE: 9/1/89 DWG. NO. 4

APPENDIX D.2
VIBRATION PERFORMANCE TESTING
VERTICAL COUPLED PUMPS

A. General

1. Perform a vibration analysis on all pumps and motors after they are installed and ready to run. All final vibration readings used for acceptance will be taken with the machinery under normal full load operating conditions. The analysis is to be performed by qualified technicians 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

5. 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.

6. 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.

7. Vibration amplitude readings in inches/second. 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.

8. 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

3. (4) copies of a vibration report on tested machinery shall be provided to the Engineer for distribution;

e. outlining the procedures used;
f. stating the vibration standards used for the equipment;
g. stating the analysis results for each piece of equipment;
h. 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. 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
At impeller blade pass frequency	Not to exceed .25 inches/sec RMS velocity

Frequency Range	Tolerance
Above impeller blade frequency out to 120,000 Cycles Per Minute (CPM)	No vibration peaks in excess of .04 inches/sec RMS velocity

4. On Variable Frequency Drive (VFD) applications, vibration shall be evaluated against the above tolerances as follows:

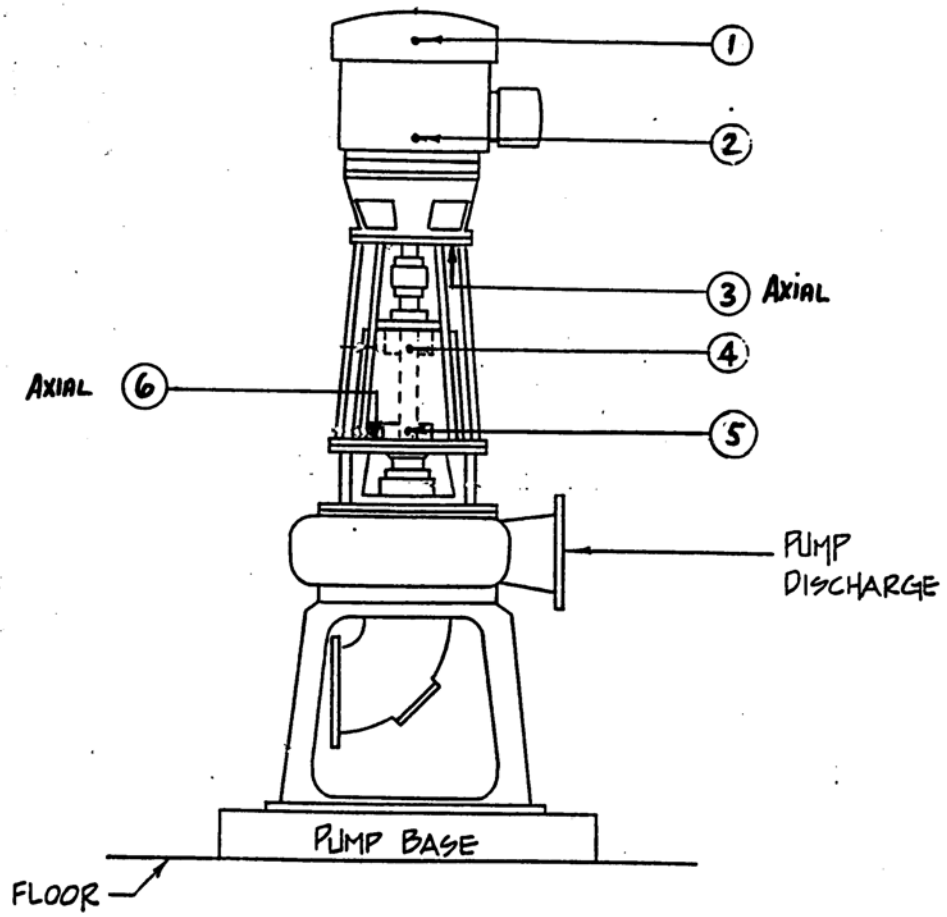
    a) Store and evaluate the vibration data against the above tolerances at all measurement points designated on the attached testing diagram under full speed conditions. These readings shall be included in the vibration report.

    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.

F. Equipment to be tested under this standard:



NOTE: ALL MEASUREMENT POINTS ARE TAKEN 90 DEGREES TO DISCHARGE PIPING

VIBRATION TEST POINTS FOR VERTICAL EQUIPMENT

APPROVED CVH	PREPARED BY BUREAU OF UTILITY OPERATIONS TECHNICAL SUPPORT SERVICES	MASTER GUIDE SPECIFICATION FOR MACHINERY VIBRATION	FILE NO.
DATE 12/ 17/89			DRAWING 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 pumps after they are installed and ready to run. All final vibration readings used for acceptance will be taken with the machinery under normal full load operating conditions. The analysis is to be performed by qualified technicians whose credentials are approved in advance by the County. An authorized representative of the County shall also witness the testing.

