SUPPLEMENTAL SPECIFICATIONS

Sludge Pumping Stations No. 1 and 2 Rehabilitation

Contract No. PC-780

SECTION 03301 – SUPPLEMENTAL

CAST-IN-PLACE CONCRETE

Supplemental Specification Summary:
This section replaces entirely Master Specification Section 03300 Cast-In-Place Concrete.

(Update text as shown.)

1.1 SCOPE

Provide all labor, equipment, materials and services necessary for the manufacture, transportation, placement, and curing of all plain and reinforced concrete work, as shown on the Drawings or as ordered by the Engineer.

1.2 GOVERNING STANDARDS. Without limiting the generality of the Specifications, all work herein shall conform to or exceed the applicable requirements of the following documents. All referenced specification, codes, and standards refer to the most current issue available at the time of Bid.

City of Detroit Building code (BOCA as amended)

Michigan Building Code (MBC) 2000.

ACI 214 – Recommended Practice for Evaluation of Strength Test Results of Concrete

ACI 301 – Specifications for Structural Concrete for Buildings

ACI 304 – Guide for Measuring, Mixing, Transporting, and Placing Concrete

ACI 305 – Hot Weather Concreting

ACI 306 – Cold Weather Concreting

ACI 308 – Standard Practice for curing concrete

ACI 309 – Recommended Practice for Consolidation of Concrete

ACI 318 – Building Code Requirements for Structural Concrete

ACI 350 – Environmental Engineering Concrete Structures

ASTM C 31 – Standard Methods of Making and Curing Concrete Test Specimens in the Field

ASTM C 33 – Standard Specification for Concrete Aggregates

ASTM C 39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

ASTM C 42 – Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

ASTM C 88 – Standard Test Method for Soundness of Aggregates by use of Sodium Sulfate or Magnesium Sulfate

ASTM C 94 – Standard Specification for Ready-Mixed Concrete

ASTM C 114 – Standard Test Method for Chemical Analysis of Hydraulic Cement

ASTM C 136 – Standard Method for Sieve Analysis of Fine and Coarse Aggregate

ASTM C 138 – Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete

ASTM C 143 – Standard Test Method for Slump of Portland Cement Concrete

ASTM C 150 – Standard Specification for Portland Cement

ASTM C 171 – Standard Specifications for Sheet Materials for Curing Concrete

ASTM C 172 – Standard Method of Sampling Fresh Concrete

ASTM C 192 – Standard Method of Making and Curing Concrete Test Specimens in the Laboratory

ASTM C 231 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

ASTM C 260 – Standard Specification for Air-Entraining Admixtures for Concrete

ASTM C 309 – Standard Specification for Liquid Membrane Forming Compounds for Curing Concrete

ASTM C 457 – Standard Recommended Practice for Microscopical Determination of Air-Void Content and Parameters of the Air-Void System in Hardened Concrete

ASTM C 494 – Standard Specification for Chemical Admixtures For Concrete

ASTM C 595 – Standard Specification for Blended Hydraulic Cements

ASTM C 618 – Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete

ASTM C 989 – Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars

ASTM C1077 – Recommended Practice for Labs Testing Concrete

ASTM C1260 – Standard Test Method for Potential Alkali Activity of Aggregates (Mortar-Bar Method)

MDOT Michigan Department of Transportation 1996 Standard Specifications for Construction

AASHTO T26 – Quality of Water to be used in Concrete

1.3 SUBMITTALS

Submit the following in accordance with Specifications herein.

Sources of all materials and certifications of compliance with specifications for all materials.

Aggregate test results showing compliance with required standards, i.e., sieve analysis, aggregate soundness tests, etc.

Manufacturer's data on all admixtures stating compliance with required standards.

In lieu of laboratory trial batch mixes, past history compressive test break data can also be used. Past history test break results must be less than 1 year old per ACI 301-4.2.3. Whether laboratory trial batch mixes or past history test break results are used for submittal, the following requirements must be met: 28 day test break results must be

done by a testing lab in accordance with ASTM C 31 and ASTM C 39 requirements. The test break results must prove that the mix tested is the same mix being proposed. The 28 day test break results must meet ACI 301-4.2.3.2.a acceptance criteria.

Concrete mixture designs and test data shall be submitted for review by the Engineer with a written request for approval. No concrete shall be placed until the Contractor has received such approval in writing. Each mixture report shall include:

Slump on which design is based.

Total gallons of water per cubic yard.

Brand, type, composition, and quantity of cement.

Brand, type composition, and quantity of fly ash.

Brand, type, composition, and quantity of microsilica

Specific gravity and gradation of each aggregate.

Ratio of fine to total aggregates.

Weight (surface dry) of each aggregate per cubic yard.

Brand, type, ASTM designation, active chemical ingredients, and quantity of each admixture.

Air content.

Compressive strength based on 7-day and 28-day compression tests.

Time initial set.

Submit reports of the sampling and testing of slump, air content and strength performed.

Submit reports of nondestructive, core and/or liquid retention testing required for acceptance of concrete in place.

Submit Shop Drawings showing the location of all joints. Included shall be a schedule of the concrete pouring. The location of joints and pouring schedule shall be subject to approval by the Engineer.

Concrete Field Delivery Tickets: Submit tickets as detailed herein.

1.4 QUALITY ASSURANCE.

Tests on materials used in the production of concrete shall be required as specified in PART 2 -- PRODUCTS. These tests shall be performed by an independent testing laboratory approved by the Engineer at no additional cost to the Owner.

PRE-INSTALLATION MEETING

Section 01039 – Coordination and Meetings: Pre-installation meeting.

Organize, arrange, and conduct meeting. Give attendees 4 days advance notice of the meeting time and place.

Convene minimum 1 week prior to commencing Work of this Section.

Attendees: OWNER, ENGINEER, CONTRACTOR’s project manager and field superintendent, Subcontractor responsible for placement of concrete (if applicable), OWNER’s testing lab, the concrete supplier and concrete supplier’s quality assurance representative.

Agenda: Discuss items of significance that affect the progress of the Work including the following:

Introduction of personnel and responsibilities.

Work sequence.

Approved concrete mix design.

Discussion of batch ticket to be presented with each truck.

The use of admixtures based on placement techniques and weather conditions.

Testing procedures including frequency.

Transmitting test reports from OWNER's testing lab.

Transmitting field testing information on concrete.

Storage of cylinders on Site for OWNER's testing lab.

Trial concrete mixes shall be tested when required in accordance with specification herein at no additional cost to the Owner.

Field quality control tests, as specified herein, unless otherwise stated, will be performed by a testing laboratory employed by the Owner. However, the Contractor shall be charged for the cost of any additional tests and investigation on work performed which does not meet the Specifications. Any individual who samples and tests concrete to determine if the concrete is being produced in accordance with this Specification shall be certified as a Concrete Field Testing Technician, Grade I, in accordance with ACI CP-2. Testing laboratory shall conform to requirements of ASTM C-1077.

PART 2 - PRODUCTS

2.1 HYDRAULIC CEMENT

Portland Cement

Portland Cement shall be Type II conforming to ASTM C 150.

For concrete mixed with only Portland Cement, the total alkalies in the cement (calculated as the percentage of NA_2O plus 0.658 times the percentage of K_2O) shall not exceed 0.40% unless aggregates to be used meet the requirements for non-reactivity with alkalies stated in Article 2.4.

For concrete mixed with Portland Cement and an appropriate amount of Ground Granulated Blast-Furnace Slag, the total alkalies in the Portland Cement (calculated as the percentage of NA_2O plus 0.658 times the percentage of K_2O) shall not exceed 0.85% unless aggregates to be used meet the requirements for non-reactivity with alkalies stated in Article 2.4.

A resubmittal will be required if different cements are proposed during the Project.

Cement shall be stored in a suitable weather-tight building so as to prevent deterioration or contamination. Cement which has become caked, partially hydrated, or otherwise damaged will be rejected.

2.2 GROUND GRANULATED BLAST-FURNACE SLAG (GGBF SLAG).

Ground Granulated Blast-Furnace Slag shall meet the requirements of ASTM C989 Grade 100 or 120.

2.3 WATER.

Potable water approved by the State Department of Public Health may be used without testing.

For water requiring testing, the tests shall be conducted in accordance with AASHTO T26 and meet the following requirements:

Total Solid Mater, max. …… 0.30%

Organic Matter, max. …… 0.05%

Alkalinity-acidity …….. neutral to litmus

2.4 AGGREGATES.

All aggregates used in normal weight concrete shall conform to ASTM C 33.

General Requirements: Washing will be required to eliminate the dust, clay, or silt coating. Aggregates, which have been washed, shall not be used sooner than 24 hours after washing, unless approved by the Engineer.

Fine Aggregate (Sand) in the various concrete mixes shall consist of natural or manufactured siliceous sand, clean and free from deleterious substances. Fine Aggregate shall be MDOT aggregate 2NS. Fine aggregates shall conform to MDOT Specification 902.09 and the Grading Requirements in Table 902.4.

Coarse Aggregate shall be gravel or crushed rock conforming to MDOT Class 6AA meeting the requirements of MDOT paragraph 902.03 as well as tables 902-1 and 902-2.

Aggregates shall be tested for soundness in accordance with ASTM C 88. The loss resulting after five cycles shall not exceed 10 percent for fine or coarse aggregate when using magnesium sulfate.

When aggregates, which are non-reactive with alkalis, are desired in order to waive the alkali content requirement of cement as stated in herein, the following tests shall be performed:

A petrographic analysis in accordance with ASTM C295 shall be performed to identify the constituents of the fine and coarse aggregate. Aggregates containing more than the following quantities of constituents shall be considered potentially reactive:

Optically strained, microfractured, or microcrystalline quartz exceeding 5.0%.

Chert or chalcedony exceeding 3.0%.

Tridymite or cristobalite exceeding 1.0%.

Opal exceeding 0.5%.

Natural volcanic glass in volcanic rocks exceeding 3.0%.

Aggregate shall be evaluated by ASTM C-1260 Aggregate sources that exhibit mean mortar bar expansions at 16 days greater than .08% shall be considered potentially reactive. Tests shall be made with cement proposed for use on the job.

Contractor shall submit a new trial mix to the Engineer for approval whenever a different aggregate or gradation is proposed.

No aggregates that have become intermixed prior to proportioning shall be used. Sufficient aggregate shall be available at the site to preclude the possibility of damaging delays while placing the concrete.

2.5 ADMIXTURES.

Air entraining agent shall be added to all concrete unless noted otherwise. The agent shall consist of a neutralized vinsol resin solution or a purified hydrocarbon with a cement catalyst which will provide entrained air in the concrete in accordance with ASTM C 260 and ACI 212. The admixture proposed shall be selected in advance so that adequate samples may be obtained and the required tests made. Air content of concrete, when placed, shall be within the ranges given in the concrete mix design. Air entraining admixture shall be Master Builders "MB AE 90", W.R. Grace "Darex II" or "Daravair".

Other admixtures shall be required at the Engineer's discretion or, if not required, may be added upon approval of the Engineer at no additional cost to the Owner. Admixtures permitted shall conform to the requirements of ASTM C 494. Admixtures shall be non-toxic after 30 days and shall be compatible with and made by the same manufacturer as the air entraining admixtures.

Set controlling admixture shall be either with or without water-reducing properties. Where the air temperature at the time of placement is expected to be consistently over 90°F., a water-reducing retarder such as Master Builder "Pozzolith 100XR", W.R. Grace "Daratard-17" may be used. Where the air temperature at the time of placement is expected to be consistently under 40°F., a non-corrosive, non-chloride accelerator such as Master Builders "Pozzutec 20", W.R. Grace "Polarset" may be used.

Low range water reducing admixture shall be in conformance with ASTM C 494 Type A or D. Water reducing admixture shall be Master Builders "Pozzolith 322-N", W.R. Grace "WRDA Series". The admixtures shall be used in strict accordance with manufacturer's recommendations.

High range water reducer shall be sulfonated polymer conforming to ASTM C 494, Type F or G.

If the high range water reducing admixture is added to the concrete at the batch plant, it shall be Type G, "Rheobuild 716L" (Master Builders), "Daracem 100" or "Daracem 19" (W.R. Grace).

If the high range water reducer is added to the concrete at the job site, it shall be used in conjunction with a low range water reducer and shall be "Rheobuild 1000" by Master Builders, "ADVAFLOW" by W.R. Grace.

The high range water reducing admixture shall be accurately measured and pressure injected into the mixer as a single dose by an experienced technician. A standby system shall be provided and tested prior to each day's operation of the job site system.

Concrete shall be mixed at mixing speed for a minimum of 100 mixer revolutions after the addition of the high range water reducer.

Admixtures containing calcium chloride, thiocyanate or more than 0.05 percent chloride ions are not permitted. The addition of admixtures to prevent freezing is not permitted.

The Contractor shall submit manufacturer's data including the chloride ion content of each admixture and certification from the admixture manufacturer that all admixtures utilized in the design mix are compatible with one another and properly proportioned prior to mix design review by the Engineer.

2.6 CONCRETE MIX DESIGN.

The proportions of cement, aggregates, admixtures and water used in the concrete mixes shall be based on the results of field experience or laboratory trial mixes in conformance with Section 5.3 "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318. When trial mixes are used they shall also conform to Article 3.1 of this specification section. Field experience records and/or trial mix data used as the basis for the proposed concrete mix design shall be submitted to the Engineer along with the proposed mix.

Class A Concrete (Typical for all concrete unless otherwise noted on drawings or in specifications): Provide concrete to the following criteria:

Compressive Strength (7 Day): 3,200 psi.

Compressive Strength (28 Day): 4,000 psi.

Water/Cement Ratio (Maximum): 0.5 by weight.

Air Entrained: 6 percent, +/- 1 percent.

GGBF Slag Content: Maximum 25 percent of cement content.

Slump (Maximum): 3 inches (due to water).

Mid or High Range Water Reducer: Add at Site to increase slump to 6 inches, ±1-1/2 inches.

Class C Concrete: (For all Concrete Fill): Provide concrete to the following criteria:

Compressive Strength (28 Day): 2,500 psi.

GGBF Slag Content: Maximum 25 percent of cement content.

Slump (Maximum): 6 inches.

PART 3 - EXECUTION

3.1 TRIAL MIX.

When field experience records are inadequate to confirm the quality of a proposed concrete mix in accordance with Section 5.3, "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318, or when required by the Engineer, an independent testing laboratory designated by the Contractor and acceptable to the Engineer shall test a trial batch of each of the preliminary concrete mixes submitted by the Contractor. The trial batch shall be prepared using the aggregates, cement and admixtures proposed for the project. The trial batch materials shall be of a quantity such that the testing laboratory can obtain enough samples to satisfy requirements stated below. Tests on individual materials stated in PART 2 -- PRODUCTS should already be performed before any trial mix is done. The cost of laboratory trial batch tests for each specified concrete mix will be borne by the Contractor and the Contractor shall furnish and deliver the materials to the testing laboratory at no cost to the Owner.

An independent testing laboratory shall observe the preparation of the trial batch, and they shall prepare a minimum of fifteen (15) standard test cylinders in accordance with ASTM C 31 in addition to conducting slump ASTM C 143, air content ASTM C 231 and unit weight ASTM C 138 tests. Compressive strength test on the cylinders shall subsequently be performed by the same laboratory in accordance with ASTM C 39 as follows: Test 3 cylinders at age 7 days; test 3 cylinders at age 21 days; test 3 cylinders at age 28 days and test 3 cylinders at 56 days. The cylinders shall be carefully labeled. If the average 28-day compressive strength of the trial mix is less than that specified, or if any single cylinder falls below the required strength by more than 500 psi, the mix shall be corrected, another trial batch prepared, test cylinders taken, and new tests performed as before. Any such additional trial batch testing required shall be performed at no additional cost to the

Owner. Adjustments to the mix shall be considered refinements to the mix design and shall not be the basis for extra compensation to the Contractor.

3.2 PRODUCTION OF CONCRETE.

All concrete shall be machine mixed. Hand mixing of concrete will not be permitted. The Contractor may supply concrete from a ready mix plant or from a site mixed plant. In selecting the source for concrete production the Contractor shall carefully consider its capability for providing quality concrete at a rate commensurate with the requirements of the placements so that well bonded, homogenous concrete, free of cold joints, is assured.

Ready-Mixed Concrete

At the Contractor's option, ready-mixed concrete may be used meeting the requirements for materials, batching, mixing, transporting, and placing as specified herein and in accordance with ASTM C 94.

Truck mixers shall be equipped with electrically-actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be of the resettable, recording type, and shall be mounted in the driver's cab. The counters shall be actuated at the time of starting mixers at mixing speeds.

Each batch of concrete shall be mixed in a truck mixer for not less than 70 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolutions of mixing.

Truck mixers and their operation shall be such that the concrete throughout the mixed batch, as discharged, is within acceptable limits of uniformity with respect to consistency, mix and grading. If slump tests taken at approximately the 1/4 and 3/4 points of the load during discharge give slumps differing by more than one inch when the specified slump is 3 inches or less, or if they differ by more than 2 inches when the specified slump is more than 3 inches, the mixer shall not be used on the work unless the causing condition is corrected and satisfactory performance is verified by additional slump tests. All mechanical details of the mixer, shall be checked before a further attempt to use the unit will be permitted.

Ready-mixed concrete shall be delivered to the site for the work and discharge shall be completed before the drum has been revolved 250 revolutions and within the time requirements stated in Article 3.03 of this Section.

Each and every concrete delivery shall be accompanied by a delivery ticket containing at least the following information:

Date and truck number

Ticket number

Mix designation of concrete

Cubic yards of concrete

Cement brand, type and weight in pounds

Weight in pounds of fine aggregate (sand)

Weight in pounds of coarse aggregate (stone)

Air entraining agent, brand, and weight in pounds and ounces

Other admixtures, brand, and weight in pounds and ounces

Water, in gallons, stored in attached tank

Water, in gallons, maximum that can be added without exceeding design water/cement ratio

Water, in gallons, actually used (by truck driver)

Time of loading

Time of delivery to job (by truck driver)

Signatures of inspectors at plant and site

Any truck delivering concrete to the job site, which is not accompanied by a delivery ticket showing the above information will be rejected and such truck shall immediately depart from the job site.

The use of non-agitating equipment for transporting ready-mixed concrete will not be permitted. Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted. The quality and quantity of materials used in ready-mixed concrete and in batch aggregates shall be subject to continuous inspection at the batching plant by the Engineer.

3.3 CONCRETE PLACEMENT.

Supplemental Specifications—which are issued separately from the Master Specifications on a per contract basis—shall supersede and govern over all other specifications or contract documents. All other wording in the Master Specifications that is not specifically stated to be modified in the Provisional Specifications shall remain in effect as is. The Supplemental Specification Summary is included to clarify and/or highlight changes.

No concrete shall be placed prior to approval of the concrete mix design. Concrete placement shall conform to the recommendations of ACI 304.

Prior to concrete placement, all reinforcement shall be securely and properly fastened in its correct position. Formwork shall be clean, oiled and form ties at construction joints shall be retightened. All bucks, sleeves, castings, hangers, pipe, conduits, bolts, anchors, wire, and any other fixtures required to the embedded therein shall be in place. Forms for openings to be left in the concrete shall be in place and anchored by the Contractor. All loose debris in bottoms of forms or in keyways shall be removed and all debris, water, snow, ice and foreign matter shall be removed from the space to be occupied by the concrete. The Contractor shall notify the Engineer in advance of placement, allowing sufficient time for a concurrent inspection and for any corrective measures which are subsequently required.

On horizontal joints where concrete is to be placed on hardened concrete, a slush coat of mortar 1/2-inch to 1-inch thick with slump less than 6 inches, made of the same materials as the concrete, but without the coarse aggregate, shall be worked well into the irregularities of the hard surface just ahead of the concrete placement.

All concrete shall be placed during the daylight hours except with the consent of the Engineer. If special permission is obtained to carry on work during the night, adequate lighting must be provided.

When concrete arrives at the site with slump below that suitable for placing, as indicated by the Specifications, water may be added to bring the concrete within the specified slump range provided that the design water-cement ratio is not exceeded. Slump adjustment, with water, shall be made only one time. Water may be added only to full trucks. On-site tempering shall not relieve the Contractor from furnishing a concrete mix that meets all specified requirements.

Concrete shall be conveyed as rapidly as practicable to the point of deposit by methods which prevent the separation or loss of the ingredients. It shall be so deposited that rehandling will be unnecessary. Discharge of the concrete to its point of deposit shall be completed within 90 minutes after the addition of the cement to the aggregates. In hot weather, or under conditions contributing to quick stiffening of the concrete, the time between the introduction of the

cement to the aggregates and discharge shall not exceed the requirements stated herein.

No concrete shall be deposited in any unit until the area has been completely de-watered, and not until after the CONTRACTOR has made satisfactory provisions to eliminate all possibility of water entering or flowing through the concrete while it is being poured or is taking its set.

Before depositing new concrete on or against concrete which has already been cast, it shall be roughened as required by the Engineer and thoroughly cleaned of foreign matter and laitance. It shall be saturated with water, and then cleaned. The saturated surface of the hardened concrete, including vertical and inclined surfaces, shall be slurried with a slush coat of mortar 1/2-inch to 1-inch thick with slump less than 6 inches.

Where concrete is conveyed to position by chutes, a practically continuous flow in the chute shall be maintained. The angle and discharge arrangement of the chute shall be such as to prevent segregation of the concrete ingredients. The delivery end of the chute shall be as close as possible to the point of deposit and in no case shall the free pour from the delivery end of the chute exceed five feet.

The interior hopper slope shall be not less than 60 degrees from the horizontal, the minimum dimension of the clear gate opening shall be at least five (5) times the nominal maximum size aggregate and the area of the gate opening shall be not less than two (2) square feet. The maximum dimension shall not be greater than twice the minimum dimension. The bucket gates pneumatically or hydraulically operated except for buckets larger than two, (2) cubic yards shall not be manually operated. The design of the bucket shall provide means for positive regulation of the amount and rate of deposit of concrete in each dumping position.

Conveyors shall be designed and operated to assure a uniform flow of concrete from mixer to final place of deposit without segregation of ingredients or loss of mortar and shall be provided with positive means for preventing segregation of the concrete at the transfer points and the point of placing.

Special care must be exercised to prevent splashing of forms or reinforcement with concrete, and any such splashes or accumulations of hardened or partially hardened concrete on the forms or reinforcement above the general level of the concrete already in place must be removed before the work proceeds. Concrete shall be placed in all forms in such way as to prevent any segregation.

Placing of concrete shall be so regulated that the pressure caused by the wet concrete shall not exceed that used in the design of the forms.

All concrete for walls shall be placed through openings in the form spaced at frequent intervals or through tremies (heavy duct canvas, rubber, etc.), equipped with suitable hopper heads. Tremies shall be of variable lengths so that the free fall shall not exceed five (5) feet and a sufficient number shall be placed in the form to insure the concrete being kept level at all times.

When placing concrete that is to be exposed, sufficient illumination shall be provided in the interior of the forms so that the concrete, at places of deposit, is visible from deck and runways.

Concrete shall be placed so as to thoroughly embed all reinforcement, inserts, and fixtures.

When forms are removed, surfaces shall be even and dense, free from aggregate pockets or honeycomb. To achieve this, concrete shall be consolidated using mechanical vibration, supplemented by forking and spading by hand in the corners and angle of forms and along form surfaces while the concrete is plastic under the vibratory action. Consolidation shall conform to ACI 309. Vibrators shall be used at 18” to 30” intervals in the concrete.

Mechanical vibration shall be applied directly to the concrete, unless otherwise approved by the Engineer. The bottom of vibrators used on floor slabs must not be permitted to ride the form supporting the slab. Vibration shall be applied at the point of deposit and in the area of freshly placed concrete by a vertical penetration of the vibrator. Vibrators shall not be used to move concrete laterally within the forms.

The intensity of vibration shall be sufficient to cause settlement of the concrete into place and to produce monolithic joining with the preceding layer. It shall be of sufficient duration to accomplish thorough compaction and complete embedment of reinforcement and

fixtures with a vibrator transmitting not less than 7,000 impulses per minute. Since the duration of vibration per square foot of surface is dependent on the frequency, size of vibrator, and slump of concrete, the length of time must therefore be determined in the field. Vibration, however, shall not be continued in any one location to the extent that pools of grout are formed. All such vibrating, including methods and equipment, shall be subject to review by the Engineer.

Care shall be taken to prevent cold joints when placing concrete in any portion of the work. The concrete placing rate shall be such as to ensure that each layer is placed while the previous layer is soft or plastic, so that the two layers can be made monolithic by penetration of the vibrators. Maximum thickness of concrete layers shall be 18 inches. The surface of the concrete shall be level whenever a run of concrete is stopped.

To prevent featheredges, construction joints that are located at the tops of horizontal lifts near sloping exposed concrete surfaces shall be inclined near the exposed surface, so that the angle between such inclined surface and the exposed concrete surface will be not less than 50°.

In placing unformed concrete on slopes, the concrete shall be placed ahead of a non-vibrated slip-form screed extending approximately 2-1/2 feet back from its leading edge. The method of placement shall provide a uniform finished surface with the deviation from the straight line less than 1/8 inch in any concrete placement. Concrete ahead of the slip-form screed shall be consolidated by internal vibrators so as to ensure complete filling under the slip-form. Prior to placement of concrete on sloped walls or slabs, the Contractor shall submit a plan specifically detailing methods and sequence of placements, proposed concrete screed equipment, location of construction joints and waterstops, and/or any proposed deviations from the aforementioned to the Engineer for review and approval.

Concrete shall not be placed during rains sufficiently heavy or prolonged to wash mortar from coarse aggregate on the forward slopes of the placement. Once placement of concrete has commenced in a block, placement shall not be interrupted by diverting the placing equipment to other uses.

3.4 PLACING FLOOR SLABS ON GRADE.

The subgrade for slabs on ground shall be well drained and of adequate and uniform loadbearing nature. The in-place density of the subgrade soils shall be at least the minimum required by the specifications. No foundation, slab, or pavement concrete shall be placed until the depth and character of the foundation soils have been inspected and approved by the Engineer.

The subgrade shall be free of frost before concrete placing begins. If the temperature inside a building where concrete is to be placed is below freezing it shall be raised and maintained above 50°F. long enough to remove all frost from the subgrade.

The subgrade shall be moist at the time of concreting. If necessary, it shall be dampened with water in advance of concreting, but there shall be no free water standing on the subgrade nor any muddy or soft spots when the concrete is placed.

Thirty-pound felt paper shall be provided between edges of slab-on-grade and vertical and horizontal concrete surfaces, unless otherwise indicated on the Drawings.

Contraction joints shall be provided in slabs-on-grade at locations indicated on the Drawings. Contraction joints shall be installed as per Section 03250 - Concrete Accesories.

Floor slabs shall be screeded level or pitched to drain as indicated on the Drawings. Finishes shall conform with requirements of Section 03345 - Concrete Finishes.

3.5 PLACING CONCRETE UNDER PRESSURE (PUMPING).

Where concrete is conveyed and placed by mechanically applied pressure, the equipment shall have the capacity for the operation. The operation of the pump shall be such that a continuous stream of concrete without air pockets is produced. To obtain the least line resistance, the layout of the pipeline system shall contain a minimum number of bends with no change in pipe size. If two sizes of pipe must be used, the smaller diameter should be used at the pump end and the larger at the discharge end. When pumping is completed, the concrete remaining in the pipelines, if it is to be used, shall be ejected in such a manner that there will be no contamination of the concrete or separation of the ingredients. Concrete may be conveyed using a pump only when authorized by the ENGINEER.

The maximum size coarse aggregate shall not be reduced to accommodate the pumps. The distance to be pumped shall not exceed limits recommended by the pump manufacturer. The concrete shall be supplied to the pump continuously. When pumping is completed, concrete remaining in the pipeline shall be ejected without contamination of concrete in place. After each operation, equipment shall be thoroughly cleaned, and flushing water shall be wasted outside of the forms.

No aluminum parts shall be in contact with the concrete during the entire placing of concrete under pressure at any time.

Prior to placing concrete under pressure, the Contractor shall submit the concrete mix design together with test results from a recognized testing laboratory proving the proposed mix meets all requirements. In addition, an actual pumping test under field conditions may be required by the ENGINEER prior to acceptance of the mix. This test requires a duplication of anticipated site conditions from beginning to end. The batching and truck mixing shall be the same as will be used; the same pump and operator shall be present and the pipe and pipe layouts will reflect the maximum height and distances contemplated.

If the pumped concrete does not produce satisfactory end results, the Contractor shall discontinue the pumping operation and proceed with the placing of concrete using conventional methods.

The pumping equipment must have two cylinders and be designed to operate with one cylinder only in case the other one is not functioning. In lieu of this requirement, the Contractor may have a standby pump on the site during pumping.

The minimum diameter of the hose (conduits) shall be 4 inches.

Pumping equipment and hoses (conduits) that are not functioning properly shall be replaced.

Concrete samples for quality control in accordance with Article 3.9 and will be taken at the placement (discharge) end of the line.

3.6 ORDER OF PLACING CONCRETE.

In order to minimize the effects of shrinkage, the concrete shall be placed in units as bounded by construction joints shown on the

Drawings and maximum lengths as indicated on Drawings. Where required on the Drawings and wherever else practical, the placing of such units shall be done in an alternating or checkerboard pattern.

3.7 CONCRETE WORK IN COLD WEATHER.

Cold weather concreting procedures shall conform to the requirements of ACI 306.

The Engineer may prohibit the placing of concrete at any time when air temperature is 40°F. or lower. If concrete work is permitted, the concrete shall have a minimum temperature, as placed, of 55°F. for placements less than 12" thick, 50°F. for placements 12" to 36" thick, and 45°F. for placements greater than 36" thick. The temperature of the concrete as placed shall not exceed the aforementioned minimum values by more than 20°F.

All aggregate and water shall be preheated. Precautions shall be taken to avoid the possibility of flash set when aggregate or water are heated to a temperature in excess of 100°. in order to meet concrete temperature requirements. The addition of admixtures to the concrete to prevent freezing is not permitted. All reinforcement, forms, and ground with which the concrete is to come in contact shall be defrosted by an approved method. No concrete shall be placed on frozen ground.

3.8 CONCRETE WORK IN HOT WEATHER.

Hot weather concreting procedures shall conform to the requirements of ACI 305.

When air temperatures exceed 85°F., or when extremely dry conditions exist even at lower temperatures, particularly if accompanied by high winds, the Contractor and his concrete supplier shall exercise special and precautionary measures in preparing, delivering, placing, finishing, curing and protecting the concrete mix. The Contractor shall consult with the Engineer regarding such measures prior to each day's placing operation and the Engineer reserves the right to modify the proposed measures consistent with the requirements of this Section of the Specifications. All necessary materials and equipment shall be on hand an in position prior to each placing operation.

Preparatory work at the job site shall include thorough wetting of all forms, reinforcing steel and, in the case of slab pours on ground or subgrade, spraying the ground surface on the preceding evening and again just prior to placing. No standing puddles of water shall be permitted in those areas which are to receive the concrete.

The temperature of the concrete mix when placed shall not exceed 90°F.

Temperature of mixing water and aggregates shall be carefully controlled and monitored at the supplier's plant, with haul distance to the job site being taken into account. Stockpiled aggregates shall, if necessary, be shaded from the sun and sprinkled intermittently with water. If ice is used in the mixing water for cooling purposes, it must be entirely melted prior to addition of the water to the dry mix.

Delivery schedules shall be carefully planned in advance so that concrete is placed as soon as practical after it is properly mixed. For hot weather concrete work (air temperature greater than 85°F), discharge of the concrete to its point of deposit shall be completed within 60 minutes from the time the concrete is batched.

The Contractor shall arrange for an ample work force to be on hand to accomplish transporting, vibrating, finishing, and covering of the fresh concrete as rapidly as possible.

Temperature Limits of Mixture: The temperature of the cement, at the time of delivery to the mixer, shall not exceed 165°F. It may be required that it be stored at CONTRACTOR’s expense until cooled to that temperature.

The temperature limits of aggregates and water entering the mixer shall be as follows:

LIMITS OF TEMPERATURES

	Minimum	Maximum
Water	75°F	140°F
Fine Aggregate	65°F	140°F
Coarse Aggregate	65°F	110°F
Concrete (resulting)	60°F	90°F

3.9 QUALITY CONTROL.

Field Testing of Concrete

The Contractor shall coordinate with the Engineer's project representative the on-site scheduling of the testing firm's personnel as required for concrete testing.

Concrete for testing shall be supplied by the Contractor at no additional cost to the Owner, and the Contractor shall provide assistance to the testing laboratory in obtaining samples. The Contractor shall dispose of and clean up all excess material.

Tests shall be made of each batch of concrete delivered, each 50 cubic yards, or whenever consistency appears to vary. The sampling and testing of slump, air content and strength will be performed at no cost to the CONTRACTOR. Composite samples shall be secured in accordance with the Method of Sampling Fresh Concrete, ASTM C172

Consistency

The consistency of the concrete will be checked by the Engineer by standard slump cone tests. The Contractor shall make any necessary adjustments in the mix as the Engineer may direct and shall upon written order suspend all placing operations in the event the consistency does not meet the intent of the specifications.

Slump tests shall be made in accordance with ASTM C 143. Slump tests will be performed as deemed necessary by the Engineer and each time compressive strength samples are taken.

Concrete with a specified maximum slump shall be placed having a slump less than the specified slump.

Air Content

Samples of freshly mixed concrete will be tested for entrained air content by the Engineer in accordance with ASTM C 231.

Air content tests will be performed as deemed necessary by the Engineer and each time compressive strength samples are taken.

In the event that test results are outside the limits specified, additional tests will be run. Admixture quantity adjustments shall be made immediately upon discovery of incorrect air entrainment.

Compressive Strength

Samples of freshly mixed concrete will be taken by the Engineer and tested for compressive strength in accordance with ASTM C 172, C 31 and C 39, except as modified herein. Any deviations from the requirements specified shall be recorded in the test report.

In general, one sampling shall be taken for each placement in excess of five (5) cubic yards, with a minimum of one (1) sampling for each day of concrete placement operations, or for each fifty (50) cubic yards of concrete, whichever is greater.

Each sampling shall consist of at least four (4) cylinders. Each cylinder shall be identified by a tag, which shall be hooked or wired to the side of the container. The Engineer will fill out the required information on the tag, and the Contractor shall satisfy himself that such information shown is correct.

The Contractor shall be required to furnish labor to the Owner for assisting in preparing test cylinders for testing. The Contractor shall provide approved curing boxes for storage of cylinders on site. The insulated curing box shall be of sufficient size and strength to contain all the specimens made in any four consecutive working days and to protect the specimens. The box shall be erected, furnished and maintained by the Contractor. Such box shall be equipped to provide the moisture and to regulate the temperature necessary to maintain the proper curing conditions required by ASTM C 31. Such box shall be located in an area free from vibration such as pile driving and traffic of all kinds. No concrete requiring inspection shall be delivered to the site until such storage curing box has been provided. Specimens shall remain undisturbed in the curing box until ready for delivery to the testing laboratory but not less than sixteen hours.

When transported, the cylinders shall not be thrown, dropped, allowed to roll, or be damaged in any way.

Compression tests shall be performed in accordance with ASTM C 39. One test cylinder will be tested at seven days and two at 28 days. The remaining cylinder will be held to verify test results, if needed.

The acceptance test results shall be the average of the strengths of the two (2) specimens tested at 28 days. If one (1) specimen in a test manifests evidence of improper sampling, molding or testing, it shall be discarded and the strength of the remaining cylinder shall be considered the test result. Should both specimens in a test show any of the above defects, the entire test shall be discarded.

Acceptance of Concrete: The strength level of the concrete will be considered satisfactory so long as the averages of all sets of three (3) consecutive strength test results equal or exceed the specified 28-day strength and no individual strength test result falls below the specified 28-day strength by more than 500 psi. If the strength test is not acceptable, further testing shall be performed to qualify the concrete.

Concrete Temperature: Determine the temperature of concrete sample for each strength test.

Evaluation and Acceptance of Concrete

Evaluation and acceptance of the compressive strength of concrete shall be according to the requirements of ACI 214 and ACI 318.

The strength level of concrete will be considered satisfactory if all of the following conditions are satisfied.

The average of 28-day cylinder tests for any three consecutive samplings shall meet or exceed the strength required for the mix specified (see Article 2.6).

No more than 20 percent of the compressive tests have strengths less than that specified.

No individual compressive strength test results falls below the specified strength by more than 500 psi.

In the event that any of the conditions listed above are not met, the mix proportions shall be corrected for the next concrete placing operation.

In the event that condition 2c is not met, additional tests in accordance with Article 3-9, Paragraph F shall be performed.

When a ratio between 7-day and 28-day strengths has been established by these tests, the 7-day strengths shall subsequently be taken as a preliminary indication of the 28-day strengths. Should the 7-day test strength from any sampling be more than 10% below the established strength, the Contractor shall:

Immediately provide additional periods of curing in the affected area from which the deficient test cylinders were taken.

Maintain or add temporary structural support as required.

Correct the mix for the next concrete placement operation, if required to remedy the situation.

All concrete which fails to meet the ACI requirements and these specifications is subject to removal and replacement at no additional cost to the Owner.

Additional Tests

When ordered by the Engineer, additional tests on in-place concrete shall be provided and paid for by the Contractor.

In the event that the 28-day test cylinders fail to meet the strength requirements as outlined in Article 3-9 Paragraph E, the Contractor shall have concrete core specimens obtained and tested from the affected area immediately.

Three cores shall be taken for each sample in which the strength requirements were not met. Core holes shall be filled with low slump concrete or mortar.

The drilled cores shall be obtained and tested in conformance with ASTM C 42. The tests shall be conducted by an independent testing laboratory to be selected by the Engineer.

The location from which each core is taken shall be approved by the Engineer. Each core specimen shall be located, when possible, so that its axis is perpendicular to the concrete surface and not near formed joints or obvious edges of a unit of deposit.

The core specimens shall be taken, if possible, so that no reinforcing steel is within the confines of the core.

The diameter of core specimens should be at least 3 times the maximum nominal size of the course aggregate used in the concrete, but must be at least 2-inches in diameter.

The length of specimen, when capped, shall be at least twice the diameter of the specimen.

The core specimens shall be taken to the laboratory and when transported, shall not be thrown, dropped, allowed to roll, or damaged in any way.

Two (2) copies of test results shall be mailed directly to the Engineer. The concrete in question will be considered acceptable if the average of the test results on core specimens taken from a given area equal or exceed 85% of the specified 28-day strength and if the lowest core strength is greater than 75% of the specified 28-day strength.

In the event that concrete placed by the Contractor is suspected of not having proper air content, the Contractor shall engage an independent test laboratory to be selected by the Engineer, to obtain and test samples for air content in accordance with ASTM Specification C 457.

3.10 CARE AND REPAIR OF CONCRETE.

The Contractor shall protect all concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance by the Owner. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Care shall be exercised to avoid jarring forms or placing any strain on the ends of projecting reinforcing bars. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time prior to the final acceptance of the completed work, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete at no additional cost to the Owner.

Repair surface defects, including tie holes, immediately after form removal. Thoroughly and liberally coat with a bonding agent and then thoroughly fill with a non-shrink, cementitious material using a plunger type or other mechanical injecting device to force mortar through holes passing through walls. Remove honeycombed and other defective concrete down to sound concrete.

Concrete formwork blowouts or unacceptable deviations in tolerances for formed surfaces due to improperly constructed or misaligned formwork shall be repaired as directed by the Engineer. Bulging or protruding areas, which result from slipping or deflecting forms shall be ground flush or chipped out and redressed as directed by the Engineer.

Areas of concrete in which cracking, spalling, or other signs of deterioration develop prior to final acceptance shall be removed and replaced, or repaired as directed by the Engineer.

Concrete which fails to meet the strength requirements as outlined in Article 3-9 Paragraph E, will be analyzed by the Engineer as to its adequacy based upon loading conditions, resultant stresses and exposure conditions for the particular area of concrete in question. If the concrete in question is found unacceptable based upon this analysis, that portion of the structure shall be strengthened or replaced by the Contractor at no additional cost to the Owner. The method of strengthening or extent of replacement shall be directed by the Engineer.

Testing of Concrete In Place: Additional testing of materials or concrete occasioned by their failure by test or inspection to meet specification requirements shall be at the expense of the Contractor.

Nondestructive Devices: Testing by impact hammer, sonoscope, or other nondestructive device may be permitted by the Engineer to determine relative strengths at various locations in the structure as an aid in evaluating concrete strength in place or for selecting areas to be cored. Such tests, unless properly calibrated and correlated with other test data, shall not be used as a basis for acceptance or rejection.

Two (2) copies of test results shall be mailed directly to the Engineer. The concrete in question will be considered acceptable if the average of the test results on core specimens taken from a given area equal or exceed 85% of the specified 28-day strength and if the lowest core strength and if the lowest core strength is greater than 75% of the specified 28-day strength.

In the event that concrete placed by the Contractor is suspected of not having proper air content, the Contractor shall engage an independent test laboratory to be selected by the Engineer, to obtain and test samples for air content in accordance with ASTM Specification C 457.

End of Supplemental Section

SECTION 08345 – SUPPLEMENTAL

FIBERGLASS DOORS AND FRAMES

1.1 SCOPE.

Fiberglass Reinforced Plastic Doors.

Fiberglass Reinforced Plastic Frames.

Light Openings.

Louvers.

1.1.01 Related Sections. Section 08700 - Finish Hardware

1.1.02 References.

ASTM C 365 - Standard Test Method for Flatwise Compressive Strength of Sandwich Cores.

ASTM C 518 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

ASTM D 256 - Test Methods for Impact Resistance of Plastics and Electrical Insulation Materials.

ASTM D 638 - Standard Test Method for Tensile Properties of Plastics.

ASTM D 696 - Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 degrees C and 30 degrees C.

ASTM D 790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

ASTM D 792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.

ASTM D 1622 - Standard Test Method for Apparent Density of Rigid Cellular Plastics.

ASTM D 2583 - Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.

ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

ASTM E 152 - Standard Methods of Fire Tests of Door Assemblies.

SDI 107 - Hardware on Steel Doors (Reinforcement - Application).

SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames.

Certification Listings; Warnock Hersey.

1.3 SUBMITTALS. Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

1.4.01 Drawings and Data. Manufacturer's installation instructions. Manufacturer's care and maintenance instructions. Color charts for selection of door colors.

Dimensions, elevations, assembly methods, hardware reinforcement locations and preparations, wall conditions, and opening identification.

1.4.02 Samples. Submit samples representing specific construction of doors and frames required for this project.

Doors: Show stiles, core, and fiberglass-encapsulated reinforcements.

Frame: Show profile with corner joint, core, and fiberglass-encapsulated reinforcements.

1.4.02 Calculations. Submit calculations for fiberglass composite door, verifying theoretical limits of thermal warpage based upon the exposure temperature differential.

1.5 DELIVERY, STORAGE, AND HANDLING. Deliver, store, and handle doors and frames with care to prevent damage and deformation. Identify doors and frames with the manufacturers name tag, location, door type, color, and weight. Inspect doors and frames upon delivery for damage. Minor damage may be repaired provided refinished items are equal in all respects to new work, and are acceptable to the Architect. Otherwise remove and replace damaged items as directed. Store on pallets in the original carton at the job site.

1.6 WARRANTY. The manufacturer shall warrant the fiberglass reinforced plastic doors and frames:

From failure due to workmanship and materials for 5 years from date of installation.

Against corrosion failure caused by the environment specified for 10 years from date of installation.

From thermal warpage as determined by the theoretical limits for a structurally steel reinforced fiberglass composite door.

This guarantee shall not extend to failure caused by physical abuse and shall not cover costs for dismounting or reinstallation, labor, rating, or freight.

PART 2 - PRODUCTS

2.1 MANUFACTURE AND FABRICATION. Provide products manufactured by Chem-Pruf Door Co., Ltd., P.O. Box 4560 Brownsville, Texas 78523 Phone: 1-800-444-6924-7943, Fax: 956-544-7943, Website: www.chem-pruf.com, or approved.

Products from other manufacturers will be considered for substitution prior to receipt of bids. Requests for substitution after bids have been received will not be considered. Requests for substitution must include the following information in order to be considered:

Formal written request certifying that products to be substituted will match specified products in terms of structural properties, dimensions, physical appearance, quality level, and quantities, and that they will perform the same function in the same manner and will achieve the same end result.

Manufacturer's and supplier's material data sheets, specifications, and performance data.

A list of three or more projects in satisfactory service for not less than three years that use products identical to those being proposed for substitution. For each project, include name, address, and telephone number of the engineer, the contractor, and the plant manager.

2.1 FIRE RATINGS. Fire-Rated Openings: Provide assemblies tested in accordance with ASTM E 152 and labeled by Warnock Hersey.

2.2 FIBERGLASS DOORS.

A. Shall be made of fiberglass reinforced plastic (FRP) using Class 1 premium resin with no fillers that is specifically tailored to resist chemicals and contaminants typically found in environment for which these specifications are written. Doors shall be 1 ¾ inch thick and of flush construction, having no seams or cracks. All doors up to 4’0 x 8’0 shall have equal diagonal measurements. For consistency in the resin chemistry tailored for this application and to maintain the same physical properties throughout the structure, all fiberglass components including face plates, stiles and rails and frames must be fabricated by the same manufacturer. Components obtained through various outside sources for plant assembly will not be accepted.

B. Exterior Surface:

Finish of door shall be identical with 25 mil resin-rich gelcoat of the specified color integrally molded in at time of manufacture resulting in a smooth gloss surface that is dense and non-porous. To achieve optimum surface characteristics, the gelcoat shall be cured within a temperature range of 120F to 170F creating an impermeable outer surface, uniform color throughout, and a permanent homogeneous bond with the resin/fiberglass substrate beneath. Only the highest quality gelcoat will be used to ensure enduring color and physical properties. Paint and/or post application of gelcoat results in poor mechanical fusion and will be deemed unacceptable for this application. The finish of the door and frame must be field repairable without compromising the integrity of the original uniform composite structure, function or physical strength.

C. Core:

Materials option to be:

- Polypropylene plastic honeycomb core with a non woven polyester veil for unparalleled plate bonding, 180 PSI typical compression range.
- 2 PSF expanded polyurethane foam core, which completely fills all voids between the door plates. Foam properties ASTM E-84 comply with IBC Code.
- As specifically requested.

D. Internal Reinforcements:

Shall be #2 SPF of sufficient amount to adequately support required hardware and function of same.

E. Produce doors seamlessly by molding in place all mortises, openings, recesses, pockets, and steel encapsulated reinforcements to receive finish hardware, including drilling and tapping, in accordance with finish hardware schedule and templates provided by hardware supplier.

2.3 FIBERGLASS FRAMES.

A. Fiberglass Reinforced Plastic Frames:

(Rated and Non-Rated) shall be fiberglass and manufactured using the resin transfer method creating one solid piece (no voids) with complete uniformity in color and size. Beginning with a minimum 25 mil gelcoat layer molded in and a minimum of two layers of continuous strand fiberglass mat saturated with resin, the frame will be of one-piece construction with molded stop. All frame profiles shall have a core

material of 2 psf polyurethane foam. Metal frames or pultruded fiberglass frames will not be accepted.

B. Exterior Gel Coat Surface: Match gel coat of doors.

C. Structural core:

1/2 inch thick end grain Balsa core with a density of 8 pounds per cubic foot.

Core porosity to allow resin to penetrate the surface during molding and to develop a high strength bond between the core and laminate.

D. Internal reinforcements:

Shall be continuous within the structure to allow for mounting of specified hardware. Reinforcing material shall be a dense matrix of cloth glass fibers and premium resin with a minimum hinge screw holding value of 1000 lbs per screw. All reinforcing materials shall be completely encapsulated. Documented strength of frame screw holding value after third insert must be submitted. Dissimilar materials, such as steel, will be deemed unacceptable as reinforcement for hardware attachment.

E. Produce frame, jambs, and head seamlessly by molding in place all mortises, openings, recesses, pockets, and steel encapsulated reinforcements to receive finish hardware, including drilling and tapping, in accordance with finish hardware schedule and templates provided by hardware supplier.

2.4 TRANSOMS AND LIGHTS. Provide transom panels where indicated. Provide borrowed lights where indicated. Provide side lights where indicated. Transoms shall be identical to the doors in finish, construction, materials, thickness and reinforcement.

2.5 FIBERGLASS LIGHT OPENINGS. Provide fiberglass light opening where indicated.

Openings shall be provided for at time of manufacture and shall be completely sealed so that the interior of the door is not exposed to the environment. Fiberglass retainers, which hold the glazing in place, shall be resin transfer molded with a profile that drains away from glazing. The window retainer must match the color and finish of the door plates with 25 mil of resin-rich gelcoat integrally molded in at time of manufacture. Mechanical fasteners shall not be used to attach retainers. Glass, as specified herein, shall be furnished and installed by door and frame manufacturer. In order to maintain uniform appearance, product longevity and the corrosion resistance this application requires, window retainers fabricated from Metal, PVC or Vinyl will not be accepted.

2.6 FIBERGLASS LOUVERS. Provide fiberglass louvers where indicated.

Openings shall be completely sealed so that the interior of the door is not exposed to the environment. Louvers are to be solid fiberglass “V” Vanes and shall match the color and finish of the door plates.

2.7 COLOR SELECTION.

Color: The selected color shall pigment both the gel-coat and exterior laminate. Part 1. Color as selected by the Architect from the manufacturer's color chart.

2.8 FIBERGLASS THRESHHOLD. Provide fiberglass threshold unless otherwise specified in hardware section. 1/2 inch high x 6 inch deep x opening width. Skid resistant surface.

2.8 ANCHORS.

Provide jamb anchors within 10 inches of top and bottom each frame and at 24 to 30 inches on center in between, unless otherwise required for fire-rated frames.

New Masonry: Butt mounting jamb anchors, 18 gauge flat "T" anchors to suit frame size with legs a minimum of 1 inch x 6 inch.

Existing Masonry: Butt mounting jamb anchors, 3/8 inch diameter flat head stainless steel sleeve anchor and plastic "T" spacer.

Wood Studs: Strap anchors; 18 gage x 3/4 inch high x stud width.

Wood Studs: Screw through-frame anchors with stainless steel lag screws 3/8 inch in diameter.

PART 3 - EXECUTION

3.1 INSTALLATION.

3.1.01 Frame Installation. Install frames plumb, level, square, and rigidly secured in the opening. Use field applied bottom and center spreader to maintain opening dimensions. Fabricate spreader from lumber at least 1 inch thick and approximately as wide as frame depth. Cut clearance notches for frame stops.

Install anchors in appropriate positions; type as indicated by construction.
After frame is installed and secure, remove spreaders, leaving surfaces smooth and undamaged.

3.1.02 Door Installation. Install doors plum, level, and square. Apply hardware and adjust to achieve quiet and smooth operation. Adjust doors to fit snugly and close without sticking or binding.

Maximum clearances:

1/8 inch at jambs and heads.

1/4 inch at meeting stiles of pairs of doors.

1/4 inch between door bottom and finished floor or threshold.

3.1.03 Cleaning and Protection. Wrap doors and frames after installation and keep free of paint, plaster, cement, scratches, etc. Leave Project site clean and free of debris.

3.2 SOURCE QUALITY CONTROL. The manufacturer shall maintain a continuous quality control program, and upon request shall furnish to the Architect certified test results of physical properties.

A. Minimum physical properties of the laminate:

Tensile Strength (ASTM D 638): 9,000 PSI.

Flexural Strength (ASTM D 790): 20,000 PSI.

Barcol Hardness (ASTM D 2583): 40 Min. Average.

Impact Resistance (ASTM D 256): 12 ft-lbs/inch.

Heat Distortion Point (ASTM D 384): 175 F.

Density/Specific Gravity (ASTM D 792): 93.6 PCF/1.5.

Burning Characteristics (ASTM E 84): Flame Spread, less than 25; Smoke Density, less than 200.

Thermal Expansion (ASTM D 696): 8 x 10-6 in/in degree F.

B. Minimum physical properties of the urethane foam core:

Thermal Conductivity (ASTM C 518): 0.13.

Density/Specific Gravity (ASTM D 1622): 1.9 PCF/.03.

Burning Characteristics (ASTM E 84): Flame spread, less than 35; smoke density, less than 240.

C. Minimum physical properties of end grain Balsa core:

Thermal Conductivity (ASTM C 518): 0.45.

Density/Specific Gravity (ASTM D 1622): 9-1/2 PCF/.128.

Compressive Strength (ASTM C 365): 1870 PSI.

D. Prepare tests in accordance with ASTM D 618.

End of Supplemental Section

SECTION 08711 – SUPPLEMENTAL

FINISH HARDWARE

PART 1 – GENERAL

1.1 SCOPE. Furnish hardware required to complete the work as shown on the drawings and as specified herein. Furnish trim attachments and fastenings, specified or otherwise required, for proper and complete installation. Deliver to the job site those items of finish hardware scheduled to be installed at the job site; and delivered to other points of installation those items of finish hardware scheduled to be factory installed, including:

1. Butt Hinges
2. Continuous Hinges
3. Lock cylinders and keys
4. Lock and latch sets
5. Bolts
6. Exit devices
7. Push/pull units
8. Closers
9. Overhead holders
10. Miscellaneous door control devices
11. Door trim units
12. Protection plates
13. Weather-stripping (except where provided with aluminum entrance doors)
14. Thresholds
15. Wall or floor stops

1.2 GENERAL.

1.2.01 Related Work. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1. Section 08110: Steel doors and frames
2. Section 08800: Glazing
3. Division 16: Electrical

1.2.02 Governing Standards.

1. National Fire Protection Associations (NFPA):
   - NFPA 101, "Life Safety Code" Current Edition
   - NFPA 80-1999, "Installation of Fire Doors and Windows"

2. Michigan Building Code – Current Edition

3. American National Standards Institute (ANSI):
   - ANSI A 156 Standards series.
   - ANSI A117.1-1998 Accessible and Usable Buildings and Facilities

4. National Electric Code – Current Edition

1.2.03 Definitions. "Finish Hardware": Items required for swinging, sliding and folding doors, except special types of unique and non-matching hardware specified under door and frame Sections of these Specifications.

1.3 SYSTEM DESCRIPTION.

1.3.01 Design Requirements. Review of hardware requirements:

Thoroughly review finish hardware schedule, comparing it with the floor plan, door schedule, and door details to verify hardware requirements, quantities, door swings, finishes, and sizes.

If an inconsistency or error in the proposed construction documents is suspected, the hardware supplier is to bring it immediately to the attention of the Architect. If

the quantity of items is questioned, for bidding purposes, assume the higher quantity is required and price accordingly.

Architect's review of Submittals is for design concept only, and does not relieve the Contractor of the responsibility to furnish sufficient material and functions required for a complete, and code-worthy installation. Determination of all quantities is the responsibility of the Contractor.

1.3.02 Performance Requirements. Furnish finish hardware complying with the requirements of laws, codes, ordinances and guidelines of governmental authorities having jurisdiction:

1. NFPA 101, "Life Safety Code", Current Edition
2. NFPA 80, "Installation of Fire Doors and Windows", Current Edition
3. Michigan Building Code - Current Edition
4. ANSI A117.1-1998 Accessible and Usable Buildings and Facilities

1.4 QUALITY ASSURANCE. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the requirements and the methods needed for proper performance of the work of this Section.

1.4.01 Supplier Qualifications. A recognized architectural finish hardware supplier with warehousing facilities within a 100 mile radius of the project site and a direct distributor of all products listed on the approved finish hardware schedule.

Continuously in business of finish hardware supply for not less than 5 years.

Provide the service of a qualified Architectural Hardware Specialist to:

Be available for consultation with the Architect at no additional cost to the Owner and inspect installation of all finish hardware items. Make all minor adjustments required and report to the Architect on completeness of the installation. The hardware consultant may be an employee of the supplier.

1.4.02 Installer Qualification. Employ a competent hardware installer with at least five (5) years experience installing commercial grade hardware similar to that proposed for the Work.

1.4.03 Source Limitations. Obtain each type of hardware (latch and lock sets,

hinges, closers, etc.) from a single manufacturer, although several may be indicated as offering products complying with requirements.

1.4.04 Mandatory Pre-construction Meeting. Immediately following the Architect's final approval of the submittals, convene a mandatory pre-installation meeting to be attended by the Architect, Contractor, Installer, Supplier, and the Architect's hardware consultant. Proposed agenda to include review of:

1. The Contract Documents;
2. Installation schedule;
3. Hardware Specifications;
4. Hardware locations and opening descriptions;
5. Special installation instructions;
6. Other items of pertinence to the Work.

1.4 SUBMITTALS. Comply with pertinent provisions of Section 01080.

1.4.01 Drawings and Data. Initial submittal of the proposed "Finish Hardware Schedule" in the following format:

1. Vertically-typed, double-spaced;
2. Organized into "hardware sets", indicating complete designations of every item required for each door or opening. Include the following information for each item of finish hardware:

    A. Manufacturer
    B. Type
    C. Style
    D. Function
    E. Size
    F. Degree and direction of opening swing ("hand")
    G. Finish
    H. Fasteners
    I. Location of hardware set cross-referenced to indications on floor plans, door, schedule, and frame schedule.

J. Explanation of all abbreviations, symbols, codes, etc. contained in schedule.

K. Door and frame sizes and materials.

L. Keying information.

3. Final Finish Hardware Schedule immediately following receipt of the Architect's approval of the initial submittal.

1.4.02 Samples. When requested by the Architect or Owner, submit one sample of each type of exposed hardware unit, finished as required, and tagged with a full description for coordination with schedule. Samples will be returned to the supplier. Units which are acceptable and remain undamaged through submittal, review and field comparison procedures may, after final check of operation, be built into the Work, within limitations of keying coordination requirements.

1.4.03 Templates. Furnish hardware templates with final submittal of Finish Hardware Schedule.

1.4.04 Contract Close-out Submittals. Operation and maintenance data shall comply with pertinent provisions of Section 01190. Provide two complete sets of finish hardware schedules, and two complete copies of manufacturer's catalog cuts and maintenance instructions for each item furnished under the Work of this Section.

1.5 DELIVERY, STORAGE, AND HANDLING. Comply with manufacturer's provisions.

1.5.01 Product Identification. Tag and mark each item separately in manufacturers unopened package, identifying it by product number and architectural opening number, as listed in the approved Finish Hardware Schedule. Include instructions, templates, and fasteners needed for installation.

Deliver individually packaged hardware items on a vehicle operated by a direct employee of the Hardware Supplier. Contractor shall immediately, and in the presence of the Hardware Supplier, inventory the contents of the delivery. Hardware supplier shall furnish finish hardware items directly to the factory or mill for factory-installation, where required.

1.6 PROJECT CONDITIONS. Provide a secure, dry storage area for the sole purpose of storing finish hardware. Prohibit access to all jobsite personnel, except those employed by the installing contractor.

1.7 WARRANTY.

1.7.01 Manufacturer's Warranty. Warrant all finish hardware items against defects in materials and workmanship for one year.

Extended Warranty: Extend the above warranty on certain items of finish hardware as follows:

1. Door closers: To ten years
2. Continuous hinges: To ten years
3. Exit devices: To five years
4. Locks and latch sets: To five years

Manufacturer agrees to promptly replace (including installation by a factory representative) defective products at no additional cost to the Owner, for the duration of the warranty period.

The terms of such warranties extend from the Date of Substantial Completion as that date is defined by the General Conditions.

Failures due to defective materials or workmanship is deemed to include, but not to be limited to failures in operation of any operating component and defects which contribute to unsightly appearance, potential safety hazard, or potential untimely failure of the products furnished under this Section.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL. Requirements for design, grade, function, finish, size, and other distinctive qualities of each finish hardware item is indicated in the Finish Hardware Schedule at the end of this Section.

Product Designations: One or more manufacturers are listed for each hardware type required. Provide the product designated or the comparable product listed under this Section.

ANSI/BHMA Designations: Used to describe hardware items, or to define quality or function. Provide products complying with these standards in addition to additional requirements of this Section.

Hand of Door: Drawings show direction of slide, swing ("hand") of door leafs.

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

2.2 MATERIALS.

A. Base metals:

1. Manufacturer's standard metal alloy, composition, temper and hardness, but in no case of lesser (commercially-recognized) quality than that specified for applicable hardware units by applicable ANSI A156 series standard for each type hardware item and with ANSI A156.18 for finish designations indicated.

2. Do not furnish "optional" materials for those indicated, except as otherwise specified.

B. Fasteners:

1. Furnish Phillips flat-head screws with each hardware item, unless otherwise indicated.

2. Exposed screws: Match finish of hardware (even where noted to be "prepared for paint").

3. Use concealed fasteners for hardware units which are exposed when door is closed, except where no standard units of type specified are available with concealed fasteners.
4. Do not use thru-bolts where bolt head or nut on opposite face would be exposed.

5. Where adequate reinforcement is not feasible, thru-bolting would only be acceptable if through sleeves, or if sex-screw fasteners are used.

C. Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of finish hardware.

2.3 MANUFACTURED UNITS, GENERAL.

A. Reference Standards:

ITEM		COMPLY WITH
1.	Butts and hinges	ANSI A156.1-1988 (BHMA 101)
2.	Locks and lock trim	ANSI A156.2-1987 (BHMA 601)
3.	Exit devices	ANSI A156.3-1989, Grade 1 BHMA 701)
4.	Door controls-closers	ANSI A156.4-1986,Grade 1 BHMA 301)
5.	Architectural door trim	ANSI A156.6 (BHMA 1001)
6.	Template hinge dimensions	ANSI A156.7
7.	Door controls-overhead holders	ANSI A156.8 (BHMA 311)
8.	Mortise locks and latches	ANSI A156.13-1987, Grade 1
9.	Auxiliary hardware	ANSI A156.16-1989(BHMA 1201)

B. Hardware Finishes:

1. Materials and Finishes Standard: Comply with ANSI A156.18 (BHMA 1301). Finish designations used in schedules are listed, therein.
2. Provide US32D or US26D at all finish hardware exposed to view.
3. Provide matching finishes for hardware units at each door, unless otherwise indicated.
4. Match the color and texture of hardware items to manufacturer's standard finish for the latchset, lockset, or push-pull unit.
5. Provide quality of finish, including thickness of plating or coating, composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than that specified or described by referenced standards.

C. Hardware for fire-rated openings:

1. Comply with NFPA 80
2. Tested and listed by Underwriters Laboratory (UL), or Factory Mutual (FM) for type, size and use of door, and complying with requirements of door and door frame label.
3. Provide UL or FM label on door indicating "Fire door to be equipped with fire-exit hardware".
4. Provide UL or FM label on exit device indicating "Fire Exit Hardware".

2.4 PRODUCTS.

A. Hinges, Butts and Pivots:

1. General:
   a. ANSI A156.1 - 1988 for commercial quality.
   b. Provide only template-produced units.
   c. All hinges to be concealed bearing-type.
   d. Hinges at exterior doors shall be of non-ferrous material.

2. Screws:
   a. At metal doors and frames: Machine screws.
   b. At wood doors and frames: Phillips flat-head wood screws.
   c. Finish screw heads to match surface of hinges or pivots.

3. Pins:
   a. Steel hinges: Steel

   b. Non-ferrous hinges: Stainless Steel
   c. Hinges at exterior doors: Non-removable (NRP)
   d. Hinges at out-swing corridor doors: Non-removable (NRP)
   e. Hinges at interior doors: Non-rising

4. Tips:
   a. Flat button with matching plug
   b. Finish to match leaves, except where hospital tip (HT) indicated.

5. Number of hinges: Provide number of hinges indicated but not less than 3 hinges.

6. Hinge sizing:
   a. According to hinge manufacturer's recommendation for door size and weight, unless otherwise specified.
   b. Hinges for door widths 3 feet, or less: Standard-weight (.134)
   c. Hinges for door widths over 3 feet: Heavy-weight (.180) hinges

7. Acceptable products:
   a. For interior/exterior standard weight hinges:
      (1) Stanley CB179/CB191
      (2) Hager AB700/AB800

b. For interior/exterior heavy weight hinges:
   (1) Stanley CB168/CB199
   (2) Hager AB750/AB850

B. Continuous Hinges:

1. Stainless Steel, pinned-type. (Steel pin & barrel only when scheduled. Geared aluminum hinges will be rejected.)

2. Fire-rating: "WHI-listed" and "UL-listed"

3. Capacity: Doors weighing up to 600 lbs.

4. Fasteners: As required by door and frame condition, and as recommended by hinge manufacturer.

5. Acceptable manufacturers:
   a. Stanley
   b. Markar

C. Lock Cylinders and Keying:

1. General:
   a. Meet with Owner and Architect to finalize keying requirements and obtain final written instructions.

2. Cylinders:
   a. Type: Mortise , or rim-type as required by function of locking device.
   b. Provide cams or tail piece as required.
   c. Construct lock cylinder parts from brass/bronze, stainless steel or nickel silver.
   d. Provide solid machined cylinder rings with tension spring to resist wrenching of cylinder. Length, finish and size as required.

3. System:

    a. Except as otherwise indicated, provide BEST cylinders with cores keyed to owners Best IC, 7-pin great grand master key system.
    b. Furnish construction cores for all cylinders.

4. Keying:
    a. Deliver keys and final cores to the hardware installation Contractor for final installation, when directed by the Owner.
    b. Comply with Owner's instructions for master keying and, except as otherwise indicated, provide individual change key for each lock which is not designated to be keyed alike with a group of related locks.
    c. Key material: Nickel silver
    d. Key quantity:
        (1) Three (3) change keys for each lock;
        (2) Five (5) master keys for each master system;
        (3) Five (5) grandmaster keys for each grandmaster system.
        (6) Block out blades -keying directed by owner.

D. Locksets:

1. Mortise Locks
    a. Comply with ANSI A156.13 - 1987, Grade 1 criteria for mortise locks
    b. Function: Indicated in the hardware sets.
    c. Provide appropriate fasteners for lock and strike.
    d. Trim: 14H lever-type equal to Best Lock
    e. Acceptable products: Best 45H series

E. Exit Devices:

1. General:
    a. Comply with ANSI A156.3, Grade 1, Types 1, 4, and 28 criteria for products supplied.
    b. At fire doors:
        (1) Provide UL or FM label on exit device indicating "Fire Exit Hardware", where appropriate.
        (2) Mount exit device using sex-bolts on labeled wood doors.

2. Type: Flat, push-bar type with cylinder-dogging and dead-locking latch bolts.

3. Function:
   a. Indicated in the hardware sets.
   b. Provide all cylinder functions at electrically-operated exit devices, including cylinder dogging.

4. Trim: Extra-heavy-duty, vandal-resistant, compression clutch lever matching the lockset.

5. Acceptable products:
   a. Precision Apex 2000 series x V4900 series

F. Door Closers:

1. General:
   a. ANSI A156.4 - 1986 Grade 1 criteria.
   b. All closers shall be the products of one manufacturer.
   c. Description:
      (1) Full rack-and-pinion type
      (2) Cast aluminum R14 alloy.
      (3) Hydraulic fluid: Non-gumming and non-freezing.
      (4) Closer body: Non-handed, with sized-, or multi-size spring power adjustment to permit setting of spring power. (See hardware sets indicating when sized or multi-size closers are required.)
      (5) With two non-critical valves and hex key adjustment to independently regulate sweep and latch speed.
      (6) Provide mounting brackets necessary to clear sound seals and weatherstrip.
      (7) Enclose in a full, molded cover.
      (8) Provide drop plates or special brackets for proper mounting.
      (9) Presure Relief Valves will NOT be accepted on Door Closers.
   d. Acceptable products:
      (1) Stanley D-4550 series
   e. Provide drop brackets as required.
   f. Provide BF (Barrier Free) closers only where scheduled.
   g. Provide thru-bolts for closers mounting on fire-rated wood or metal doors unless doors are reinforced to receive wood or machine screws, in accordance with Section 08100 or Section 08210. In all cases, provide fasteners required to meet "UL" requirements.

G. Stops:

1. General:
   a. ANSI A156.16 - 1989 Grade 1 criteria.
   b. Provide stops where scheduled, wall or floor, as opening conditions dictate, utilizing wall stops wherever possible.

2. Description:
   a. Wall stops: Wrought brass, bronze or stainless steel
   b. Floor stops: Cast brass or bronze, and plated as required.
   c. Make selection of floor stop height based upon floor conditions and door undercut.

3. Acceptable products:
   a. Rockwood 409/442/ 487/463

H. Thresholds:

1. General:
   a. ANSI A156.21 - 1989, Grade 1 criteria.
   b. Comply with A.D.A. requirements, unless otherwise scheduled.

2. Description:
   a. Flat profile
   b. Installation locations are scheduled.
   c. Provide templates for thresholds to related door suppliers to coordinate proper undercut.

3. Acceptable products:
   a. Durable Products C-200 series.
   b. Reese
   c. Zero

I. Door Seal:

1. General:
   a. ANSI A156.21 - 1989, Grade 1 criteria.

2. Description:
   a. Flat profile.
   b. Dimensions: Appropriate to door opening size.

c. Installation locations are scheduled.
d. Provide templates for thresholds to related door suppliers to coordinate proper undercut.

3. Mounting:
   a. Apply related hardware (closer, foot bracket, strike, etc.) on top of weatherstrip.
   b. Do not notch or splice weather strip.
   c. Adjust related template hardware locations, as required.

4. Acceptable products:
   a. Durable Products 306 with vinyl insert for jamb and head
   b. Reese
   c. Zero

2.5 OTHER MATERIALS. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Architect.

2.6 HARDWARE FINISHES. Provide matching finishes for hardware units at each door or opening, to the greatest extent possible and except as otherwise indicated. Reduce differences in color 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 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.
Provide finishes matching those established by BHMA or, if none established, match the Architect's sample.

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 that specified for the applicable units of hardware by referenced standards.

Finish designations used in schedules and elsewhere listed in ANSI A156.18 "Materials and Finishes Standard", including coordination with the traditional U.S. finishes shown by certain manufacturers for their products.

Provide the following hardware finishes, unless otherwise scheduled:

1.	Hinge	US26D - Satin Chrome or US32D - Satin Stainless Steel
2.	Exit device	US32D - Satin Stainless Steel
3.	Lock	US26D - Satin Chrome
4.	Cylinder	To match surrounding hardware
5.	Closer	AL - Sprayed Aluminum
6.	Push/pull bar	US32D - Satin Stainless Steel
7.	Kick/mop/armor plate	US32D - Satin Stainless Steel
8.	Wall stops	US32D - Satin Stainless Steel
9.	Floor stops	US26D - Satin Chrome
10.	Heavy duty stops	US26D - Satin Chrome
11.	Overhead stops	US32D - Satin Stainless Steel
12.	Thresholds/door seals	AL - Anodized Aluminum

Base material: Manufacturer’s standard high-carbon steel, brass, or bronze.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 COORDINATION.

A. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this Section.

3.3 INSTALLATION. Install each item in its proper location firmly anchored into position, level and plumb, and in accordance with the manufacturer's recommendations.

Handing, hardware heights, locations, and degree of opening swing are indicated in the Drawings and Finish Hardware Schedule.

3.3.01 Mount Finish Hardware Units. The finish hardware units shall be mounted at recommended heights and locations as shown in approved finish hardware schedule, complying with requirements of the A.D.A., and pertinent provisions of the

Building Code. The finish hardware units shall function at proper degree of opening of doors as indicated on approved finish hardware schedule.

Prior to final finishing of the door, remove hardware to allow finishing of door, and permanently reinstall hardware upon completion of finishing operation. Reinforce, where necessary, the substrate to assure proper attachment. Drill and countersink units which are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

3.3.02 Installing Closers. Mount closers per manufacturer's template, and secure the Architect's approval of the closer installation.

The Contractor will be required to **REPLACE** doors onto which closers are improperly mounted at no additional cost to the Owner. Repair or patching of such doors will not be acceptable.

3.3.03 Installing Thresholds at Exterior Doors. Set in full bed of butyl-rubber, or polyisobutylene mastic sealant.

3.4 FIELD QUALITY CONTROL. Inspection of final hardware installation: The Contractor, hardware suppliers, and Architectural Hardware Consultant (AHC) shall thoroughly check the quality of the installation and the functionality of each unit of finish hardware at all openings in the Work. The Hardware Supplier shall forward a detailed written report of all operational or installation deficiencies to the Architect and Contractor.

3.5 CLEANING AND ADJUSTING. Check and adjust each item of hardware and each door upon completion of final installation. Verify proper function, and replace units which cannot be made to operate freely and smoothly, as intended for the application. Clean adjacent surfaces soiled by hardware installation.

3.6 FINISH HARDWARE SCHEDULE (Will be provide with the next submittal)

End of Supplemental Section

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SECTION 10201 – SUPPLEMENTAL

LOUVERS AND VENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Fixed, extruded-aluminum louvers.

2. Fixed, formed-metal louvers.

3. Blank-off panels for louvers.

3. Equipment Screening.

B. Related Sections include the following:

1. Section 07920 "Joint Sealants" for sealants installed in perimeter joints between louver frames and adjoining construction.

2. Section 09900 "Painting and Special Coatings" for field painting louvers.

3. Division 15 Sections for louvers that are a part of mechanical equipment.

4. Division 16 Sections for electrical power connections for motor-operated adjustable metal louvers.

1.03 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section, unless otherwise defined in this Section or in referenced standards.

B. Standard Free Area: Free area of a louver 48 inches (1220 mm) wide by 48 inches (1220 mm) high, identical to that provided.

C. Maximum Standard Airflow: Airflow at point of beginning water penetration through a louver 48 inches (1220 mm) wide by 48 inches (1220 mm) high, identical to that provided.

D. Drainable-Blade Louver: Louver designed to collect and drain water to exterior at sill by means of gutters in front edges of blades and channels in jambs and mullions.

1.04 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide exterior metal louvers capable of withstanding 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; or permanent damage to fasteners and anchors.

1. Wind Load: Uniform pressure (velocity pressure) of 30 lbf/sq. ft. (1440 Pa), acting inward or outward.

2. Thermal Movements: Provide louvers that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, and other detrimental effects:

a. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

B. Air-Performance, Water-Penetration, and Air-Leakage Ratings: Provide louvers complying with performance requirements indicated, as demonstrated by testing manufacturer's stock units 48 inches (1220 mm) wide by 48 inches (1220 mm) high. Test units according to AMCA 500.

1. Perform testing on unpainted, cleaned, degreased units.

1.05 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Submittal 10200-01: Product Data

For each type of product specified.

C. Submittal 10200-02: Shop Drawings

For louver units and accessories. Include plans; elevations; sections; and details showing profiles, angles, and spacing of louver blades. Show unit dimensions related to wall openings and construction; free area for each size indicated; profiles of frames at jambs, heads, and sills; and anchorage details and locations.

1. For installed louvers and vents indicated to comply with design loadings, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

2. Wiring Diagrams: Detail power, signal, and control systems for motorized adjustable louvers and differentiate between manufacturer-installed and field-installed wiring.

D. Submittal 10200-03: Samples for Initial Selection

Manufacturer's color charts showing the full range of colors available for units with factory-applied color finishes.

E. Submittal 10200-04: Samples for Verification

Of each type of metal finish required, prepared on Samples of same thickness and material indicated for final Work. Where finishes involve normal color and texture variations, include Sample sets showing the full range of variations expected.

F. Submittal 10200-05: Product Certificates

Signed by manufacturers of louvers certifying that the products furnished comply with requirements and are licensed to bear the AMCA seal based on tests made according to AMCA 500 and complying with AMCA's Certified Ratings Program.

G. Submittal 10200-06: Product Test Reports

Indicate compliance of products with requirements based on comprehensive testing of current products.

H. Submittal 10200-07: Qualification Data
For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.06 QUALITY ASSURANCE

A. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of kind indicated. Engineering services are defined as those performed for installations of louvers that are similar to those indicated for this Project in material, design, and extent.

B. Source Limitations: Obtain louvers and vents through one source from a single manufacturer where alike in one or more respects regarding type, design, or factory-applied color finish.

C. Welding Standards: As follows:

1. Comply with AWS D1.2, "Structural Welding Code--Aluminum."

2. Comply with AWS D1.3, "Structural Welding Code--Sheet Steel."

3. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

D. SMACNA Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" recommendations for fabrication, construction details, and installation procedures.

E. UL and NEMA Compliance: Provide motors and related components for motor-operated adjustable louvers that are listed and labeled by UL and comply with applicable NEMA standards.

1.07 PROJECT CONDITIONS

A. Field Measurements: Verify louver openings by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating louvers without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to established dimensions.

Part 2 - PRODUCTS

2.01 MANUFACTURERS

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

1. Airline Products Co.

2. Airolite Co.

3. Arrow United Industries.

4. Greenheck Fan Corporation.

5. Ruskin Manufacturing; Tomkins Industries, Inc.

2.02 MATERIALS

A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy 6063-T5 or T-52.

B. Fasteners: Of same basic metal and alloy as fastened metal or 300 series stainless steel, unless otherwise indicated. Do not use metals that are incompatible with joined materials.

1. Use types and sizes to suit unit installation conditions.

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

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

E. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12 but containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.

2.03 FABRICATION, GENERAL

A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

1. Continuous Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates and without interrupting blade-spacing pattern.

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

C. Maintain equal louver blade spacing to produce uniform appearance.

D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining materials' tolerances, and perimeter sealant joints.

1. Frame Type: Channel type, unless otherwise indicated.

2. Frame Type: Exterior flange, unless otherwise indicated.

3. Frame Type: Interior flange, unless otherwise indicated.

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

F. Provide vertical mullions of type and at spacings indicated, but not more than recommended by manufacturer, or 72 inches (1830 mm) o.c., whichever is less. At horizontal joints between louver units, provide horizontal mullions, unless 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.

H. Join frame members to one another and to fixed louver blades with fillet welds concealed from view, unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

I. Join frame members to one another and to fixed louver blades with fillet welds, threaded fasteners, or both, as standard with louver manufacturer, concealed from view; unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.04 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Louver Construction: Provide fixed-blade louvers with extruded-aluminum frames and blades.

B. Horizontal Louvers: Either drainable- or nondrainable-blade type complying with the following:

1. Louver Depth: 4 inches (100 mm), unless otherwise indicated.

2. Frame Thickness: 0.081 inch (2.06 mm).

3. Blade Thickness: 0.081 inch (2.06 mm).

4. Performance Requirements: Maximum standard airflow not less than 8500 cfm (4010 L/s) with not more than 0.20- inch wg (50-Pa) static-pressure loss.

a. Louver Free Area: Not less than 8.32 square feet using a 48 inch wide by 48” high testing unit per AMCA.

6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

C. Horizontal, Drainable-Blade Louvers: As follows:

1. Louver Depth: 4 inches (100 mm), unless otherwise indicated.

2. Frame Thickness: 0.081 inch (2.06 mm).

3. Blade Thickness: 0.081 inch (2.06 mm).

4. Blade Angle and Spacing: 45 degrees and 4 inches (100 mm) o.c. for 4-inch-(100-mm-) deep louvers.

D. Continuous, Horizontal, Drainable-Blade Louvers: Fabricated with close-fitting, field-made splice joints in blades designed to permit expansion and contraction without deforming blades or framework and with mullions recessed from front edges of blades so blades have continuous appearance.

E. Continuous, Horizontal, Nondrainable-Blade Louvers: Fabricated with close-fitting, field-made splice joints in blades designed to permit expansion and contraction without deforming blades or framework. Supporting framework is concealed from view by placing braces, mullions, and brackets on inside face of louver.

1. Louver Depth: 4 inches (100 mm), unless otherwise indicated.

2. Frame Thickness: 0.081 inch (2.06 mm).

3. Blade Thickness: 0.081 inch (2.06 mm).

4. Blade Angle and Spacing: 45 degrees and 5 inches (125 mm) o.c. for 4-inch-(100-mm-) deep louvers.

5. Exterior Corners: Prefabricated corner units with mitered and welded blades aligned with straight sections, with concealed bracing.

2.06 LOUVER SCREENS

A. General: Provide louvers with screens at locations indicated.

B. General: Provide each exterior louver with louver screens complying with the following requirements:

1. Screen Location for Fixed Louvers: Interior face.

2. Screening Type: Bird screening, unless otherwise indicated.

C. Secure screens to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches (150 mm) from each corner and at 12 inches (300 mm) o.c.

D. Louver Screen Frames: Fabricate screen frames with mitered corners to louver sizes indicated and to comply with the following requirements:

1. Metal: Same kind and form of metal as indicated for louver to which screens are attached.

a. Reinforce extruded-aluminum screen frames at corners with clips.

2. Finish: Same finish as louver frames to which louver screens are attached.

3. Type: Rewirable frames with a driven spline or insert for securing screen mesh.

4. Type: Non-rewirable, U-shaped frames for permanently securing screen mesh.

E. Louver Screening for Aluminum Louvers: As follows:

1. Bird Screening: Stainless steel, 1/2-inch- (12.7-mm-) square mesh, 0.047-inch (1.19-mm) wire.

2. Bird Screening: Flattened, expanded aluminum, 3/4 by 0.050 inch (19 by 1.27 mm) thick.

2.07 BLANK-OFF PANELS

A. General: Fabricate blank-off panels from materials and to sizes indicated and comply with the following requirements:

1. Finish: Same as finish applied to louvers.

2. Attach blank-off panels to back of louver frames with clips.

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

4. Aluminum blanked-off panels to be insulated.

B. Uninsulated, Blank-off Panels: Metal sheet complying with the following requirements:

2.08 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish louvers after assembly.

2.09 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with system established by the Aluminum Association for designating aluminum finishes.

B. Class I, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 606.1 or AAMA 608.1.

Part 3 - EXECUTION

3.01 PREPARATION

A. Coordinate Setting Drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.02 INSTALLATION

A. Locate and place louver units level, plumb, and at indicated alignment with adjacent work.
B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

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

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Equipment Screen shall be installed in accordance with manufacturers recommended attachement method and in accordance with the building code.

Blades shall be attached and held in place by vinyl blade locks.

F. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be

refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

G. 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.

H. Install concealed gaskets, flashings, joint fillers, and insulation, as louver installation progresses, where weathertight louver joints are required. Comply with Division 7 Section "Joint Sealants" for sealants applied during louver installation.

3.03 ADJUSTING, CLEANING, AND PROTECTING

A. Test operation of adjustable louvers and adjust as needed to produce fully functioning units that comply with requirements.

B. Periodically clean exposed surfaces of louvers and vents that are not protected by temporary covering to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning.

C. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

D. Protect louvers and vents from damage during construction. Use temporary protective coverings where needed and approved by louver manufacturer. Remove protective covering at the time of Substantial Completion.

E. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

1. Clean and touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

End of Section

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SECTION 11325 – SUPPLEMENTAL

SEAL WATER SYSTEMS

PART 1 - GENERAL

1.1 SCOPE. This section covers the installation of seal water systems utilizing plant secondary water at Sludge Pumping Station No. 1 and Sludge Pumping Station No. 2.

1.2 QUALITY ASSURANCE. The manufacturer shall test each pump casing hydrostatically to 1.5 times maximum shut-off pressure. Each assembled pump shall be fully tested on water and have curves plotted to determine the rated capacity of each pump in accordance with the Hydraulic Institute Standards.

1.3 SUBMITTALS.

1.3.01 Drawings and Data. Submit manufacturer's product data. This data should be included, unless otherwise directed, in a schedule shown elsewhere. The data and specifications for each unit shall include, but not be limited to, the following:

Name of manufacturer

Type and model

Rotative speed

Size of suction nozzle

Size of discharge nozzle

Net weight of pump

Complete performance curves showing capacity versus head, NPSH required, pump efficiency, and bhp

Submit shop drawings detailing fabrication methods, assembly, accessories, and installation details. Drawings shall also show details of the installation of anchor bolts and other anchorages. Submit Control Panel layout drawings showing details of all panel components, including wiring diagrams and manufacturer's details and catalog cut sheets.

Submit Operation and Maintenance Manual, including parts list, control diagrams in ladder format, spare parts listing, and recommended schedule of inspection, cleaning and lubrication. Include manufacturer's recommended lubricants.

1.4 DELIVERY, STORAGE AND HANDLING. The Contractor shall transport and store all material and equipment in a manner to eliminate the possibility of damage, breakage or chipping.

1.5 WARRANTY. The pump manufacturer shall warrant the units being supplied to the Owner against defects in workmanship and material for a period of 2 years from the date of acceptance by Owner.

PART 2 - PRODUCTS

2.1 SERVICE CONDITIONS. Seal water systems shall utilize plant secondary water as indicated on the drawings.

2.2 PERFORMANCE AND BASIS OF DESIGN REQUIREMENTS. Each pumping unit shall be designed for the operating conditions indicated on the drawings and below. Minimum hydrostatic test pressure shall be 1.5 times shutoff head plus max suction pressure. It shall be designed, constructed and installed for the service intended and shall comply with the following minimum conditions:

Location: Basement level of Sludge Pumping Station No. 1 and No. 2

Quantity: 2 Pumps per System (Lead and Standby)

Liquid Pumped: Plant Secondary water (Potable water after an air gap)

Liquid Temp.: 50° – 70° F

Flow (gpm): 8

Discharge Pressure (psi): 80

Motor Horsepower (Hp): 1/2

Motor RPM: 3500

2.3 ACCEPTABLE MANUFACTURERS. Provide seal water system as manufactured by Aurora Pump Division, a unit of Pentair Water, Goulds Pumps, or equal.

2.4 PUMP CONSTRUCTION. Seal water system shall be skid mounted, completely pre-piped and pre-wired; only requiring connections for the suction and discharge piping and the incoming power. The skid shall be fabricated from welded A-36 structural steel and provided with means for collecting and draining oil and water. The seal water system shall be a constant pressure, variable volume duplex unit consisting of one lead and on stand-by pump. System shall be complete with pressure sensing controls and factory adjusted pressure regulating valves for automatic operation at the design pressure.

2.5 MOTORS. Motor shall be TEFC, high efficiency type design, 460 volt, 60 Hz, 3-phase, 1800 rpm, solid shaft ball bearing type. Motors shall be in accordance with all current applicable standards of NEMA, IEEE, AFBMA, NEC AND ANSI at a minimum. Motors shall be normal starting torque, normal slip, squirrel cage induction type.

Motor shall have Class F insulation and shall be permanently lubricated with grease or oil for extended service life.

2.6 CONTROLS. Provide a factory assembled and pre-wired NEMA 4x control panel from the pump manufacturer. Panel shall be skid mounted. Panel shall be all Type 304 stainless steel construction with a minimum thickness of 12 gage for all surfaces (expect those areas requiring reinforcement) having a smooth brush finish. Provide continuous stainless steel piano hinged door with stainless steel screws and clamps on three sides of door. Provide all internal devices mounted on 12 gage steel subpanel with enamel finish.

Control panel shall include, but not be limited to, the following components

Two Main fused disconnect switches with external operable handles

Combination circuit breaker/overload/disconnect unit with magnetic trip element for each pump

Contacts rated 5A, 120 VAC for remote indication of all pump status and alarm conditions

Individual magnetic motor starters for each pump with overload protection on each phase

480/120 volt control power transformer (CPT) to provide all 120 volt power requirements. CPT shall automatically switch between 480v source as required to maintain control power.

AUTO/MANUAL selector switch.

Start and Stop pushbuttons for each pump.

Alarm Reset pushbuttons for each pump.

“Running” pilot light (red – per pump), “Off” pilot light (green – per pump), “Power On” pilot light (white), “Overload” pilot light (amber), “Low Suction Pressure” (amber), “High System Pressure” (amber).

Automatic pump alternator for lead/standby pump alternation on successive starts.

Elapse time meters for each pump.

Adjustable timers for low suction pressure and high and low system discharge pressure shutdown.

Terminal blocks for all wiring terminations.

2.7 ACCESSORIES. Provide all accessories and appurtenances as required for a complete and operation system including, but not limited to, the following:

All piping on the seal water skid shall be copper. Provide all transitions/adapters for connection to secondary water and to seal water piping.

Provide a pressure gage on the suction manifold (0-50 psig) and on the discharge manifold (0-150 psig). Gages shall be provided with shut off valve and individual air bleed type valves. Gages shall have 3-1/2 inch faces.

Each pump shall have bronze isolation gate valves on both suction and discharge, and a combination pressure regulation non-slam swing check valve on the discharge, factory adjusted to the set system pressure.

Provide a low pressure switch on suction manifold and a high and low pressure switch on the discharge manifold.

Provide the following accessories as part of the seal water set required for each Wemco sludge pump.

Provide a Y-strainer .

Provide a pressure relief valve.

Provide a flow control valve manufactured by GE or equal. Flow control valve shall be specified ½ inch FNPT, for a flow rate of 2.0 gpm. GE Part Number 1407098, Model 2 GB.

Provide a flow switch.

Provide a pressure gage (0-150 psig).

PART 3 - EXECUTION

3.1 INSTALLATION. Installation shall be in complete accordance with manufacturer's instructions and recommendations. Skids shall be installed on concrete bases or steel frame support and secured with anchor bolts in accordance with the manufacturer's recommendations and as shown. Concrete work and grout are in Division 3. Pipe skid drains to nearest drainage inlet. Installation shall include furnishing and applying an initial supply of grease and oil, recommended by the manufacturer. Support piping independent of skid and mounted equipment.

3.2 START-UP AND TEST. Contractor shall verify that structures, pipes and equipment are compatible. Make adjustments required to place seal water system in proper operating condition. A manufacturer's representative shall check and approve the installation before operation. He shall test operate the system in the presence of Engineer and verify that the seal water systems conform to requirements, and instruct plant personnel on care and maintenance of the equipment. He shall revisit the jobsite as often as necessary until the installation is entirely satisfactory. Submit test report to Engineer.

End of Supplemental Section

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SECTION 14241 – SUPPLEMENTAL

ELEVATOR REFURBISHMENT

PART 1 - GENERAL

1.1 SCOPE. This section covers the refurbishment of the existing elevator at Sludge Pumping Station No. 2.

1.2 GENERAL. Evaluate elevator phone and wiring to determine replacement requirements. Replace phone if the wiring is not faulty. Remove current rope and replace with new rope. Remove current brake pads and replace with new brake pads. Replace door detection system device with a microlight detection system.

It is not the intent to specify all the details of refurbishment. Refurbish elevator in accordance with the manufacturer's standard practices where they do not conflict with this specification. All work performed shall be identified prior to work in an inspection report prepared by the Contractor as submitted to the Engineer for approval.

1.2.01 Governing Standards.

ASME – American Society of Mechanical Engineers: A17.1 - Safety Code for Elevators and Escalators.

1.3 SUBMITTALS.

1.3.01 Inspection Report. Prepare and submit to Engineer a report that fully discloses the defects, details, materials, recommended replacement parts, and methods of refurbishment. Indicate elevator components found unsuitable for reuse and not included as part of the Work as specified.

1.3.02 Drawings and Data. Contractor shall submit for review detailed drawings, catalog data, descriptive matter, and manufacturer's specifications for the proposed equipment.

1.4 QUALITY ASSURANCE. Quotations shall only be requested from Specialize Service Contractors which are extensively experienced and are regularly engaged in providing overhaul and repair of elevators and associated equipment. In order to be considered qualified, the Special Service Contractor shall have adequate equipment, tools and qualified technicians to perform the repair services.

1.5 DELIVERY, STORAGE AND HANDLING. The Contractor shall transport and store all material and equipment in a manner to eliminate the possibility of damage, breakage or chipping. Damaged material shall be promptly replaced. All materials shall be stored off the ground and protected from weather.

1.6 WARRANTY. The elevator contractor shall warrant the elevator and replaced equipment against defects in workmanship and material for a period of 12 months from the date of acceptance by Owner.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS. The elevator shall be refurbished by Thyssen Krupp, Montgomery Kone, or Otis. Alternate contractors may be proposed as required and as acceptable to the Engineer.

2.2 PERFORMANCE AND DESIGN CRITERIA.

2.2.01 General Equipment Requirements. The General Equipment Stipulations in the Master Specification Section 01180, Equipment, Materials, Parts, and Tools shall apply to all equipment and accessories furnished under this section.

2.2.02 Governing Standards. The elevator shall be refurbished in accordance with ASME A17.1, the National Electrical Code, and all other applicable building and fire code, laws, and regulations. In case of conflict, the applicable code, ordinance, law, or regulation shall govern.

2.3 MATERIALS. Provide the proper equipment to complete the following tasks:

A. Restore the existing phone to working order.
B. Replace the existing elevator rope.
C. Replace the existing elevator brake pads.
D. Replace the existing door safety device.
E. Retain existing lock-out key.

Where components are not otherwise indicated, provide standard components, produced by the original manufacturer as included in standard pre-engineered elevator systems and as required for a complete system. All parts components shall be new. No refurbished or reconditioned parts or components shall be accepted.

PART 3 - EXECUTION

3.1 REPAIR/RESTORATION. Accessories shall be installed by an elevator erector

and elevator mechanics who are acceptable to, and authorized for the work by, the manufacturer of the elevator furnished. Equipment will be erected in accordance with the manufacturer's instructions.

3.1.01 Elevator Telephone. The elevator shall be provided with a telephone and all necessary hardware. Telephone cable shall be provided by the elevator contractor from the telephone in the elevator to the telephone junction box located in the Elevator Equipment Room. All necessary hardware shall be provided and installed in the junction box to enable an external telephone circuit to be connected to the hardware provided by the elevator contractor to complete the telephone circuit.

3.1.02 Door Safety Devices. The elevator contractor shall replace the existing safe edge safety device with a new microlight detection system. Interruption of the light beams will cause the doors to stop and reopen.

3.1.03 Ropes. The elevator contractor shall replace the existing elevator rope with new rope.

3.1.04 Brake Pads. The elevator contractor shall replace the existing brake pads with new pads.

3.2 FIELD QUALITY CONTROL. Upon nominal completion of elevator repairs and before permitting use of elevators, perform acceptance tests as required and recommended by the Code and governing regulations and agencies. Contractor shall provide a certified test report stating that all work is complete, the elevator has been tested, and the elevator is in working order.

End of Supplemental Section

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SECTION 15190 – SUPPLEMENTAL

MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SCOPE. This section covers the requirements for furnishing and installing identification materials and devices for the mechanical systems.

1.2 GENERAL.

1.2.01 Governing Standards.

ASME – American Society of Mechanical Engineers: A13.1 – Scheme for the Identification of Piping Systems.

1.3 SUBMITTALS. Provide all submittals, including the following, as specified in Division 1. Submit the manufacturer's technical product data and installation instructions for each identification material and device required.

Submit a typewritten valve schedule for each piping system, reproduced on 8-1/2-inch by 11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special "flags", in the schedule margin.

Submit samples of each color, lettering style, and other graphic representation required for each identification material or system. Provide a mock-up type sample installation.

Include product data and schedules in the appropriate operation and maintenance manuals.

1.4 QUALITY ASSURANCE.

1.4.01 Manufacturer’s Qualifications. Provide the specified items from firms regularly engaged in the manufacture of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

1.5 SPARE PARTS. Furnish a minimum of 5% extra stock of each mechanical identification material required, including additional numbered valve tags (not less

than 3) for each piping system, additional piping system identification markers, and additional plastic laminate engraving blanks of assorted sizes. Where stenciled markers are provided, clean and retain the stencils after completion of stenciling and include used stencils in the extra stock, along with the required stock of stenciling paints and applicators.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS. Identification materials shall be manufactured by All Systems, Inc., Brady (W.H.) Co.; Signmark Div., Industrial Safety Supply Co., Inc., Seton Name Plate Corp. or equal.

2.2 MATERIALS. Provide the manufacturer's standard products of categories and types required for each application as referenced in other Division-15 sections. Where more than a single type is specified for an application, selection is at the Contractor's option, but provide a single selection for each product category. Comply with ASME A13.1 for lettering size, length of color fields, colors and viewing angles of identification devices.

2.2.01 Painted Identification Materials. Provide metal stencils, prepared for the required applications with a letter sizes generally complying with the recommendations of ASME A13.1 for piping and similar applications, but not less than 1-1/4 inches high letters for ductwork and not less than 3/4-inch high letters for access door signs and similar operational instructions. Provide a standard exterior type stenciling enamel, black, except as otherwise indicated, for either brushing grade or pressurized spray-can form and grade. Provide a standard identification enamel of the colors indicated or, if not otherwise indicated for piping systems, comply with ASME A13.1 for colors.

2.2.02 Plastic Pipe Markers. This section applies to product service piping, concealed piping and piping not continuously color code painted. Provide the manufacturer's standard pre-printed, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, complying with ASME A13.1. Furnish 1-inch thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125 degrees F or greater. Cut the insulation length to extend 2 inches beyond each end of the plastic pipe markers. For external diameters less than 6 inches (including insulation if any), provide full-band pipe markers, extending 360 degrees around the pipe at each location, fastened by one of the following methods:

Adhesive lap joint in pipe marker overlap.

Laminated or bonded application of pipe marker to pipe (or insulation).

Taped to the pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4 inches wide; full circle at both ends of pipe marker, tape lapped 1-1/2 inches.

For external diameters of 6 inches and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than 3 times the letter height (and of required length), fastened by one of the following methods:

Laminated or bonded application of pipe marker to pipe (or insulation).

Taped to the pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2 inches wide; full circle at both ends of pipe marker, tape lapped 3 inches.

Strapped-to-pipe (or insulation) application of semi-rigid type, with the manufacturer's standard stainless steel bands.

Comply with the piping system lettering nomenclature as specified, scheduled or shown, and abbreviate only as necessary for each application length. Print each pipe marker with arrows indicating the direction of flow, either integrally with the piping system service lettering (to accommodate both directions), or as a separate unit of plastic.

2.2.03 Plastic Tape. Provide the manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick. Provide 1-1/2 inch wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6 inches, 2-1/2 inches wide tape for larger pipes. Except where another color selection is indicated, comply with ASME A13.1.

2.2.04 Underground-Type Plastic Line Marker. Provide the manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6 inches wide by 4 mils thick. Provide tape with printing which most accurately indicates the type of service of the buried pipe. Provide multi-ply tape consisting of a solid aluminum foil core between 2-layers of plastic tape.

2.2.05 Valve Tags. Provide 19-gauge polished brass valve tags with stamp-engraved piping system abbreviations in 1/4-inch high letters and sequenced valve

numbers 2-inch high. Provide a 5/32-inch hole for the fastener. Provide 1-1/2-inch diameter tags, except as otherwise indicated. Fill tag engraving with black enamel. Provide the manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of the tags to valves, and manufactured specifically for that purpose. Provide the manufacturer's standard 1/16 inch thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to the concealed valve. Include a 1/8-inch center hole to allow for attachment. Provide manual and automatic balancing valve tags with the valve model number, rated flow in GPM, differential pressure range and zone or unit identification for each valve.

2.2.06 Valve Schedule Frames. For each page of the valve schedule, provide a glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.

2.2.07 Engraved Plastic-Laminate Signs. Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the sizes and thicknesses required, engraved with the engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of the substrate. Provide tags 1/8 inch thick, except as otherwise indicated. Provide self-tapping stainless steel screws, or contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.2.08 Plastic Equipment Markers. Provide the manufacturer's standard laminated plastic, color coded equipment markers conforming to the following color code:

Green: Cooling equipment and components.

Yellow: Heating equipment and components.

Yellow/Green: Combination cooling and heating equipment and components.

Blue: Equipment and components that do not meet any of the above criteria.

For hazardous equipment, use colors and designs recommended by AMSE A13.1.

Include the following, matching terminology on schedules as closely as possible:

Name and drawing number

Equipment service

Design capacity

Other design parameters such as pressure drop, entering and leaving conditions, rpm, etc.

Provide approximate 2-1/2-inch x 4-inch markers for control devices, dampers, and valves; and 4-1/2-inch x 6-inch for equipment.

2.2.09 Plasticized Tags. Provide the manufacturer's standard pre-printed or partially preprinted accident-prevention tags, of plasticized card stock with a matt finish suitable for writing, which are approximately 3-1/4-inch x 5-5/8-inch, with brass grommets and wire fasteners, and with appropriate pre-printed wording including large-size primary wording (as examples; DANGER, CAUTION, DO NOT OPERATE).

2.2.10 Lettering and Graphics. Coordinate names, abbreviations and other designations used in mechanical identification Work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by the manufacturers or as required for proper identification, operation and maintenance of mechanical systems and equipment. Where multiple systems of the same generic name are shown and specified, provide identification which indicates the individual system number as well as the service (as examples; Boiler No. 3, Air Supply No. 1H, Standpipe F12).

PART 3 - EXECUTION

3.1 PREPARATION. Degrease and clean surfaces to receive adhesive for identification materials. Prepare surfaces in accordance with Section 09900 for stencil painting.

3.2 INSTALLATION. Install in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1. Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install the identification after completion of the covering and painting. Install the identification prior to installation of acoustical ceilings and similar removable concealment.

3.3 DUCTWORK IDENTIFICATION. Identify air supply, return, exhaust, intake and relief ductwork with duct markers, or provide stenciled signs and arrows, showing ductwork service and direction of flow, in black or white (whichever provides the most contrast with the ductwork color). In each space where ductwork is exposed, or concealed only by a removable ceiling system, locate signs near points where the ductwork originates or continues into concealed enclosures (shaft, underground or similar concealment), and at 50 foot spacings along exposed runs. Paint all exposed ductwork per color selection as approved. Provide duct markers or stenciled signs on each access door in ductwork and housings, indicating purpose of access (to what equipment) and other maintenance and operating instructions, and appropriate safety and procedural information.

3.4 PIPING SYSTEM IDENTIFICATION. Install pipe markers of one of the following types on each system and include arrows to show normal direction of flow:

Stenciled markers, including color-coded background band or rectangle, and contrasting lettering of black or white. Extend the color band or rectangle 2 inches beyond ends of lettering.

Plastic pipe markers, with application system as indicated under "Materials" in this Section. Install on pipe insulation segment where required for hot uninsulated pipes.

Stenciled markers, black or white for best contrast, wherever continuous color-coded painting of piping is provided.

Continuously paint and color code all exposed piping to allow for quick identification. Paint each piping system a different color as selected and approved. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior nonconcealed locations.

Near each valve and control device.

Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be a question of the flow pattern.

Near locations where pipes pass through walls or floors/ceilings, or enter nonaccessible enclosures.

At access doors, manholes and similar access points which permit view of the concealed piping.

Near major equipment items and other points of origin and termination.

Spaced intermediately at a maximum spacing of 50 feet along each piping run, except reduce spacing to 25 feet in congested areas of piping and equipment.

On piping above removable acoustical ceilings, except omit intermediately spaced markers.

3.5 UNDERGROUND PIPING IDENTIFICATION. During back-filling and placing of top-soil over each exterior underground piping system, install a continuous underground-type plastic line marker, located directly over the buried line at 6 to 8 inches below the finished grade. Where multiple small lines are buried in a common trench and do not exceed an overall width of 16 inches, install a single line marker. For tile fields and similar installations, mark only the edge pipe lines within the field.

3.6 VALVE IDENTIFICATION. Provide a valve tag on every valve, cock and control device in each piping system. Exclude check valves, valves within factory-fabricated equipment units, plumbing fixture faucets, convenience and lawn-watering hose bibs, and shut-off valves at plumbing fixtures, HVAC terminal devices and similar rough-in connections of end-use fixtures and units. List each tagged valve in the valve schedule for each piping system. Mount the valve schedule frames and schedules in machine rooms where indicated or, if not otherwise indicated, where directed. Where more than one major machine room is shown for the Project, install a mounted valve schedule in each major machine room, and repeat on the schedule only main valves which are to be operated in conjunction with operations of more than single machine room.

3.7 MECHANICAL EQUIPMENT IDENTIFICATION. Install engraved plastic laminate signs on or near each major item of mechanical equipment and each operational device, as specified if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:

Main control and operating valves, including safety devices and hazardous units such as gas outlets

Meters, gauges, thermometers and similar units

Fuel-burning units including boilers

Pumps, compressors, chillers, condensers and similar motor-driven units

Fans, blowers, primary balancing dampers and mixing boxes

Packaged HVAC central-station or zone-type units

Tanks and pressure vessels

Strainers, filters, humidifiers, water treatment systems and similar equipment

Use a minimum 1/4 inch high lettering for name of unit where viewing distance is less than 2 feet, 2-inch high for distances up to 6 feet, and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 of the size of the principal lettering.

In addition to the name of the identified unit, provide lettering to distinguish between multiple units, inform the operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

3.8 ADJUSTING AND CLEANING. Relocate any mechanical identification device which has become visually blocked by the Work of this division or other divisions. Clean the face of identification devices, and glass frames of valve charts.

End of Supplemental Section

SECTION 15400 – SUPPLEMENTAL

PLUMBING

PART 1 - GENERAL

1.1 SCOPE. This section covers the furnishing and installation of materials, appliances, fixtures, equipment, and appurtenances associated with the plumbing systems as specified herein and as indicated in the Contract Documents. Additional requirements for plumbing systems shall be as indicated in the schedules on the drawings. Suitable connections shall be provided for each fixture, piece of equipment, and appurtenance.

Pipe materials, valves, thermal insulation, and pipe supports which are not an integral part of the fixture or piece of equipment and are not specified herein are covered in other sections.

1.2 GENERAL. Equipment furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer unless exceptions are noted by Engineer.

1.2.01 Coordination. Contractor shall verify that each component of the plumbing system is compatible with all other parts of the system; that all piping, fixtures, and appurtenances are appropriate; and that all devices necessary for a properly functioning system have been provided.

Where two or more units of the same class of equipment are required, they shall be the product of a single manufacturer; however, all the component parts of the system need not be the products of one manufacturer.

Each manufacturer of major equipment shall have a local service center, or with written consent of Engineer, shall be able to provide service from other locations within 24 hours. The service center shall be equipped and staffed to service the system and shall maintain a local parts supply. Information on equipment manufacturers' representatives shall be included with the submittals.

Where several manufacturers' names have been listed in this section as possible

suppliers, only the products of the first manufacturer listed have been checked for size, functions, and features.

1.2.03 Governing Standards. Except as modified or supplemented herein, all work covered by this section shall be performed in accordance with the current publications and addenda thereto all applicable municipal codes and ordinances, laws, and regulations. In case of a conflict between this section and any state law or local ordinance, the latter shall govern.

All work shall conform to the requirements of AGA, ASTM, NFPA, and UL safety requirements.

1.2.05 Metal Thickness. Metal thicknesses and gages specified herein are minimum requirements. Gages refer to US Standard gage.

1.2.06 Lubrication. Equipment shall be adequately lubricated by systems which require attention no more frequently than weekly during continuous operation. Lubrication systems shall not require attention during startup or shutdown and shall not waste lubricants.

1.3.02 Equipment Plates. Plumbing equipment shall be identified with engraved or stamped equipment plates securely affixed to the equipment in an accessible and visible location. Equipment plates shall be in addition to the number plates specified in the preceding paragraph. Equipment plates shall indicate the manufacturer's name, address, product name, catalog number, serial number, capacity, operating and power characteristics, labels of tested compliances, and any other pertinent design data. Equipment plates listing the distributing agent only will not be acceptable.

1.3.03 Piping. Piping identification shall be as specified in Specification Section 09900, Painting.

1.3.04 Valves. Valves that have been assigned an identification number shall be identified with tags.

Lubricants of the types recommended by the equipment manufacturer shall be provided in sufficient quantities to fill all lubricant reservoirs and to replace all consumption during testing, startup, and operation prior to acceptance of equipment. Unless otherwise specified or permitted, the use of synthetic lubricants will not be acceptable.

1.4 SUBMITTALS.

1.4.01 Drawings and Data. Complete assembly and installation drawings, and wiring and schematic diagrams, together with detailed specifications and data covering materials, parts, devices, and accessories forming a part of the equipment furnished, shall be submitted in accordance with Specification Section 01080 Project Submittals. Device tag numbers indicated on the drawings shall be referenced on the wiring and schematic diagrams where applicable. The data and specifications to be submitted for each unit shall include, but shall not be limited to, the following:

Plumbing Fixtures

Name of manufacturer.

Type and model.

Construction materials, thicknesses, and finishes.

Water consumption data.

Overall dimensions.

Rough-in dimensions.

Piping connection sizes and locations.

Net weight.

1.5 QUALITY ASSURANCE.

1.5.01 Welding Qualifications. All welding procedures and welding operators shall be qualified by an independent testing laboratory in accordance with the applicable provisions of AWS Standard Qualification Procedures. All procedure and operator qualifications shall be in written form and subject to Engineer's review. Accurate records of operator and procedure qualifications shall be maintained by Contractor and

made available to Engineer upon request.

1.5.02 Qualification. The plumbing system installer shall be licensed as stipulated by the authority having jurisdiction.

1.5.03 Manufacturer's Experience. Unless the equipment manufacturer is specifically named in this section, the manufacturer shall have furnished equipment of the type and size specified which has been in successful operation for not less than the past 5 years.

1.5.04 Construction. Plumbing fixtures shall be constructed in accordance with the following standards:

Enameled Cast Iron	ANSI/ASME A112.19.1M
Vitreous China	ANSI/ASME A112.19.2M
Stainless Steel	ANSI/ASME A112.19.3M
Enameled Steel	ANSI/ASME A112.19.4M
Emergency/Safety Fixtures	ANSI Z358.1

Electric water coolers shall be UL listed and certified in accordance with the Air Conditioning and Refrigeration Institute (ARI) Standard 1010. All materials in contact with water shall comply with the Safe Drinking Water Act of 1986, and the Lead Contamination Control Act of 1988.

1.6 DELIVERY, STORAGE, AND HANDLING. Shipping, handling and storage shall be in accordance with Specification Section 01180, Equipment, Materials, Parts, and Tools.

1.7 EXTRA MATERIALS. Extra materials shall be furnished for each type and size of plumbing fixture or equipment as indicated in the Contract Documents, in the quantities indicated below.

Part	Number Required
Flushometer valve repair kits	1 per 5 fixtures

Tank type water closet ballcocks, flush valves, and floats	1 per 5 fixtures
Water closet seats	1 per 10 fixtures
Faucet washer and O-ring kits	1 per 5 fixtures
Faucet cartridge and O-ring kits	1 per 5 fixtures
Electric water heater elements	1 per heater
Water heater relief valves	1 per heater

Extra materials shall be packaged with labels indicating the contents of each package. Each label shall indicate manufacturer's name, equipment name, part nomenclature, part number, address of nearest distributor, and current list price. Extra materials shall be delivered to Owner as directed.

Extra materials subject to deterioration such as ferrous metal items and electrical components shall be properly protected by lubricants or desiccants and encapsulated in hermetically sealed plastic wrapping.

PART 2 - PRODUCTS

2.1 SERVICE CONDITIONS. All plumbing fixtures and equipment shall be designed and selected to meet the specified conditions indicated in the Contract Documents.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS. All fixtures and equipment shall be designed to meet the performance and design conditions specified herein and indicated on the drawings.

2.2.01 Dimensional Restrictions. Layout dimensions will vary between manufacturers and the layout area indicated on the drawings is based on typical values. Contractor shall review the contract drawings, the manufacturer’s layout drawings, and installation requirements and shall make any modifications required for proper installation subject to acceptance by Engineer.

2.2.02 Elevation. Equipment shall be designed to operate at the elevation as indicated

on the drawings.

2.3 ACCEPTABLE MANUFACTURERS. Acceptable manufacturers shall be as listed in the respective product description paragraphs.

2.4 MANUFACTURE AND FABRICATION.

2.4.01 Anchor Bolts and Expansion Anchors. Anchor bolts, expansion anchors, nuts, and washers shall be as indicated in Specification Section 05550, Anchor Bolts and Expansion Anchors.

2.4.02 Surface Preparation. All iron and steel surfaces, except motors and speed reducers, shall be shop cleaned by sandblasting or equivalent, in strict conformance with the paint manufacturer's recommendations. All mill scale, rust, and contaminants shall be removed before shop primer is applied.

2.4.03 Shop Coating. All steel and iron surfaces shall be protected by suitable coatings applied in the shop. Surfaces which will be inaccessible after assembly shall be protected for the life of the equipment. Coatings shall be suitable for the environment where the equipment is installed. Exposed surfaces shall be finished, thoroughly cleaned, and filled as necessary to provide a smooth, uniform base for painting. Electric motors, speed reducers, starters, and other self-contained or enclosed components shall be shop primed or finished with an oil-resistant enamel or universal type primer suitable for top coating in the field with a universal primer and aliphatic polyurethane system.

Surfaces to be coated after installation shall be prepared for painting as recommended by the paint manufacturer for the intended service, and then shop painted with one or more coats of the specified primer.

Surface finish damaged during installation shall be repaired to the satisfaction of Engineer. Field painting shall conform to the requirements of Specification Section 09900, Painting.

2.4.04 Special Tools and Accessories. Equipment requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments, and accessories required for proper maintenance. Equipment requiring special devices for lifting or handling shall be furnished complete with those devices.

2.4.05 Piping Systems. Unless otherwise specified herein, piping system materials shall conform to Specification Section 15062, Steel Pipe and Specification Section 15065, Miscellaneous Steel Pipe, Tubing and Accessories.

2.4.06 Valves. Unless otherwise specified herein, valves indicated to be a part of the plumbing systems shall conform to the Specification Section 15100, Miscellaneous Valves.

2.5 WATER SUPPLY PIPING ACCESSORIES.

2.5.02 Trap Primers. Trap primer valves shall be flow activated, pressure activated, or tailpiece type as indicated in the Contract Documents.

2.5.02.01 Flow Activated Trap Primers. Flow activated trap primer valves shall be the automatic type activated by water flow in a pipeline. The primer valve shall consist of a bronze body with removable operating parts, an integral vacuum breaker, and a gasketed access cover. Connections shall be 1/2 inch (13 mm) NPT. Trap primer valves shall be tested and certified in accordance with American Society of Sanitary Engineering (ASSE) Standard 1018. Trap primer valves shall be Smith "2699", Josam "Series 88250", Wade "W-2400", or approved equal.

2.5.02.02 Pressure Activated Trap Primers. Pressure activated trap primer valves shall be the automatic type activated by pressure drop in a pipeline. The primer valve shall consist of a brass body with removable operating parts and an integral air gap. A distribution unit shall be provided when a single primer valve serves multiple traps. The trap primer shall be self-adjusting to line pressure and shall not require field adjustment. Connections shall be 1/2 inch (13 mm) NPT. Trap primer valves shall be tested and certified in accordance with American Society of Sanitary Engineering (ASSE) Standard 1018. Trap primer valves shall be Precision Plumbing Products "Prime-Rite PR-500", or approved equal.

2.5.02.03 Tailpiece Trap Primers. Trap primers installed in a flush valve water closet supply or lavatory drain shall consist of a chrome plated brass plumbing fixture tailpiece with a 1/2 inch (13 mm) OD diverter pipe and compression connection for copper tubing.

2.5.02.04 Thermostatic Mixing Valves. Thermostatic mixing valves shall comply with ASSE 1017, shall be bronze or brass body, with stainless steel flow control components, threaded end connections, rotating handle adjustment, lockable setpoint,

and hot and cold check stops. Valves shall be suitable for flow ranges and have temperature adjustment ranges as indicated in the schedules. Accuracy shall within 3° F (2° C) of setpoint. Thermostatic mixing valves shall be manufactured by Symmons, Leonard, Powers, or approved equal.

2.6 DRAINAGE.

2.6.01 Downspout Nozzles. Downspout nozzles shall be cast brass or bronze, and shall be provided with a threaded inlet and a mounting flange. The mounting flange shall be provided with drilled fastening lugs. Downspout nozzles shall be Smith "Model 1770", Josam, Wade, or approved equal.

2.7 PLUMBING FIXTURES AND ACCESSORIES.

2.7.01 General. Plumbing fixtures shall be provided with all required supports, fasteners, supply and drain fittings, gaskets, and escutcheons required for a complete installation.

2.7.02 Water Closets. Water closets shall be of vitreous china, with an elongated bowl and siphon jet flushing action. The type and water use of water closets shall be as indicated on the drawings. All water closets shall be provided with anchor bolt caps. Flush valve type water closets shall be provided with top spud connections for flushometer valves. Flush tank type water closets shall be provided with factory installed tank liners. Field installed liner kits will not be acceptable. Water closets shall be manufactured by Kohler, American Standard, Eljer, or approved equal.

2.7.02.01 Seats. Water closet seats shall be white, solid plastic, contoured, elongated open front type without cover, with concealed check and stainless steel hinges. The seats shall be manufactured by Kohler, American Standard, Eljer, Church, or approved equal.

2.7.02.02 Flush Valves. Flush valves for top spud type water closets shall be exposed type, with a chrome plated brass body, an externally adjustable diaphragm, an angle stop, a renewable valve seat, a tailpiece, a vacuum breaker, a wall flange, a spud nut and flange, and a 1 inch (25 mm) NPT water supply connection. Flush valves shall be Sloan "Royal" Delaney, or approved equal.

2.7.02.03 Supply Set. A supply set consisting of a 1/2 inch (13 mm) NPT brass angle loose key stop valve, a copper supply tube, and an escutcheon plate shall be furnished

for each tank type water closet. All supply components shall be polished chrome.

2.7.02.04 Chair Carriers. Wall-mounted water closets shall be provided with adjustable chair carriers. The carriers shall be suitable for the chase depth and piping arrangement and shall consist of a heavy-duty cast iron body, complete with a drainage fitting, pylon feet, a drainage nipple, fitting and fixture gaskets, a positioning frame or template, and mounting hardware. Chair carriers shall be manufactured by Smith, Josam, Wade, or approved equal.

2.7.03.01 Flush Valves. Flush valves shall be exposed type, of chrome plated brass with an externally adjustable diaphragm, an angle stop, a renewable valve seat, a tailpiece, a vacuum breaker, a wall flange, a spud nut and flange, and a 3/4 inch (19 mm) NPT water supply connections. Flush valves shall supply a maximum of 1.0 gallon (3.8 L) per flush, and shall be Sloan "Royal 186-1", Delaney, or approved equal.

2.7.03.02 Supports. A fixture support system, including support legs, upper and lower bearing plates, and bearing studs shall be provided for urinals mounted on all walls other than masonry. Urinals mounted on masonry walls shall be provided with suitable anchor bolts. Urinal supports shall be manufactured by Smith, Josam, Wade, or approved equal.

2.7.04 Lavatories. Lavatory types, dimensions, and water use shall be as indicated on the drawings. Lavatories shall be of vitreous china, constructed with overflow drains and soap depressions. Countertop lavatories shall be self-rimming, and shall be provided with suitable adhesive and/or fastening clamps. Wall-mounted lavatories shall be drilled for a concealed arm carrier. Faucet drillings shall be 4 inches (100 mm) on center unless otherwise indicated. Lavatories shall be manufactured by Kohler, American Standard, Eljer, or approved equal.

2.7.04.01 Faucets and Trim. Lavatory faucets shall be 4 inches (100 mm) on center, of polished chrome, with a vandal-resistant single-lever handle and all-brass or copper waterways. Each faucet shall be provided with a flow restrictor, a cast brass grid strainer or pop-up drain, and a 1-1/4 inch (32 mm) cast brass tailpiece. Supply sets consisting of 1/2 inch (12.5 mm) NPT brass angle loose key stop valves, copper supply tubes, and escutcheon plates shall be furnished for each lavatory faucet. All supply components shall be polished chrome. Where indicated to be ADA-compliant and exposed to human contact, lavatory supplies shall be insulated. Lavatory faucets and supply sets shall be manufactured by Kohler, American Standard, Eljer, or approved

equal.

2.7.04.02 Traps. Lavatory traps shall be at least 1-1/4 inches (32 mm) in diameter, cast brass with polished chrome finish, with an escutcheon flange and a cleanout plug. Where indicated to be ADA-compliant and if exposed to human contact, lavatory traps shall be offset, insulated type.

When insulation is needed, lavatory supplies and traps may be pre-insulated or furnished with an insulation kit for field installation. Insulating material shall be flame retardant closed cell vinyl. The supply insulating kit shall be snap form type or shall be provided with ties. The trap insulation material shall not require the use of ties or mechanical fasteners to be held in place. Pre-insulated traps and supply insulation kits shall be McGuire Products "ProWrap", or approved equal. Trap and supply insulation kits shall be as manufactured by TRUEBRO Inc, or approved equal.

2.7.04.03 Supports. Wall-hung lavatories shall be provided with a complete fixture support system, including support legs, bearing plates, concealed arms, and anchor bolts. The support legs shall be mounted within the partition wall. For lavatories mounted on masonry walls, support legs may be omitted. Lavatory supports shall be manufactured by Smith, Josam, Wade, or approved equal.

2.7.05 Water Heater. Water heater shall be manufactured by A.O. Smith, Model Type DEL-6S, 6 US Gallon, 2.5 kW, or approved equal.

PART 3 - EXECUTION

3.1 INSPECTION. Equipment installed in existing facilities with limited access shall be suitable for being installed through available openings. Contractor shall field verify existing opening dimensions and other provisions for installation prior to submittal of bids.

3.2 PREPARATION.

3.2.01 Surface Preparation. All surfaces to be field painted shall be dry and free of dirt, dust, sand, grit mud, oil, grease, rust, loose mill scale, or other objectionable substances, and shall meet the recommendations of the paint manufacturer for surface preparation. Cleaning and painting operations shall be performed in a manner which will prevent dust or other contaminants from getting on freshly painted surfaces. Oil and grease shall be completely removed by use of solvents or detergents before mechanical

cleaning is started. The gloss of previously painted surfaces shall be dulled if necessary for proper adhesion of top coats.

3.3 INSTALLATION. Plumbing fixtures and materials furnished under this section shall be installed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

Unless otherwise indicated, sleeves shall be provided for all pipe penetrations through concrete and masonry walls. Sleeves and sealing requirements shall be as detailed on the drawings. Piping penetrations through fire-rated floors and walls shall be provided with fire-rated sleeves, sealants, and devices as necessary to maintain the rating of the assembly.

Not all required reducing fittings and unions are indicated. Additional fittings and unions shall be provided as needed to connect all equipment and appurtenances.

Insulating fittings shall be provided to prevent the contact of dissimilar metals in piping systems as specified Specification Section 15065, Miscellaneous Steel Pipe, Tubing and Accessories.

Piping shall not be routed over or in front of electrical switchboards or panels unless acceptable to Engineer.

3.3.03 Plumbing Fixtures and Accessories. Plumbing fixtures shall be set level and plumb, and shall be securely attached to the floor or wall. Unless otherwise indicated on the drawings, each fixture shall be mounted at the height recommended by the manufacturer. Where required to be in compliance with ADA, fixtures shall be mounted at the heights established by the Federal Government.

Fixtures shall be sealed to the floor or wall with a sealant as specified in Specification Section 07600, Caulking and Sealers. The color of sealant shall match the color of the fixture.

Fixture traps shall be easily removable for servicing and cleaning. Escutcheons shall be placed at all locations where fixture supply or drain piping penetrates walls, floors, or ceilings.

Water piping at stop valves, shower heads, and flush valves shall be rigidly secured to

blocking. Drop-ear elbows shall be used whenever possible. All water supply piping shall be cleaned and flushed before the plumbing fixtures are installed.

3.4 FIELD QUALITY CONTROL.

3.4.01 Installation Check. An experienced, competent, and authorized representative of the manufacturer shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. The representative shall be present when the equipment is placed in operation in accordance with Specification Section 01180, Equipment, Materials, Parts, and Tools, and shall revisit the jobsite as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of Engineer.

The manufacturer's representative shall furnish a written report certifying that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping or anchor bolts; and has been operated under full load conditions and that it operated satisfactorily.

All costs for these services shall be included in the Contract Price.

3.4.02 Startup and Testing. Field performance tests shall be conducted to demonstrate that each system is functioning as specified and to the satisfaction of Engineer.

Field performance testing of the plumbing piping systems shall conform to Specification Section 15065, Miscellaneous Steel Pipe, Tubing and Accessories.

If inspection or tests indicate defects, the defective work or material shall be replaced, and inspection and tests repeated. All repairs to piping shall be made with new materials. Caulking of threaded joints or holes will not be acceptable.

3.5 ADJUSTING. All flush valves and other devices shall be adjusted for proper flow and quiet operation. Faucet and supply assemblies shall be adjusted or repaired to eliminate leaks. All drains shall be checked for proper operation.

3.6 PROTECTION. Plumbing fixtures, equipment, and appurtenances shall be protected from damage immediately after installation. Plumbing fixtures shall not be used during the construction.

3.7 CLEANING. After completion of testing and immediately before the final inspection,

plumbing fixtures, equipment, piping, and appurtenances shall be thoroughly cleaned. Cleaning materials and methods shall be as recommended by the manufacturer. All faucet aerators shall be removed, cleaned, and reinserted.

Any stoppage, discoloration, or other damage to parts of the building, its finish, or furnishings shall be repaired at no additional cost to Owner.

3.8 DISINFECTION. Before the potable water system is placed in operation, it shall be disinfected in accordance with the requirements of the local authority having jurisdiction. In the absence of local requirements, the following disinfection method shall be used:

1. The system shall be purged with clean potable water until all dirt and other substances are flushed from the system.

2. The system shall be filled with a water/chlorine solution containing at least 50 parts per million (50 mg/L) of available chlorine and allowed to stand for 24 hours; or the system shall be filled with a water/chlorine solution containing at least 200 parts per million (200 mg/L) of available chlorine and allowed to stand for 3 hours.

3. The system shall be purged with clean potable water until the chlorine is flushed from the system.

4. The procedure shall be repeated if a bacterial examination indicates that contamination remains present in the system.

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SECTION 15501 - SUPPLEMENTAL

HVAC GENERAL PROVISIONS

PART 1 - GENERAL

1.1 SCOPE. These Sections and Drawings cover(s) the general requirements of the HVAC work to be performed and shall not void any of the requirements specified under the General Conditions or General Requirements.

Heating Equipment

Flue Stacks, Breechings and Vents

Air Handling Units

Centrifugal Fans

Ductwork and Accessories

Electric Automatic Temperature Control System

HVAC Systems Testing, Adjusting and Balancing

The requirements specified herein shall be modified only if specified otherwise for a particular application in other Divisions. Work to be included under the "Scope of Work" of each HVAC Section listed above shall include all labor, material, equipment, tools and services necessary to furnish, deliver, unload, install, test and place in satisfactory operation the equipment, services and systems as called for under each HVAC Section including any incidental work not shown, or not specified but which can reasonably be inferred as belonging to the various systems and necessary in good practice to provide a complete and satisfactory operating system.

This HVAC specification is incomplete without the information contained on the Drawings and in the Schedules.

Description of the work included in each Section is not intended to in any way limit the above broad statement, but is intended as a more specific mention of the most important items included therein.

Without limiting the scope of work as shown on the Drawings and required in this Section the following specific mention of items of included work is made.

The scope of work shall include: fans, air handlers, make up air units, air-conditioning units, roof mounted units, duct work by material, thermal insulation by system, acoustical insulation by system, piping by system, sting and balancing, space heaters, ductwork accessories, louvers and dampers, automatic controls by type. In addition any item that could be considered unusual shall be included.

The contractor shall coordinate with the equipment manufacturers control and field installation items furnished. The contractor shall field install and wire furnished loose by the equipment manufacturer.

All ductwork, piping, and equipment shown on the Drawings is intended to be approximately correct to scale, but figured dimensions and detailed drawings of the actual equipment furnished shall be followed in every case. The Drawings shall be taken in a sense as diagrammatic. Size of ductwork and piping are shown, but it is not the intent to show every offset or fitting, nor every hanger or support, or structural difficulty that may be encountered. To carry out the intent and purpose of the drawings all necessary parts to make a complete working system ready for use shall be furnished without extra charge. The Contractor shall be responsible to coordinate the system installation and routing with the work of all trades.

1.2 RELATED REQUIREMENTS. Cutting coving and patching, except for items specified herein, is included in Division 1. Temporary heating, electric power and lighting is included in Division 1. Trenching, excavation and backfill except for items specified herein, is included in Division 2. Concrete work except for furnishing of required anchor bolts, sleeves and templates, which shall be furnished with equipment, is included in Division 3. Flashing and counter flashing, except for items specified herein is included in Division 7. Painting except for factory finished equipment, shop painting and identification labeling is included in Division 9. Miscellaneous metal for supplementary steel required for hangers, equipment supports, anchors and guides, which shall be furnished with equipment, is included in Division 15. Exterior louvers including installations are included in Division 10. Plumbing except water and drains in connections to HVAC equipment is included in other Sections of this Division. Electrical field power wiring except for field wiring for automatic temperature controls as specified and as shown on the HVAC Drawings is included in Division 16.

1.3 SUBMITTALS. Submit, in accordance with Section 01080, all shop drawings specified in the individual Sections. Submittals shall include the following:

Catalog data for all motors to include operating efficiency.

Catalog data on vibration isolator, including operating efficiency and layout diagram that locate the isolates on the equipment by model number. Catalog data on bearings and confirmation of bearing life for the service specified.
Information on coatings as specified in the coating section.

Shop Drawing Data to include performance curves, data sheets, flow diagrams, wiring diagrams, and descriptive drawings.

In general, corrections or comments or lack there of, made relative to submittals during review shall not relieve the Contractor from compliance with the requirements of the drawings and specifications. Submittals are for review of general conformance with the design concepts of the project and general compliance with the contract documents. The Contractor is responsible for the final design conforming and correlating all quantities and dimensions, selecting fabrication processes and techniques of construction, coordinating the work of all trades, and performing the work in a safe and satisfactory manner.

For units that will be shipped exposed, provide a description of the protective packaging that will be used during transit

All submittals shall contain a statement that Section 15501 and all other referenced Sections have been read and complied with. The certification statement shall be made by all of the following that are applicable; the Contractor, sub-contractor and the vendor. The statement shall be an individual statement for each party involved, and shall be included with every submittal and resubmittal.

1.3.01 Operation and Maintenance Data and Manuals. Submit to the Engineer as provided in Section 01160, Operating and Maintenance Manuals. The following information shall be considered a minimum. Where applicable, provide information required for specific pieces of equipment.

Contents - Each volume shall contain the following minimum contents:

Operating Instructions to provide pre-operational checks, start up and shut down, and description of all control modes. Include emergency procedures for all fault conditions and actions to be taken for all alarms. Procedures for long term storage shall be included.

Maintenance shall include preventive, and corrective. Schedules for test of other functions are to be included. Provide a list of tools required to service the equipment. Trouble shooting instructions to include a trouble-shooting guide shall

be included.

Provide information in three ring binders. All sheets shall have reinforced punches. Tabbed dividers shall separate all sections. Drawings will be bound in the manual, or contained in envelopes bound into the manual. Personnel familiar with the operation and maintenance of the specific information shall prepare manuals.

Equipment shall be identified with the Engineers Equipment Numbers and Identification as shown in the Schedules and on the Drawings.

Installation including instructions for unpacking, installing, aligning, checking and testing. Foundation data, allowable piping loads, and electrical design shall be included.

1.4 REFERENCE STANDARDS. The latest published issue of Standards or Recommendations of the following listed Societies, Associations or Institutes in effect 3 months prior to the date of this Contract are part of this Section. These shall be considered as minimum requirements. Specific requirements of this Section and/or Drawings shall have precedence. In case of conflict between published requirements, the Engineer shall determine which is to be followed.

Abbreviation and the title of Federal, State and industry standards, technical societies, associations and institutes and other organizations used are as follows:

AABC - Associated Air Balance Council

ACGIH - American Conference of Governmental Industrial Hygienists

ADC - Air Diffusion Council

ABMA - American Bearing Manufacturers Association

AMCA - Air Movement and Control Association

ANSI - American National Standards Institute

ARI - Air-Conditioning and Refrigeration Institute

ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers

ASME - American Society of Mechanical Engineers

ASTM - American Society for Testing and Materials

CTI - Cooling Tower Institute

FM - Factory Mutual Engineering and Research Corp.

IBR - Institute of Boiler and Radiator Manufacturers

1IEEE - Institute of Electrical and Electronics Engineers

NIST - National Institute of Standards and Technology

NEBB - National Environmental Balancing Bureau

NEC - National Electrical Code

NEMA - National Electrical Manufacturers Association

NFPA - National Fire Protection Association

OSHA - Occupational Safety and Health Administration

SMACNA - Sheet Metal and Air Conditioning Contractors National Association

UL - Underwriters Laboratories

1.5 QUALITY ASSURANCE. All equipment of a given type included in this Section shall be furnished by or through a single manufacturer or as specified on the schedules
Inspection by the Engineer's representative or failure to inspect shall not relieve the Contractor of responsibility to provide materials and perform the work in accordance with the documents.

1.6 DELIVERY, STORAGE AND HANDLING. All materials shall be inspected for size, quality and quantity against approved shop drawings upon delivery.

Delivery schedule of all equipment shall be coordinated with the Contractor. Equipment ready for shipment prior to the agreed on shipping date shall be stored without cost to the Owner by the manufacturer.

All materials shall be suitably packed for shipment and long term storage. Each

package shall be labeled to indicate the project and the contents of each package. Where applicable, equipment numbers shall be marked on the container.

All equipment shipped that is exposed such as on a flat bed truck shall be protected during transit. The equipment shall be protected from moisture, road salt, dirt and stones or other materials thrown up from other vehicles. Electrical components shall be protected as above, but with special attention to moisture. The method of shipment protection shall be defined in the submittals.

Instructions for the servicing and startup of equipment in long term or prolonged storage shall accompany each item.

All materials shall be stored in a covered dry location off of the ground. When required to protect the materials they shall be stored in a temperature-controlled location.

1.7 DEFINITIONS. Particular terminology used under this Division is defined as follows: Air Conditioning - Environmental control of temperature, humidity, cleanliness and air circulation, including the cooling of an enclosed space.

Air Conditioner or Air Conditioning Unit – One or more field-erected or factory-made assemblies, which includes the refrigeration compressor-condenser assembly, for the handling and control of air temperature, humidity, and cleanliness used for cooling.

Fan-Unit - Any unit or assembly containing a fan, motor and drive.

Temperature Controller - Any device which is used to modulate the automatic temperature control system by a change in temperature at the location of the controller.

Explosion Proof - Any equipment or device, which is called to be explosion proof, shall be certified as explosion proof as a complete unit.

1.8 COORDINATION. The Drawings indicate the extent and general arrangement of the systems. If any departures from the Drawings or specifications are deemed necessary, details of such departures and the reasons therefore shall be submitted as soon as practical for review. No such departures shall be made without the prior written concurrence of the Engineer. The Contractor shall coordinate the location and placement of all concrete inserts and welding attachments with the structural engineer. The Contractor shall assume full responsibility for coordination of the HVAC systems, including; scheduling, and verification that all structures, ducts, piping and the mounting

of equipment are compatible.

1.9 ENGINEERING SERVICES. When engineering services are specified to be provided by the Contractor, the Contractor shall retain a licensed professional engineer to perform the services. The engineer shall be licensed at the time the work is done and in the State in which the project is located. If the State issues discipline specific licenses, the engineer shall be licensed in the applicable discipline. In addition, the engineer shall be experienced in the type of work being provided.

All work is to be done according to the applicable regulations for professional engineers, to include signing, sealing and dating documents. When submittals are required by a professional engineer, in addition to state required signing and sealing, a copy of the current wallet card or wall certificate indicating the date of expiration shall be included with the submittal.

1.10 ELECTRIC MOTORS. Electric motors in NEMA frame sizes shall conform to the requirements in Section 16150, unless otherwise specified herein.

Clean Dry Areas ODP

Outdoors TEFC

Process Areas

NOT Div. 1 or 2 TEFC

Div. 1 or 2 Explosion Proof.

The motor manufacturer shall confirm that motors used to power equipment are provided with bearings that will provide a bearing life equal to the driven equipment or better. Confirmation shall be included with shop drawing submittal.
Motors will be selected to be non-overloading over the entire operating range of the equipment. A safety factor of 25 percent will be added to all motors up to and including 50 horsepower. A safety factor of 15 percent will be added to all motors over 50 horsepower. Motors indicated in the schedules are to be considered a minimum. The schedule sizing is not to limit compliance with the above requirements.

1.11 SPARE PARTS. Spare parts shall include all special items on the manufacturer's standard list of spare parts In addition to special items, the following spare parts shall be provided:

Furnish all special tools required for normal operation and proper servicing of the equipment.

Spare parts shall include all items on the manufacturer's standard list of spare parts and the following for each unit:

One complete set of drive belts for each piece of belt driven equipment

Pack spare parts in containers suitable for extended storage without deterioration of the parts. Containers shall be clearly labeled designating contents, pieces of equipment for which intended and equipment identification numbers.

Spare parts shall meet the requirements of Sections 01180.

1.12 WARRANTY. In the event that the equipment or components fail to perform satisfactorily at any time within the Defects Liability Period, the Contractor shall replace it with one capable of operating as specified, and shall comply with the requirements in Division 1. The Contractor shall be responsible for all cost incurred in furnishing and installing the replacement equipment.

PART 2 - PRODUCTS

2.1 ELECTRICAL EQUIPMENT. Certain items of electrical equipment which are furnished under this Section shall meet the requirements specified in Division 16:

Disconnect switches, motor starters and combination motor starters (starters with disconnecting means and short circuit protection) shall be as specified in Section 16050.

Cord-connected controls for hazardous areas shall be provided with intrinsically safe relays, which shall be as specified in Section 16050.

Raceways, boxes and fittings shall be as specified in Section 16050.

Wires and cables shall be as specified in Section 16050.

Electrical enclosures and panels, to include automatic temperature control panels and components shall be suitable for the environment and electrical classification for the space they are located in. The type of enclosure for the various spaces shall be as specified in Division 16. Refer to the electrical drawings for the space classifications.

Where location designations are not shown on the HVAC Drawings refer to the Electrical Drawings

2.2 EQUIPMENT VIBRATION ISOLATORS AND MOUNTINGS. Unless otherwise specified in this Division all machinery or vibrating mechanical equipment shall be isolated from the building structure by vibration isolators with a minimum deflection as specified. Operating equipment that can transmit objectionable vibration and noise must be installed with special types of vibration isolators such as flexible connectors to ductwork, piping and wiring. In more critical areas and under particular conditions, additional vibration isolators shall be installed as specified in other related Sections in this Division, or in specific equipment schedules.

All equipment shall be provided with attachment points for floor or suspended mounting that will safely transmit all loads to the supports.

The vibration isolator manufacturer shall be responsible for the proper selection of vibration isolators suitable for the particular application. Selection of the vibration isolator shall include the following factors:

Equipment Weight

Equipment operating frequencies

Type of building support structure

Vibration isolators shall be furnished with the equipment.

All floor mounted vibration isolators shall be bolted to the floor or framing on which they rest. Bolts shall be arranged to prevent transmission of vibration through the bolts.

All isolation devices for a single piece of equipment shall be selected for a uniform static deflection according to distribution of weight in the equipment.

All pieces of equipment that have a variation in weight during operation or maintenance such as, but not limited to, cooling towers and hoppers, shall have built-in vertical limit restraints to limit motion to a maximum of 1/4-in.

Isolators exposed to the weather, in rooms classified on electrical drawings as damp, wet, or corrosive or where called for on the Drawings shall be provided with corrosion protection. Steel parts other than springs shall be galvanized. Parts subject to wear, rubbing, shall be non-corrosive material such as rubber or stainless steel. Springs and hardware shall be cadmium plated or otherwise provided with an approved coating.

After installation of equipment, isolators shall be adjusted for proper loading and distribution of weight.

Types - The following types of vibration isolators may be used.

Isolation Types for Floor Mounting

Single elastomer-in-shear isolators, molded mound shaped element designed for 1/4-in deflection under the imposed static load. Double elastomer-in-shear isolators shall be two such elements assembled in series or a molded element designed to provide 1/2-in deflection under the imposed static load. Elastomer-in-shear isolators shall be properly housed to prevent bulging and shall be provided with adequate facilities for bolting to equipment and floor slab.

Spring isolators shall be free standing and laterally stable and shall be equipped with acoustical-friction pads, leveling bolts and bolt holes for anchoring to floor slab. Springs shall have a minimum ratio of outside diameter to operating spring height of 0.8 and an additional travel to solid equal to 50 percent of the specified deflection. Where housed springs are specified or required, provide units with telescoping cast iron or steel housing, containing one or more springs, complete with resilient alignment insert and a minimum of 1/4-in thick rubber or neoprene sound deadening pad bonded to the base of housing.

Heavy load pads shall be 1-1/4-in thick and shall consist of a high load capacity elastomer pad and sandwiched between two 1/8-in thick steel load distribution plates capable of supporting loads up to 250 psi. For large pad area, steel plates of suitable thickness shall be provided to distribute the load.

Light load pads shall be neoprene corrugated single, laminated double or laminated with 1/2-in thick fine granular composition cork sandwiched between two 1/4-in layers of corrugated, oil resistant neoprene. Pads shall be capable of loading to 50 psi.

Isolation for Suspension

Isolation hangers for suspension of equipment and piping shall have a single element of elastomer for 1/4-in deflection, a double or a single molded element of 1/2-in deflection, a single spring element with an elastomer grommet for up to 3/4-in deflection and a combination of an elastomer and spring elements in series for 1-in deflection and up contained within a structural rigid one piece steel hanger box. Springs shall have a minimum ratio of outside diameter to operating spring height of 0.8 and an additional travel to solid equal to 50 percent of the specified deflection.

The neoprene element shall have a bushing to prevent hanger rod contact with the housing box. The lower rod shall be free to swing in a 30 degree arc without touching the spring or the housing.

Rails and Bases - Rails and bases shall be of the following types based on the equipment and deflection required.

Rubber in shear type shall be steel rails running the full length of the supported equipment and extending under any overhang to counteract cantilever effects. The rails shall incorporate single or double deflection elastomer-in-shear fastened in place and a continuous steel floor bearing plate running the full length of each rail. The rails shall be drilled and tapped to accept the supported equipment and shall serve as a template.

Steel spring type shall be steel rails running the full length of the supported equipment and extending under any overhang to counteract cantilever effects. The rails shall consist of structural members supported by individual free standing springs. The rails shall be drilled to accept the supported equipment and shall serve as a template.

Fans and their driving motors shall be mounted on structural steel channel members forming a rigid base. A common member, parallel to the V-belt drive, shall run the full length of the fan and motor and shall be of sufficient rigidity to resist the bending stress of belt pull. The structural steel base shall incorporate single or double deflection elastomer-in-shear elements or free standing springs located for proper weight distribution. The base shall be drilled and tapped to accept the fan and motor and shall serve as a template. Integral motor slide rails shall be provided and welded in place.]

Unless specifically noted in other Sections or on specific equipment schedules, all equipment will be provided with vibration isolation as defined by the following table:

Type of Equipment	Vibration Isolation Type	Minimum Deflection for Slab on Grade Inches	Minimum Deflection for up to 20-ft floor span inches	Minimum Deflection for 20-ft to 30-ft Floor Span Inches	Minimum Deflection for 30-ft to 40-ft Floor Span Inches
Axial & Cabinet Fans					
22-in dia. and less	Rubber	0.25	--	--	--
22-in dia. And					

less	Spring	--	0.75	0.75	0.75
Over 22-in dia. Over 2-in S.P.	Spring	0.75	1.75	1.75	2.50

Type of Equipment	Vibration Isolation Type	Minimum Deflection for Slab on Grade Inches	Minimum Deflection for up to 20-ft floor span inches	Minimum Deflection for 20-ft to 30-ft Floor Span Inches	Minimum Deflection for 30-ft to 40-ft Floor Span Inches
Centrifugal Fan					
22-in dia. and less	Rubber	0.25	--	--	--
22-in dia. and less	Spring	--	0.75	0.75	1.75
24-in dia. and greater					
40 HP and less	Spring	0.75	0.75	0.75	1.75
50 HP and greater	Spring	1.00	1.75	1.75	2.50
Condensing Units					
	Rubber	0.25	--	--	--
	Spring	--	0.75	1.75	1.75
Air Handling Units					
10 HP and less	Spring	0.75	0.75	0.75	0.75
15 HP and greater	Spring	0.75	1.75	1.75	1.75

Isolation for Piping

Supplemental Specifications are issued separately from the Master Specifications on a per contract basis to provide information not provided in the Master Specifications. All Conditions of the Contract apply to information provided in this Supplemental Specification.

Flexible piping for systems with operating temperatures over 200 degrees F shall be flexible annular corrugated stainless steel hose. The hose shall be provided with an external stainless steel braid to minimize elongation under pressure. Hoses 2-1/2-in and smaller shall be threaded and hoses 3-in and larger shall be flanged. The manufacturer shall confirm the suitability of the flexible piping for the temperature and pressure of the systems.

Flexible piping for systems with operating temperatures 200 degrees F and less shall be spherical EPDM connections. Connections shall have multiple plies of corded fabric reinforcing. Connection shall be rated for 150 psi at 220 degrees F. For equipment with connections from 2-1/2 to 12-in, 90 degree bend connections can be used. Straight connections shall be double sphere and bend connections shall be single sphere. Provide control cables to prevent excessive elongation on straight connection where required. The manufacturer shall confirm the suitability of the connections for the temperature, pressure, and pipe contents for the systems.

Rigidly Mounted Equipment

When equipment doesn't require vibration isolation, it shall be firmly attached to the building structure. Bolts and support structure shall include allowances for seismic loads as required by the applicable building codes to include shear and moment loads.

2.3 BEARINGS. Grease lubricated bearings (except where driven by motors smaller than 1/2 Hp) shall be equipped with Zerk lubrication fittings and with provision for automatic relief of lubricant pressure away from fan wheel or pump seal. The latter may be accomplished by either built-in relief devices or automatic ball-and-spring relief fittings at the bottom of the bearing housing.

Pressure relieves shall be located outside of the units and shall be visible from maintenance locations. Lubrication fittings shall be located to be easily accessible from maintenance or operating levels. Where necessary, extension tubes shall be provided to bring the service fitting to an accessible location and the relief visible from the same location.

Bearings for all equipment in the schedule below shall have heavy-duty grease lubricated ball or roller bearings. Bearings shall have ample thrust provision to prevent end play during the normal life of the bearing. Unless specifically noted otherwise, all fans and pumps shall have bearings for both the equipment and motors with the following ABMA L-10 life.

Fans over 3000 cfm – 40,000 hours.

Continuous duty fans with motors over 25 horse power 100,000 hours.

For systems with bearings requiring L-10 lives of 100,000 hours or greater, the equipment supplier shall provide calculations for both the equipment bearings and the motor bearings to confirm the bearing selections. For belt drives, the calculations shall include the effect of the sheave size, number of belts, the sheave location on the shaft, and the location of the motor to the driven sheave.

The equipment manufacturer shall provide confirmation of the required life based on the actual drive components. For motors 50 horsepower and greater, the bearing life calculations for both the equipment bearings and the motor bearings shall be provided.

2.4 FLAME AND SMOKE RATINGS. All materials, including adhesives, surface coatings, sealers, assemblies of several materials, insulation, jacketing, finish, etc, shall have flame spread ratings not over 25 (fire resistive) and smoke development ratings not over 50 and fuel contributed rating not over 50, as established by tests conducted in accordance with the Federal Standard 00136B, National Bureau of Standards Radiant Energy Fire Test and the National Fire Code of the NFPA.

These requirements shall apply to all circumstances whether the materials are field applied or have been applied by a manufacturer in his/her shop, or elsewhere, prior to delivery to the project for installation.

2.5 V-BELT DRIVE. V-belt drives shall consist of the driver and driven sheaves and one or multiple matched V-belts. Drives furnished to transmit less than 3/4 Hp may be a single groove, single belt type. Drives to transmit 3/4 Hp or more shall consist of at least two belts. Belts smaller than "A" cross-section shall not be used.

Each sheave shall be grooved to match the belt selection, bored and keyed to fit the receiving shaft, and grooves shall be in parallel planes exactly perpendicular to the bore for the full 360 degrees. Sheaves shall have keys and setscrews. Sheave material may be cast iron.

The drive shall be sized 1.5 times the motor nameplate rating and also shall have ample strength to start the driven equipment by full voltage across-the-line motor starting.

Where variable speed drive is specified, the drive sheave shall be of the variable pitch type which will provide a 5 percent speed variation of the driven equipment at the nominal rated speed. However, the higher speed side shall not cause the driven equipment to draw more than full nameplate rating horsepower from the driver.

2.6 NOISE CRITERIA. The selection of fans, air handling equipment, air conditioners, heating ventilating and air conditioning machinery and mechanical equipment and the installation of the system components such as duct work and piping shall be such as not to exceed to maximum permissible noise for non-equipment spaces as defined in Table 2, Design Guidelines for HVAC System Noise in Unoccupied Spaces contained in the 2003 edition of the ASHRAE Application Handbook. Under no conditions shall the noise created by equipment exceed the levels of permissible noise exposures of occupational areas as established by the OSHA and other Federal, State and local safety and health standards, codes and ordinances.

The equipment supplier shall provide actual data for the equipment submitted. If the space does not meet the required criteria, and the noise level of the equipment is found to be the cause, the equipment supplier shall be responsible for the modifications required to correct the condition.

PART 3 – EXECUTION

3.1 INSTALLATION. The Contractor shall start up each piece of equipment and system and shall make all adjustments so that the system is placed in proper operating condition.

The Contractor shall not install any equipment or materials until the Owner and Engineer have approved all submittals. If any equipment or materials are installed prior to approval of the submittals, it shall be at the Contractor's risk.

3.2 CLEANING AND DISINFECTION. All piping, ductwork and equipment shall be left in a thoroughly cleaned condition. All piping shall be thoroughly flushed to remove all foreign materials prior to any cleaning procedure. All strainer baskets shall be removed, cleaned and reinstalled at the completion of the cleaning operation and also at the completion of all system and equipment final tests. All flushing and cleaning shall be to the satisfaction of the Engineer. Furnish, install and remove all temporary piping and equipment used in the cleaning and flushing operations. Cleaning and flushing shall be performed as specified in other Sections.

3.3 TESTS AND BALANCING. General - Balance and test all systems. Test the work as required by the Engineer during the progress of the work to demonstrate the strength durability and fitness of the installation. Furnish all instruments, ladders, lubricants, test equipment and personnel required for the tests; including manufacturer's representatives for testing and start-up of all supplied equipment. Balancing and testing shall be performed as specified in other Sections. Before testing and balancing, all systems shall be cleaned and disinfected as specified. Four copies of records of all tests, measurements, settings of throttling devices and nameplate data shall be

presented to the Engineer.

Final Tests - Tests of all systems shall be carried out as required by the Engineer prior to final acceptance of the systems for the purpose of demonstrating satisfactory functional and operating efficiency as well as adjustment. During this period, the setting of all automatic controls shall be checked and sufficient measurements taken to ensure that conditions are correct and that capacities are adequate to meet the specified requirements. Provide competent personnel to conduct all tests. Systems will not be considered complete until all tests have been concluded to the satisfaction of the Engineer and all other parties having jurisdiction. In event of leakage or defects, tests must be repeated until all faults are corrected. All tests shall be performed in the presence of the Engineer. The general operating tests shall be performed under as near design conditions as possible.

Testing and balancing of all heating, ventilating and air conditioning air and water systems shall be performed by an AABC or NEBB certified agency, which is independent of all suppliers and installers on the particular job. All testing, adjusting and balancing shall be done under the supervision of a qualified heating, ventilating, and air conditioning Engineer employed by the air balance and testing agency. Reporting forms for testing and balancing shall be as recommended by the AABC or the NEBB.

3.4 START-UP AND TEMPORARY OPERATION. Properly maintain and service all equipment and systems until the particular equipment or the system has been accepted by the Owner.
This maintenance shall include compliance with the manufacturers operating and maintenance instructions as well as periodic checking and cleaning of the strainers and filters and the lubrication of moving parts and all required adjustments.

Records of all maintenance and lubrication work performed on Owner or Contractor furnished equipment shall be maintained at the construction or installation site and shall be available at all times for a review by the Owner or Engineer. At the request of the Owner or Engineer copies of these records shall be submitted to the Owner for information and/or review.

3.5 PAINTING AND COATINGS. Unless otherwise specified, all machinery and factory finished equipment such as fans, air handling units, air conditioning units, and other items of manufacture shall be hot dipped galvanized or will have a factory applied finish, color as standard with the manufacturer. Components fabricated from stainless steel do not require a coating finish unless otherwise specified. All tanks, supporting steel, hangers, rods and all other uncoated or non galvanized steel other than standard piping and fittings shall have a shop coat consisting of a suitable primer and finish coat. If not

factory applied, the prime coat shall be as specified in Division 9. All items not factory or shop primed prior to installation shall be suitably cleaned of rust and mill scale by wire brushing, sanding, or other means and prime painted, immediately after installation.

The Contractor shall be responsible for the repair of all defects, blemishes, holidays and the like apparent in manufactures coatings and shall ensure that the materials used for such repair shall match and be compatible with the manufacturer's standard color, coatings and practices. Surfaces to be repaired or recoated are to be prepared as recommended by the paint or coating supplier. Care shall be taken not to paint over nameplates.

Furnish touch up paint for the various types of equipment furnished and deliver unopened paint to the Owner at completion of the project. The amount of touch-up paint supplied shall be sufficient to cover 15 percent of the applicable painted surfaces or one pint, whichever is greater.

Where specified, or called for on the following schedule, special corrosion resistant/protective coatings shall be provided. Whenever a protective coating is specified, the equipment shall be coated both inside and out. Whenever necessary to provide full coverage of the equipment, the equipment shall be completely disassembled to allow proper preparation and coating application. Any component that would block the coating process shall be removed. Equipment provided with gaskets or liners shall be coated before the application of the gasketing or liner. The equipment Vendor shall test rotating equipment after coating to confirm dynamic balance. If work needs to be done to correct the equipment balance, the integrity of the coating must be corrected after such work.

Ductwork connections to units that require corrosion resistant coatings shall be made with flanges. Flanges shall be factory drilled before coating. Resilient washers suitable for the environment shall be used to protect the coating from the bolts in the flange. The use of self tapping screws or other fastening methods that will damage the coating are not acceptable.

All items to be provided with a protective coating shall have the following data on the coating included with the unit submittal. Submittal shall include vendor data sheets on the specific coating being used, corrosion resistance data sheets, detailed application data sheets to include surface preparation procedures. For baked coatings submit a letter from the coating manufacturer, that the company doing the actual coating operation is an approved coating company. When an equipment supplier provides the coating, the information shall be supplied by the coating manufacturers.

Coating shall be factory applied by the equipment manufacturer/supplier. If this is not

possible, coating shall be applied by a specialty shop under contract to the equipment manufacturer/ supplier. After coating application is completed, the equipment manufacturer/supplier shall test the equipment and certify system operation prior to releasing the equipment to the job site.

Any holidays, runs, sags, blisters, or inclusions in the coating are unacceptable and will be corrected. With the approval of the Engineer, small areas no more than 4-in by 4-in may be corrected in the field. Larger faults shall be returned to the coater to be repaired. The faulty material shall be removed by sanding and in the case of blisters, the edges feathered. The material used for recoating shall be manufactured by the same manufacturer as the original coating and shall be suitable for field repairs. The touch up material shall have the same corrosion resistance as the original coating, and if the original coating required an ultraviolet protection, the same protection will be provided as part of the repair. The final mil thickness of the repaired coating shall be equal to the originally specified thickness. Where baked coatings have been damaged, the repair shall be made with heat applied to the repaired surface to cure the coating. After curing a solvent test as recommended by the manufacturer shall be used to confirm that the coating is cured.

3.6 BALANCE OF ROTATING EQUIPMENT. All machines shall be balanced both statically and dynamically by the manufacturer within the limits of best commercial practices. The term machine, as used above, is to be considered as any piece of equipment which contains rotating components. All machines furnished shall have operating speed not exceeding 80 percent of the first critical speed.

END OF SECTION

SECTION 15551 - SUPPLEMENTAL

HEATING EQUIPMENT

PART 1 - GENERAL

1.1 SCOPE. Furnish and install all heating units, scheduled, as specified herein and as shown on the drawings. Mechanical Contractors responsibility to coordinate with General Contractor the option of providing either field assembled or factory assembled make-up air units.

1.2 REFERENCE STANDARDS.

Air Movement and Control Association (AMCA)

National Electrical Code (NEC)

Factory Mutual (FM)

Underwriters Laboratories (UL)

American Society of Heating, Refrigeration and Air Conditioning Engineers. (ASHRAE)

Where reference is made to one of the above standards, the revisions in effect at the time of bid opening shall apply.

1.3 QUALITY ASSURANCE. All equipment of a given type included in this section shall be furnished by or through a single manufacturer or as specified on the schedules. Inspection by the Engineer's representative or failure to inspect shall not relieve the Contractor of responsibility to provide materials and perform the work in accordance with the documents.
The Owner and Engineer reserve the right to sample and test any materials after delivery and to reject all components represented by a sample that fails to comply with the specified requirements. An authorized representative of the manufacturer shall perform the initial startup of the equipment. The Owner and Engineer shall witness startup. The use of local sales representatives to perform this work is not acceptable, unless the manufacturer provides documented evidence that the sales representative has been specifically trained for this work.
All rotating parts of equipment shall be dynamically balanced at the factory.

1.4 SUBMITTALS. Catalog cuts for each type of equipment and accessory.
Data sheets for each piece of equipment listing the applicable information. The information shall include heating output, capacity, energy/fuel input, air flow, entering and leaving air temperatures, heat transfer fluid flow, entering and leaving fluid conditions, electric power characteristics, motor data, dimensional data and installation instructions for items that are field assembled. A recommended list of spare parts. For units that will be shipped exposed, provide a description of the protective packaging that will be used during transit. For items that will be shipped loose provide individual dimensions of components. All submittals shall contain a statement that Sections 15501, 15551 and all other referenced Sections have been read and complied with. The certification statement shall be made by all of the following that are applicable; the Contractor, sub-contractor and the vendor. The statement shall be an individual statement for each party involved, and shall be included with every submittal and resubmittal.

1.4.01 Operating and Maintenance Manuals. The following information shall be considered a minimum. Where applicable, provide information required for specific pieces of equipment. Personnel familiar with the operation and maintenance of the specific information shall prepare manuals. Equipment shall be identified with the Engineers Equipment Numbers and Identification as shown in the Schedules and on the Drawings. Provide information in three ring binders. All sheets shall have reinforced punches. Tabbed dividers shall separate all sections. Drawings will be bound in the manual, or contained in envelopes bound into the manual.

Contents - Each volume shall contain the following minimum contents:

Installation including instructions for unpacking, installing, aligning, checking and testing. Foundation data, allowable piping loads, and electrical design shall be included. Operating Instructions to provide pre-operational checks, start up and shut down, and description of all control modes. Include emergency procedures for all fault conditions and actions to be taken for all alarms. Procedures for long term storage shall be included. Maintenance shall include preventive, and corrective. Schedules for test of other functions are to be included. Provide a list of tools required to service the equipment. Trouble shooting instructions to include a trouble-shooting guide shall be included. Shop Drawing Data to include performance curves, data sheets, flow diagrams, wiring diagrams, and descriptive drawings. In general, corrections or comments or lack there of, made relative to submittals during review shall not relieve the Contractor from compliance with the requirements of the drawings and specifications. Submittals are for review of general conformance with the design concepts of the project and general compliance with the contract documents. The Contractor is responsible for the final design conforming and correlating all quantities and dimensions, selecting fabrication processes and techniques of construction,

coordinating the work of all trades, and performing the work in a safe and satisfactory manner.

1.5 DELIVERY, STORAGE AND HANDLING. All materials shall be inspected for size, quality and quantity against approved shop drawings upon delivery. Delivery schedule of all equipment shall be coordinated with the Contractor. Equipment ready for shipment prior to the agreed on shipping date shall be stored without cost to the Owner by the manufacturer. All materials shall be suitably packed for shipment and long term storage. Each package shall be labeled to indicate the project and the contents of each package. Where applicable, equipment numbers shall be marked on the container. All equipment shipped that is exposed such as on a flat bed truck shall be protected during transit. The equipment shall be protected from moisture, road salt, dirt and stones or other materials thrown up from other vehicles. Electrical components shall be protected as above, but with special attention to moisture. The method of shipment protection shall be defined in the submittals. Instructions for the servicing and startup of equipment in long term or prolonged storage shall accompany each item. All materials shall be stored in a covered dry location off of the ground. When required to protect the materials they shall be stored in a temperature-controlled location. Contractor shall take delivery location equipment and install in final shipped in pieces and be responsible for scheduling manufacture to be on premises to assemble the components.

1.6 WARRANTY. Provide one year parts and labor warranty after the completion of the project. Meet the requirements of Section 01170.

1.7 SCHEDULES. This Section is incomplete without the information contained on the drawings and schedules. All units shall be of the manufacturer, type, capacity and arrangement as listed on the schedules. Units shall consist of the components listed in the schedule and those components obviously required for the type of unit. The order of component assembly will be as called for on the schedule and Drawings. Particular attention must be paid to the remarks and notes in these schedules and Drawings.

1.8 SPARE PARTS. Spare parts shall include all special items on the manufacturer's standard list of spare parts. In addition to special items, the following spare parts shall be provided:

Furnish all special tools required for normal operation and proper servicing of the equipment. Spare parts shall be suitably packaged with labels inidcating the contents of each package and shall meet all requirements of Master specification Sections 01180.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS. The equipment shall be as manufactured by Trane, Ruffneck, Brash, or approved equal.

2.1.01 Unit Heaters. Unit heaters shall be substantially constructed, self-contained factory-assembled unit consisting of heating element, fan, motor, housing, outlet diffuser or vanes. They shall be the suspended or wall-mounted type arranged for horizontal or vertical air flow, as shown on the Drawings and schedules. Casings shall be painted with a primer and finished with baked-on enamel at the factory. All parts shall be heavily braced and stiffened to prevent vibration and hold all working parts rigidly in line. Casing sides shall be readily removable for access to interior parts. Casings of suspended-type units shall be designed for direct attachment of the hangers. Adjustable, horizontal and vertical vanes, nozzles or diffusers, arranged to give uniform air distribution without objectionable drafts, shall be provided for each heater.

PART 3 - EXECUTION

3.1 INSTALLATION. The Contractor shall not install any equipment or materials until the Owner and Engineer have approved all submittals. If any equipment or materials are installed prior to approval of the submittals, it shall be at the Contractor's risk. Equipment shall be installed in accordance with manufacturer's recommendation. Provide piping and ductwork connections in accordance with the requirement of the other related Sections. The Contractor shall start up each piece of equipment and system and shall make all adjustments so that the system is placed in proper operating condition.

End of Supplemental Section

SECTION 15575 - SUPPLEMENTAL

FLUE STACKS, BREECHINGS AND VENTS

PART 1 - GENERAL

1.1 SCOPE. Furnish and install all flue stacks, breechings and vents as shown on the Drawings, schedules and as specified herein.

1.2 RELATED REQUIREMENTS. Section 15855 - Air Handling Units

1.3 SUBMITTALS. Submit, in accordance with Section 01160, the following: Catalog cuts and assembly directions for each type of flue or stack.

1.4 REFERENCE STANDARDS. Underwriters Laboratories (UL) Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

The complete system shall meet all applicable governing codes.

PART 2 - PRODUCTS

2.1 GENERAL. Type H or SS Factory Built Chimney - UL listed for use with residential and commercial buildings when forced venting is not required. The double wall metal chimney shall have an outer casing of aluminum coated steel (0.4 oz/sq ft), an inner casing of Type 430 or equal corrosion resistant stainless steel and a minimum dead air space of 1/2-in. Chimney shall be complete with UL listed support plates, roof thimble and guy wires and other accessories as recommended by the manufacturer for a complete installation as manufactured by Metalbestos or equal.

Type PS - UL listed for use with forced venting equipment (MAUS). The system shall be completely design by the flue manufacturer with accessories required as manufactured by Metalbestos or equal. Outer and inner casings shall be 316 stainless steel.

PART 3 - EXECUTION

3.1 INSTALLATION. Flues for all equipment exhausting combustible material shall be installed where indicated on the drawings. Flue gas systems shall be gastight to prevent leakage of combustible products into the building and shall be complete with all fittings,

hangers, supports, and flashing necessary for proper installation.

Roof penetrations shall be flashed and counter flashed to provide a weather tight installation. The installation shall include, where necessary, ventilating collars to give proper clearance from floors, ceilings, and roofs constructed of combustible materials.

The flue height dimensions indicated on the drawing are minimum and shall be increased to conform to any local codes which pertain to such work. Flues shall be supported where indicated on the drawings and where required by the system manufacturer. The entire system from the equipment connection to the termination, including accessories, shall be from one manufacturer.

Install all equipment per manufacturer's recommendations.

End of Supplemental Section

SECTION 15855 - SUPPLEMENTAL

AIR HANDLING UNITS

PART 1 - GENERAL

1.1 SCOPE. Furnish and install all indoor make-up air handling units with filters as shown on the Drawings, scheduled and as specified herein.

1.2 SCHEDULES. All units shall be of the type, capacity and arrangement as listed on the schedules. Units shall consist of the components listed in the schedule and those components obviously required for the type of unit. Unit shall be capable of being installed together in sections in the final location where shown on the drawing or as one entire unit. The order of component assembly will be as called for on the schedule. Particular attention must be paid to the remarks and notes in these schedules.

1.3 SUBMITTALS. Submit, in accordance with Sections 01160 and 15501, the following:

Unit data sheets; to include catalog data, a description of the proposed unit, size, type, arrangement, and materials of construction.

For belt drive equipment, provide drive data indicating sheave sizes, belt size, number and length.

Each submittal shall include pertinent equipment dimensional data, heating and cooling coil operating data. Submit, in accordance with Sections 01160 and 15501, all data and the fan schedules. The submittal shall include fan data sheets with a description of the proposed fan, fan size, type, arrangement, materials of construction, weight, motor horsepower, motor type, power supply, and frame size. Provide catalog data and selections for

vibration isolators, include materials of construction. For belt drive equipment; provide drive data indicating the sheave sizes, belts size, number and length. Each submittal shall include pertinent equipment dimensional data, fan performance (operating data information, and a performance curve showing the fan operating point and range. Minimum curve size shall be 8-in by 6-in. Faxed copies of curves are not acceptable. A list of accessories to be furnished shall be included on each submittal. Copies of operating and maintenance manuals shall be submitted.

Significant dimensional differences between the specified equipment and the proposed equipment shall be noted on the equipment submittal. The Contractor shall provide data to show the dimensionally different equipment will fit within the space and still provide suitable clearance. Where corrosion resistance is required, provide conformation of material suitability for the specified service.

For condensing sections provide information on number and type of compressors, type of refrigerant and refrigerant charge, and controls provided and operating weight. Provide electrical data for power and controls. For condensing coils, provide air entering and leaving conditions, air pressure drop, size, type, arrangement, and materials of construction.

List of accessories to be furnished shall be included on each submittal.

Provide a recommended list of spare parts.

Significant dimensional differences between the specified equipment versus the proposed equipment shall be noted on the equipment submitted.

For units that will be shipped exposed, provide a description of the protective packaging that will be used during transit.

All submittals shall contain a statement that Section 15501, and all other Sections have been read and complied with. The certification statement shall be made by all of the following that are applicable; the Contractor, sub-contractor and the vendor. The statement shall be an individual statement for each party involved, and shall be included with every submittal and resubmittal.

Submit to the Engineer as provided in Section 01730, Operating and Maintenance Manuals. The following information shall be considered a minimum. Where applicable, provide information required for specific pieces of equipment.

Personnel familiar with the operation and maintenance of the specific information shall prepare manuals.

Equipment shall be identified with the Engineers Equipment Numbers and Identification as shown in the Schedules and on the Drawings.

Provide information in three ring binders. All sheets shall have reinforced punches. Tabbed dividers shall separate all sections. Drawings will be bound in the manual, or contained in envelopes bound into the manual.

Contents - Each volume shall contain the following minimum contents:

Installation including instructions for unpacking, installing, aligning, checking and testing. Foundation data, allowable piping loads, and electrical design shall be included.

Operating Instructions to provide pre-operational checks, start up and shut down, and description of all control modes. Include emergency procedures for all fault conditions and actions to be taken for all alarms. Procedures for long term storage shall be included.

Maintenance shall include preventive, and corrective. Schedules for test of other functions are to be included. Provide a list of tools required to service the equipment. Trouble shooting instructions to include a trouble-shooting guide shall be included.

Shop Drawing Data to include performance curves, data sheets, flow diagrams, wiring diagrams, and descriptive drawings.

In general, corrections or comments or lack there of, made relative to submittals during review shall not relieve the Contractor from compliance with the requirements of the drawings and specifications. Submittals are for review of general conformance with the design concepts of the project and general compliance with the contract documents. The Contractor is responsible for the final design conforming and correlating all quantities and dimensions, selecting fabrication processes and techniques of construction, coordinating the work of all trades, and performing the work in a safe and satisfactory manner.

1.4 REFERENCE STANDARDS. All equipment to be furnished under this section shall be designed, constructed, and tested in accordance with the following standards:

American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)

ASHRAE 52 - Method of Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.

Air Movement and Control Association (AMCA)

National Fire Protection Association (NFPA)

NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems

NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems.

American Society for Testing and Materials (ASTM)

ASTM C581 - Standard Practice for Determining Chemical Resistance of Thermosetting Resins Used in Glass- Fiber- Reinforced Structures Intended for Liquid Service.

ASTM C1071 - Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Materials).

Air-conditioning and Refrigeration Institute (ARI)

American Society of Mechanical Engineers (ASME)

National Electrical Code (NEC)

National Electrical Manufacturers Association (NEMA)

Association of Home Appliance Manufacturers (AHAM)

Factory Mutual (FM)

Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.5 QUALITY ASSURANCE. All equipment of a given type included in this section shall be furnished by or through a single manufacturer or as specified on the schedules. Inspection by the Engineer's representative or failure to inspect shall not relieve the Contractor of responsibility to provide materials and perform the work in accordance with the documents. The Owner and Engineer reserve the right to sample and test any materials after delivery and to reject all components represented by a sample that fails to comply with the specified requirements. An authorized representative of the manufacturer shall perform the initial startup of the equipment. The Owner and Engineer shall witness startup. The use of local sales representatives to perform this work is not acceptable, unless the manufacturer provides documented evidence that the sales representative has been specifically trained for this work. All rotating parts of equipment shall be dynamically balanced at the factory.

1.6 DELIVERY, STORAGE AND HANDLING. Shipping, handling and storage are detailed in the Master Specification Section 01180.

Delivery schedule of all equipment shall be coordinated with the Contractor. Equipment ready for shipment prior to the agreed on shipping date shall be stored without cost to the Owner by the manufacturer.

All materials shall be suitably packed for shipment and long term storage. Each package shall be labeled to indicate the project and the contents of each package. Where applicable, equipment numbers shall be marked on the container.

All equipment shipped that is exposed such as on a flat bed truck shall be protected during transit. The equipment shall be protected from moisture, road salt, dirt and stones or other materials thrown up from other vehicles. Electrical components shall be protected as above, but with special attention to moisture. The method of shipment protection shall be defined in the submittals.

Instructions for the servicing and startup of equipment in long term prolonged storage shall accompany each item.

All materials shall be stored in a covered dry location off of the ground. When required to protect the materials they shall be stored in a temperature-controlled location.

1.7 SPARE PARTS. Spare parts shall include all special items on the manufacturer's standard list of spare parts and shall meet the requirements of Sections 01180.

Furnish all special tools required for normal operation and proper servicing of the equipment. Spare parts shall include all items on the manufacturer's standard list of spare parts and the following for each unit:

One complete set of drive belts for each piece of belt driven equipment

One complete shaft seal for all fans with shaft seals.

Three full sets of air filters if not otherwise specified

1.8 WARRANTY. In addition to the General Warranty, the equipment manufacturer shall warrant against parts and labor and any defect in material, construction, or performance of the Make Up Air Units and its components for a period of five (5) years from the date of acceptance for the Equipment, without any cost to the owner.

1.8.1. MAINTENANCE SERVICE. Concurrent with Parts and Labor Warranty, Manufacturer shall provide Five (5) year Full Maintenance program. Maintenance program shall include monthly service visits on each unit subject to the following:

Filter changes

Digital Performance Log

Check and/or replacement of belts

Check, Lubrication and/or replacement of fan bearing assemblies

Check and/or adjustment/replacement of electrical or control components

Check and/or adjustment/replacement of damper and operators

Check and/or adjustment/replacement of cabinetry seals, latches, panels etc

Check and/or cleaning of interior unit and coil surfaces

The above at a minimum shall appear on a Monthly Maintenance Sheet for each unit. Verification of maintenance via this sheet shall bear Witness signature of DWSD representative and turned in monthly in hard copy and/or digital copy in quantities up to Five (5) sets as determined by the DWSD. Sheet and format to be approved by DWSD prior to commencement of Five (5) Year Program.

1.8.2 WARRANTY SUBMITTAL. Submit a Written warranty signed by manufacturer agreeing to repair, restore, or replace defective work and maintain as specified in this section, within the specified warranty period without any cost to the owner.

PART 2 - PRODUCTS

2.1 MAKE-UP AIR UNITS. Acceptable manufacturers shall be Rush Air or approved equal:

2.2 DESIGN AND CONSTRUCTION. In general, units shall be factory assembled, packaged industrial type with fan, heating section, filters, motorized intake dampers, access sections with hinged access doors, motor, starters, motor base, gas train, gas pressure reducing valve, controls, drive, drive guard and vibration isolators. Rooftop units shall be completely weather proof. All units as shown and specified shall be furnished by the same manufacturer. Units shall be designed to provide an integrated assembly and factory tested when all of the components are assembled. All transition sections and filler pieces required between sections are to be provided as part of the unit. The equipment dimensions shall be coordinated to fit in the space allocated in the Mechanical Room. Support brackets or rails are to be provided with the floor- mounted unit. Units shall have all rotating components internally isolated from the main unit with vibration isolators and floor mounting rails.

2.2.01 Casings: The unit casing shall be 2" double wall constructed of 20 ga, 304 Stainless Steel for both inner and outer liner. Unit floor shall be double wall 14 ga, 304 Stainless Steel. In addition, Unit frame, unit coil frames and all structural components shall be constructed of 304 Stainless Steel. Removable panels and access doors shall be 2" double wall constructed utilizing 20ga 304 Stainless Steel for both inner and outer skins. Insulation: Insulation shall be 2" thick closed cell foam. All sections including, but not limited to, filter, spacers, access sections, fan cabinet, shall be insulated. Insulation shall be 25.4 mm (1-in) verify all English units dims provided mat faced or neoprene coated fiberglass liner, 24 kg/M3 (1-1/2 lb/ft3) minimum density, installed with stick clips and adhesives to prevent erosion of the insulation.

2.2.02 Fan Section: Fans shall be centrifugal cabinet fans with belt drives. Extended external lubrication fittings shall be provided. Drives shall be adjustable V-belt type, with motor mounted on an adjustable slide base.

Backward curved wheels shall be airfoil types.

All fans shall be statically and dynamically balanced before shipment.

All fans shall be AMCA rated for sound and air performance.

Motor shall be energy efficient TEFC, with internal load protection.

Factory wired controls shall be provided in the unit control panel. Panel shall include all safety controls and interlocks, control devices and terminal strip for remote wired devices. Control type shall be as specified on the schedules. Control voltage shall not exceed 120 Volt.

Makeup AHU's shall utilize SWSI plenum style fans for supply air. Fans shall be constructed of 304 stainless steel. Fans performance shall be as scheduled. Fan Bearings shall be rated for L10 at 200000. Fan housing shall be vibration isolated.

2.2.03 Filters: Filter Box shall have tracks for the specified filter types, to allow filter replacement from either side. Sealing material shall be provided at tracks and ends to prevent air by-passing the filters.

Disposable Filters shall be framed filters, 50.8 mm (2-in) thickness as scheduled. Filter pressure drop for clean filters at 91 M\min (300 fpm) face velocity shall be 0.15-in wg for 50.8 mm (2-in) thick filters. Filter shall have 30 to 35 percent efficiency on ASHRAE Test Standard 52. Manufacturers and type shall be American Air Filter Co., AmAir 300X; Farr Co., 30/30 Disposable; Cambridge, Aeroplate or equal.

A total of three complete sets of filter media shall be provided for each unit.

For all types of filters, each filter section shall be provided with a magnehelic type gauge to indicate static pressure across the filter. Where more than one filter is used in series, each filter shall be provided with its own gauge. Where a control panel is provided gauges shall be mounted in the control panel.

2.2.04 Unit Control Panel: Remote panels shall include all stand alone DDC controls, and all safety controls and interlocks, heavy duty fused visible break, disconnect, control devices, motor starters and terminal strip for remote wired devices. Control type and sequence shall be as specified in other Sections and on the Drawings. Control voltage shall not exceed 120 Volts. Control panel door shall be provided with a keyed lock. A complete wiring diagram shall be permanently attached to the inside of the panel door. Provide hardware and software as required to monitor with remote building central DDC management system. Remote LCD display shall show lights for dirty filter, alarm, fan on/off, air temperature heat on/off etc.

All air handling control devices shall be compatible with control devices supplied under Section 15950 by the successful Temperature Control Contractor Division 15. The Make-up Air Unit Manufacturer shall coordinate with the Control and Mechanical contractors.

For self contained package units, split systems and fuel burning units, factory wired control panel shall be furnished and mounted on the unit. Panels shall include all controls required in other sections, and all safety controls and interlocks, heavy duty fused visible break, disconnect, control devices, motor starters and terminal strip for remote wired devices. Control type and sequence shall be as specified in other Sections and on the Drawings. Control voltage shall not exceed 120V. Control panel door shall be provided with a keyed lock. A complete wiring diagram shall be permanently attached to the inside of the panel door.

Where specific area classifications are called for or shown on the electrical drawings, all equipment and wiring shall be in conformance with the requirements for that classification. Unless otherwise specified herein or shown on the Drawings, electrical enclosures shall have the following ratings:

NEMA 12 for indoor locations.

2.2.05 Accessories: Dampers shall be opposed blade type with blades mounted on 1/2-in minimum steel rods. Dampers shall be provided with low friction bushings and edge gaskets to reduce air leakage. Blades shall be sectionalized to limit unsupported blade length and warping at full system fan static pressures. Maximum damper blade width shall not exceed 6-in.

Provide top discharge section for air discharge.

Access sections shall have hinged doors for servicing.

Provide smoke detector, low and high temperature stats with additional contacts and accessories.

Provide airflow sensing switch to prove airflow and set visual and audible alarm in case of failure.

2.3 TESTING. Factory performance testing shall be provided using the governing standards of ARI, ASHRAE and SMACNA. These tests will be performed with the option of witnessing by the owner or owner's representative. Complete test procedure must be submitted for approval prior to testing. Approved testing procedures may then be scheduled. Run test will include but not limited to Air flow. Energy consumption, largest panel deflection test, per SMACNA and component verification (match components to submittal data).

PART 3 - EXECUTION

3.1 INSTALLATION. Equipment shall be installed in accordance with manufacturer's recommendation. Provide piping and ductwork connections in accordance with the requirements of the other related Sections. Wire and install any equipment shipped loose for field installation.

The Contractor shall not install any equipment or materials until the Owner and Engineer have approved all submittals. If any equipment or materials are installed prior to approval of the submittals, it shall be at the Contractor's risk.

When units are shipped disassembled, field connect all sections including wiring together as shown on the Drawings to form single air handling unit. Seal all joints with gaskets and/or sealants.

Do not operate equipment without filters. Do not run equipment with dirty filter pressure drop more than twice clean filter pressure drop. A total of three complete sets of filters shall be provided. The first set is to be installed for start-up, test and balancing. The second set shall be installed after final cleanup and acceptance by the Owner. The third set shall be turned over to the Owner as a spare.

The Contractor shall start up each piece of equipment and system and shall make all adjustments so that the system is placed in proper operating condition.

Install unit level and plumb, maintaining manufacturer's recommended clearances and tolerances.

Install wall sleeves in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Division 7 Section "Joint Sealants."

Install wall sleeves to withstand, without damage to equipment and structure, seismic forces required by building code.

Provide necessary supports to accommodate weight of unit. Supports shall be epoxy coated to withstand corrosion. Provide vibration isolation fittings.

3.2 CONNECTIONS. Electrical System Connections: Comply with applicable requirements in Division 16 Sections for power wiring, switches, and motor controls.

Ground equipment according to Division 16 Section "Grounding and Bonding."

End of Supplemental Section

SECTION 15860 - SUPPLEMENTAL

CENTRIFUGAL FANS

PART 1 - GENERAL

1.1 SCOPE. Furnish and install all fans and fan accessories as shown on the Drawings.

1.2 RELATED REQUIREMENTS.

Division 11 - Equipment.

Section 15501 - HVAC

Section 15891 - Ductwork and Accessories.

Division 16 - Electrical

Section 09900 – Surface Preparation and Prime Painting.

Section 09960 – Finish Painting.

1.3 SUBMITTALS. Submit, in accordance with sections 01080 and 15501, all data and the fan schedules. The submittal shall include fan data sheets with a description of the proposed fan, fan size, type, arrangement, materials of construction, weight, motor horsepower, motor type, power supply, and frame size. Provide catalog data and selections for vibration isolators, include materials of construction. For belt drive equipment; provide drive data indicating the sheave sizes, belts size, number and length. Each submittal shall include pertinent equipment dimensional data, fan performance (operating data 0 information, and a performance curve showing the fan operating point and range. Minimum curve size shall be 8-in by 6-in. Faxed copies of curves are not acceptable. A list of accessories to be furnished shall be included on each submittal. Copies of operating and maintenance manuals shall be submitted. Significant dimensional differences between the specified equipment and the proposed equipment shall be noted on the equipment submittal. The Contractor shall provide data to show the dimensionally different equipment will fit within the space and still provide suitable clearance. Where corrosion resistance is required, provide conformation of material suitability for the specified service.

Where called for on the schedules, provide certified test data for the fan.

For units that will be shipped exposed, provide a description of the protective packaging that will be used during transit.

All submittals shall contain a statement that Section 15501 and all other Sections have been read and complied with. The certification statement shall be made by all of the following that are applicable; the Contractor, sub-contractor and the vendor. The statement shall be an individual statement for each party involved, and shall be included with every submittal and resubmittal.

Submit, in accordance with Section 01160, Operating and Maintenance Manuals. The following information shall be considered a minimum. Where applicable, provide information required for specific pieces of equipment.

Personnel familiar with the operation and maintenance of the specific information shall prepare manuals.

Equipment shall be identified with the Engineers Equipment Numbers and Identification as shown in the Schedules and on the Drawings.

Provide information in three ring binders. All sheets shall have reinforced punches. Tabbed dividers shall separate all sections. Drawings will be bound in the manual, or contained in envelopes bound into the manual.

Contents - Each volume shall contain the following minimum contents:

Installation including instructions for unpacking, installing, aligning, checking and testing. Foundation data, allowable piping loads, and electrical design shall be included.

Operating Instructions to provide pre-operational checks, start up and shut down, and description of all control modes. Include emergency procedures for all fault conditions and actions to be taken for all alarms. Procedures for long term storage shall be included.

Maintenance shall include preventive, and corrective. Schedules for test of other functions are to be included. Provide a list of tools required to service the equipment. Trouble shooting instructions to include a trouble-shooting guide shall be included.

Shop Drawing Data to include performance curves, data sheets, flow diagrams, wiring diagrams, and descriptive drawings.

In general, corrections or comments or lack there of, made relative to submittals during review shall not relieve the Contractor from compliance with the requirements of the drawings and specifications. Submittals are for review of general conformance with the design concepts of the project and general compliance with the contract documents. The Contractor is responsible for the final design conforming and correlating all quantities and dimensions, selecting fabrication processes and techniques of construction, coordinating the work of all trades, and performing the work in a safe and satisfactory manner.

Provide a recommended list of spare parts to the owner as required to mantain general maintenance.

1.4 REFERENCE STANDARDS. These standards shall be considered as minimum requirements. This is a general list and not all standards listed are necessarily referenced elsewhere in this Section. Specific requirements of this Section and/or Drawings shall have precedence. The Engineer shall resolve conflicts between published requirements.

Titles and abbreviation of Federal, State and industry standards, technical societies, associations and institutes and other organizations, which may be used, are as follows:

Air Diffusion Council (ADC)

American Bearing Manufacturers Association (ABMA)

Air Movement and Control Association (AMCA)

American National Standards Institute (ANSI)

Air Conditioning and Refrigeration Institute (ARI)

American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)

American Society of Mechanical Engineers (ASME)

American Society for Testing and Materials (ASTM)

Factory Mutual (FM)

Institute of Electrical and Electronic Engineers (IEEE)

National Institute of Standards and Technology (NIST)

National Electrical Code (NEC)

National Electrical Manufacturers Association (NEMA)

National Fire Protection Association (NFPA)

Occupational Safety and Health Administration (OSHA)

Sheet Metal and Air Conditioning Contractors National Association (SMACNA)

Underwriters Laboratories (UL)

Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.5 QUALITY ASSURANCE. All equipment of a given type included in this section shall be furnished by or through a single manufacturer or as specified on the schedules. Inspection by the Engineer's representative or failure to inspect shall not relieve the Contractor of responsibility to provide materials and perform the work in accordance with the documents. The Owner and Engineer reserve the right to sample and test any materials after delivery and to reject all components represented by a sample that fails to comply with the specified requirements. An authorized representative of the manufacturer shall perform the initial startup of the equipment. The Owner and Engineer shall witness startup. The use of local sales representatives to perform this work is not acceptable, unless the manufacturer provides documented evidence that the sales representative has been specifically trained for this work. All rotating parts of equipment shall be statically and dynamically balanced at the factory.

1.6 DELIVERY, STORAGE AND HANDLING. All materials shall be inspected for size, quality and quantity against approved shop drawings upon delivery. All materials shall be suitably packed for shipment and long term storage. Each package shall labeled to indicate the project and the contents of each package. Where applicable, equipment numbers shall be marked on the container. Instruction for the servicing and startup of equipment in long term or prolonged storage shall accompany each item. All materials shall be stored in a covered dry location off of the ground.

When required to protect the materials they shall be stored in a temperature-controlled location.

1.7 SPARE PARTS. Spare parts shall include all special items on the manufacturer's standard list of spare parts :

- Fan belts

- Fan bearings
- Furnish all special tools required for normal operation and proper servicing of the equipment.
- Spare parts shall meet the requirements of Sections 01180.

1.8 SCHEDULES. Fans shall be belt or direct drive, of the type, materials of construction, capacity and arrangement as described herein and on the schedules. Particular attention must be paid to the remarks and notes in these schedules. This Section is incomplete without the schedules.

1.9 WARRANTY. Meet the requirements of Section 01170.

PART 2 - PRODUCTS

2.1 GENERAL. The use of a manufacturer's name and model of catalog number is for the purpose of establishing the standard quality, grade, type, size, physical arrangement, performance characteristics and availability. All fiberglass fans, as shown and specified, shall be furnished by the same manufacturer.

Fans shall be factory assembled, complete with fan wheel, fan housing or cabinet, bearings, drives, drive guard, motor, motor base, unit base and vibration isolators, dampers and bird screens unless otherwise specified. All fans shall be provided with lugs, brackets or field supplied devices to allow the fan to be firmly bolted to the structure or fastened to specified vibration isolators. The lugs, brackets or field supplied devices shall be sized to withstand the expected seismic loads for the area and type of application. Location of the attachments shall be based on the equipment being hung or base mounted as shown on the Drawings and the schedules.

All fans shall be statically and dynamically balanced prior to shipment from factory.

Where belt drives are used, motors shall be provided with adjustable slide bases. Adjustable sheaves and slide bases shall be selected so that the midpoint of the adjustable range matches the fan schedule data. Drives selected shall have a safety factor of 1.5 times motor horsepower.

All fans shall be AMCA certified for air performance and sound ratings tested in accordance with AMCA 300.

Motor shall be selected to be non overloading for the entire fan curve range and for the reasonable expected temperature and humidity. Schedule motor sizes are minimum. If a larger motor is required for the fan proposed, the larger motor shall be provided at no additional cost.

All bearings for the fan and motor shall be as defined in Section 15501.

Fans shall be assembled with OSHA shaft and motor guards. Provide access for greasing bearings, tachometer readings of fan and motor speed without removing the cover. Cover shall be properly ventilated to prevent motor overheating.

Ductwork connections to units that require corrosion resistant coatings shall be made with flanges. Flanges shall be factory drilled before coating. Resilient washers suitable for the environment shall be used to protect the coating from the bolts in the flange. The use of self tapping screws or other fastening methods that will damage the coating are not acceptable.

The noise level of the equipment operating in the field shall not exceed 85 dBA overall sound pressure level (referenced to 20 micro pascals) at a distance of 3-ft from equipment surfaces. Provide octave band sound data if another noise level is specified in the schedule or if sound data submission is specified in the schedules.

Additional requirements are contained in Paragraph 2.03 through 2.07 for specific fan types and in the schedules.

Section 15501 contains general requirements for vibration isolators, bearings and motor drives. Adhere to those requirements and the specific requirements in this Section.

When bearings are not accessible, extended supply and relief fittings shall be supplied. Both supply and relief fittings shall terminate in the same location.

Provide inlet and outlet screens for fans that are not directly duct connected.

2.2 SPARK RESISTANT CONSTRUCTION. Where called for on the Drawings and Schedules, fans shall be of spark resistant construction. Bearings shall not be placed in the air stream. Construction shall conform to AMCA and NFPA requirements.

TYPE A - All parts in contact with the gas stream shall be non-ferrous material.

TYPE B - Aluminum wheel and non-ferrous ring around shaft openings.

TYPE C - Non-ferrous ring on inlet bell and shaft opening.

2.3 CENTRIFUGAL ROOF VENTILATORS. Description: Belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

Housing: Removable, spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.

Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:

Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.

Shaft Bearings: Permanently lubricated, permanently sealed, self aligning ball bearings.

Pulleys: Cast-iron, adjustable-pitch motor pulley.

Fan and motor isolated from exhaust air stream.

Accessories.

As scheduled on the drawings.

Disconnect Switch: Non-fusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.

Bird Screens: Removable, ½-inch mesh, aluminum or brass wire.

Dampers: Counterbalanced, parallel-blade, back-draft dampers mounted in curb base; factory set to close when fan stops.

Motorized damper shall be factory wired. Provide transformer as required.

Roof curb: 12 inches. Pitch curb to match for roof slope.

Manufacturers shall be Cook, Greenheck, Penn or equal.

2.4 PROPELLER WALL FANS. Fans shall be suitable for side wall installation with safety screen, damper, boot, auto shutter, and OSHA guards.

Fans shall be direct or belt driven, centrifugal type, with aluminum wheels and housing, and a wheel guard located on the discharge side.

Provide fans statically and dynamically balanced at the factory.

The fan motors shall be of adequate size to prevent overloading when operating at the specified capacity and shall be suitable for use with the power supply indicated in the schedules on the drawings.

Approved Manufacturers shall be Cook, Greenheck, Penn or equal.

2.5 CEILING MOUNTED FAN. Centrifugal fans designed for installing in ceiling or for concealed applications.

Housing: Steel, lined with acoustical insulation.

Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.

Grille: Painted aluminum, louvered grille with flange on intake and thumbscrew attachment to fan housing.

Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

Accessories:

Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.

Isolation: Rubber-in-shear vibration isolators.

Manufacturer’s standard wall cap and transition fittings..

Other accessories as required.

Approved manufactures shall be Cook, Penn, Greenheck, or approved equal.

PART 3 – EXECUTION

3.1 INSTALLATION. The fans shall be installed in accordance with the instructions of the manufacturer and as shown on the Drawings. The Contractor shall not install any equipment or materials until the Owner and Engineer have approved all submittals. If any equipment or materials are installed prior to approval of the submittals, it shall be at the Contractor's risk.

Ensure that lubricating fluids and greases have been applied according to manufacturer's recommendations. Contractor shall be responsible for all start-up checks, vibration check, and adjustments and shall perform them unless they are done by the manufacturer's representative.

Provide manufacturers representative to inspect fans and supervise start-up of fans with 5 motor horsepower and above.

End of Supplemental Section

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SECTION 15891 - SUPPLEMENTAL

DUCTWORK AND ACCESSORIES

PART 1 - GENERAL

1.1 SCOPE. Furnish, fabricate and install all ductwork, including fittings, accessories, dampers, duct liner, hangers, diffusers, registers, grilles and any incidental work or components required to provide complete air supply, return and exhaust ductwork systems as shown on the Drawings and as specified herein.

In general, ductwork shall consist of any passageway made of sheet metal or other material substantially air-tight, used for the conveying of air, gas or materials. Included are fittings, transitions, bracing, fasteners, sealers, supports and accessories such as access panels, access doors, turning vanes and manual air balancing dampers. All ductwork shall be of size and material as specified herein and as shown on the Drawings. All duct sizes indicated on the Drawings are clear, inside dimensions. Where ductwork is lined with fiberglass, duct sizes shown on the Drawings are clear, inside dimensions to the duct liner material.

Any change in duct sizes, offsets, transitions and fittings required to accommodate job conditions shall be submitted to the Engineer for approval.

All ductwork and equipment shown on the drawings is intended to be approximately correct to scale, but figured dimensions and detailed drawings of the actual equipment furnished shall be followed in every case. The drawings shall be taken in a sense as diagrammatic. Size of ductwork and piping are shown, but it is not the intent to show every offset or fitting, nor every hanger or support, or structural difficulty that may be encountered. To carry out the intent and purpose of the drawings all necessary parts to make a complete working system ready for use shall be furnished without extra charge. The contractor shall be responsible to coordinate the system installation and routing with the work of all trades.

1.2 RELATED REQUIREMENTS. Cutting and patching is included in Division 2 except for items specified herein. Concrete work is included in Division 3 except for required HVAC anchor bolts, sleeves and templates, which shall be furnished under this Section.

Structural steel and miscellaneous metal is included in Division 5 except for supplementary steel required for HVAC hangers, equipment supports, anchors and guides, which shall be furnished under this Section.

Flashing and counter flashing is included in Division 7 except for items specified herein.

Painting is included in Division 9 except for factory finished HVAC equipment, HVAC shop painting and HVAC identification labeling and as required in Paragraph 3.15 below.

Exterior louvers and louver blank-off panels are included in this Section.

Thermal Insulation is included in Section 15290. This Section specifies the insulation type and thickness for the systems specified herein.

Electric duct heaters are specified in Section 15550 and installed under this Section.

Control dampers and duct mounted instruments are specified in Section 15950 and installed under this Section.

For fiberglass ductwork refer to Section 15895.

1.3 SUBMITTALS. Submit, in accordance with Section 01300, the following Drawings and data. Detailed equipment and ductwork drawings at a minimum scale of 1/8-in = 1-ft-0-in. Drawings shall locate ductwork accessories including manual, automatic and fire dampers. Ratings of fire dampers shall be shown. Drawings shall also show and dimension maintenance clear spaces for motors, drives, coils, filters and access doors or panels. Indicate ductwork pressure class used for fabrication.

Standard shop and field installation details for transitions, elbows, takeoffs, discharge nozzles, turning vanes, access panels and doors, volume control and splitter dampers, hangers and volume extractors. When SMACNA references are used, the specific methods for the project shall be clearly defined. Where SMACNA has more than one option, the option to be used shall be indicated.

Ductwork materials, joining methods, reinforcing and material gauges. Where options are allowed by SMACNA, the proposed option shall be clearly defined. Indicate proposed materials and methods for ductwork and equipment hangers.

For units that will be shipped exposed, provide a description of the protective packaging that will be used during transit.

All submittals shall contain a statement that Sections 15500, and all other Sections have been read and complied with. The certification statement shall be made by all of the following that are applicable; the Contractor, sub-contractor and the vendor. The statement shall be an individual statement for each party involved, and shall be included with every submittal and resubmittal.

In general, corrections or comments or lack there of, made relative to submittals during review shall not relieve the Contractor from compliance with the requirements of the drawings and specifications. Submittals are for review of general conformance with the design concepts of the project and general compliance with the contract documents. The Contractor is responsible for the final design conforming and correlating all quantities and dimensions, selecting fabrication processes and techniques of construction, coordinating the work of all trades, and performing the work in a safe and satisfactory manner.

1.4 REFERENCE STANDARDS. These standards shall be considered as minimum requirements. This is a general list and not all standards listed are necessarily referenced elsewhere in this Section. Specific requirements of this Section and/or Drawings shall have precedence. The Engineer shall resolve conflicts between published requirements.

Titles and abbreviations of Federal, State and industry standards, technical societies, associations and institutes and other organizations which may be used are as follows:

American Conference of Governmental Industrial Hygienists (ACGIH)

Air Movement and Control Association (AMCA)

American National Standards Institute (ANSI)

Air-conditioning and Refrigeration Institute (ARI)

Air Diffusion Council (ADC)

ADC 1062-R4 - Certification, Rating and Testing Manual.

American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE)

ASHRAE 68 - Laboratory Method of Testing In-Duct Sound Power Measurement Procedure for Fans.

American Society of Mechanical Engineers (ASME)

American Society for Testing and Materials (ASTM)

ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron, Alloy-Coated (Galvannealed) by the Hot-Dip Process.

ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

Factory Mutual (FM)

National Institute of Standards and Technology (NBS)

National Fire Protection Association (NFPA)

NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.

NFPA 102 - Standard for Grandstand, Folding and Telescopic Seating, Tents and Membrane Structures.

NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.

NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

Occupational Safety and Health Administration (OSHA)

Sheet Metal and Air Conditioning Contractors National Association (SMACNA)

Underwriters Laboratories (UL)

UL 181 - UL Standard for Safety Tests for Flame-Propagation of Fabrics and Films.

UL 555 - UL Standard for Safety Fire Dampers.

UL 723 - UL Standard for Safety Test for Surface Burning Characteristics of Building Materials.

Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.5 QUALITY ASSURANCE. Inspection by the Engineer's representative or failure to inspect shall not relieve the Contractor of responsibility to provide materials and perform the work in accordance with the documents. The Owner and Engineer reserve the right to check and test any materials after delivery and to reject all components represented by a sample that fails to comply with the specified requirements.

1.6 DELIVERY, STORAGE AND HANDLING. All materials shall be inspected for size, quality and quantity against approved shop drawings upon delivery. Delivery schedule of all equipment shall be coordinated with the Contractor. Equipment ready for shipment prior to the agreed on shipping date shall be stored without cost to the Owner by the manufacturer. All materials shall be stored in a covered dry location off of the ground.

1.7 SPARE PARTS. Spare parts shall include all special items on the manufacturer's standard list of spare parts and shall meet the requirements of Sections 01750 and 01760. In addition to special items, the following spare parts shall be provided:

Furnish all special tools required for normal operation and proper servicing of the equipment.

Provide a minimum of 1 or 5 percent of the total units rounded to the next full unit whichever is greater for each size and rating of the following components.

Fire damper fusible links

Thermostats

Thermometers

Pressure gages

Control relays

Damper operators

Control transmitters

Control transformers

Pack spare parts in containers suitable for extended storage without deterioration of the parts. Containers shall be clearly labeled designating contents, pieces of equipment for which intended and equipment identification numbers.

1.8 DEFINITIONS. Particular terminology used under this Section is defined as follows:

Traffic Level and Personnel Level - Areas, including process areas, equipment rooms, boiler rooms and other areas where insulation may be damaged by normal activity and local personnel traffic. Area extends vertically to 8-ft above floor, walkways, platforms and stairs, and horizontally 3-ft beyond the edge of walkways, platforms, and stairs.

Exposed Piping and Ductwork - Piping and ductwork visible from the floor level and includes all piping and ductwork in equipment rooms, boiler rooms, etc.

Concealed Piping and Ductwork - Piping and ductwork not visible from the floor level and includes piping and ductwork above hung ceilings and in shaftways.

Supply Air Ductwork - Ductwork carrying air from a fan or air handling unit to the space or spaces to which it will be introduced. This air may have been heated or cooled or in the case of ventilation system the air would be neither heated nor cooled. Supply air ductwork extends from the fan or air handling unit to the registers, grills or diffusers at the end of the ductwork.

Return Air Ductwork - Ductwork carrying air from the space it was supplied to back to a fan or air handling unit. Return air ductwork extends from the registers or grills at the end of the ductwork to the air handling unit or connection with an outdoor air intake duct.

Exhaust Air Ductwork - Ductwork carrying air from a space to a fan and then