3. 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

9. 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.

10. 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.

11. Vibration amplitude readings in inches/second. 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.

12. 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

5. (4) copies of a vibration report on tested machinery shall be provided to the Engineer for distribution;

   i. outlining the procedures used;
   j. stating the vibration standards used for the equipment;
   k. stating the analysis results for each piece of equipment;
   l. 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. 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
At impeller blade pass frequency	Not to exceed .20 inches/sec RMS velocity

Frequency Range	Tolerance
Above impeller blade frequency out to 120,000 Cycles Per Minute (CPM)	No vibration peaks in excess of .04 inches/sec RMS velocity

6. On Variable Frequency Drive (VFD) applications, vibration shall be evaluated against the above tolerances as follows:

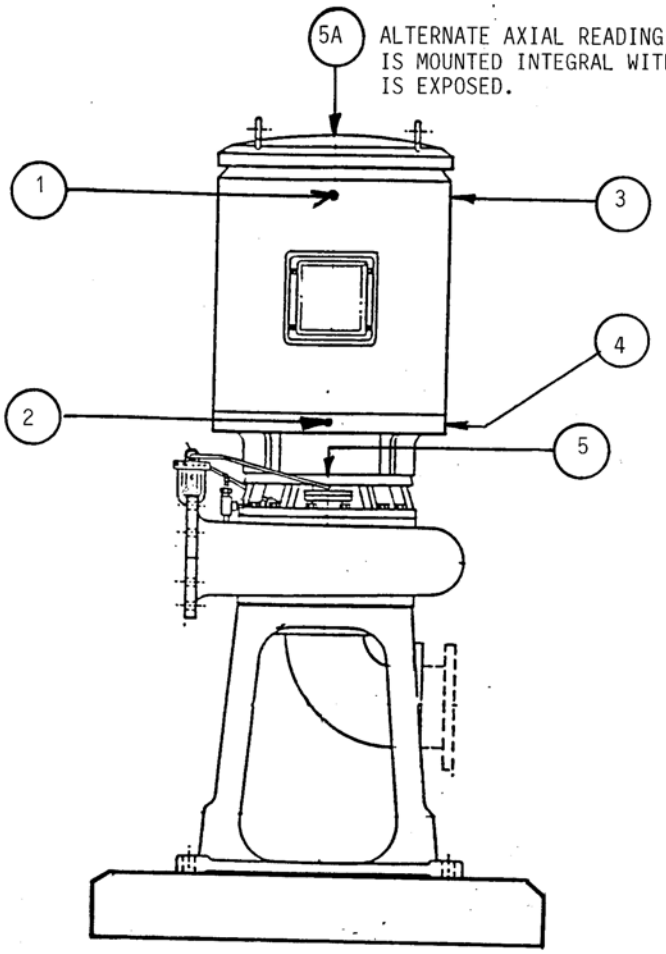
    a) Store and evaluate the vibration data against the above tolerances at all measurement points designated on the attached testing diagram under full speed conditions. These readings shall be included in the vibration report.

    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.

G. Equipment to be tested under this standard:



NOTES: * MEAS. POINTS 1 & 2 ARE AT 90 TO DISCHARGE PIPING AND MEAS. POINTS 3 & 4 ARE IN LINE WITH DISCHARGE PIPING.

* IN ORDER TO ACHEIVE GOOD VIBRATION SENSOR MOUNTING ON POINTS 1 & 3 AND TO GET AS CLOSE TO THE TOP BEARING AS POSSIBLE, IT MAY BE PRACTICAL TO REMOVE THE FAN HOOD TEMPORARILY DURING TESTING.

VIBRATION TEST POINTS

VERTICAL BUILTOGETHER SEWAGE PUMPS

PROVED DATE: REV 1 12/1/94	PREPARED BY: BUREAU OF UTILITY OPERATIONS TECHNICAL SUPPORT SVCS	MASTER GUIDE SPECIFICATIONS FOR MACHINERY VIBRATION	FILE NO. DWG. NO. 1

APPENDIX E

LOAD BANK
TESTING PROCEDURE

Published: 6/2011 Revised:

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.

II 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 sed unless the manufacturers of the EPS certify that the ry chemical system will not damage the EPS system or inder 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 uxiliary Protective Signaling Systems for Fire Alarm ervice; NFPA 72C, Standard for the Installation, Maintenance and Use of Remote Station Protective Signaling ystems for Fire Alarm and Supervisory Service; NFPA 2D, Standard for the Installation, Maintenance and Use f Proprietary Protective Signaling Systems; and NFPA 2E, 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 istribution lines, fuel distribution lines and others which rve 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 hock.

-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- n 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											

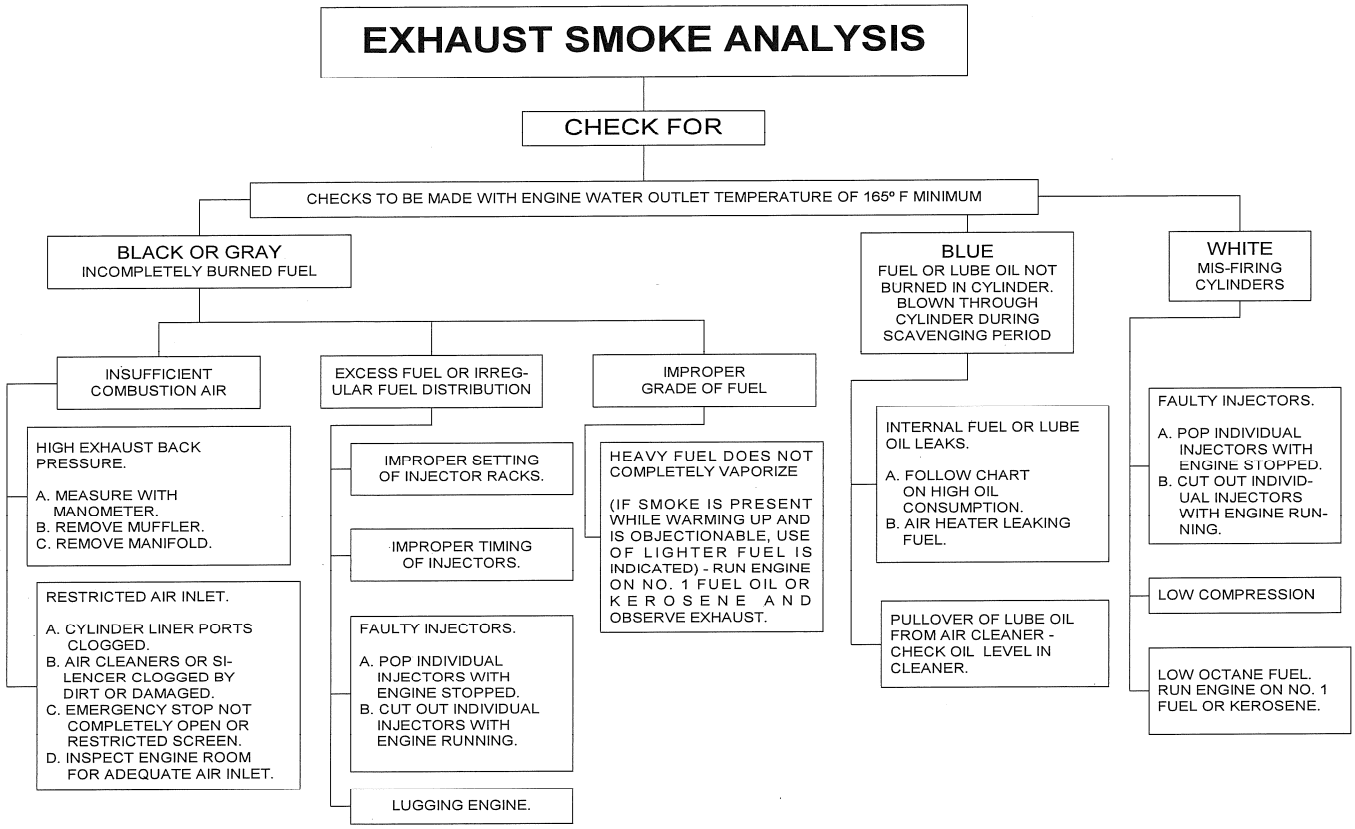
LOAD RATE 25% _____ TESTED BY:_

LOAD RATE 50% _____ OBSERVED BY:

LOAD RATE 80% _____ APPROVED BY:

FORM #1 13089/#1MXL

Published: 7/11 Revised:



Published: 7/11 Revised: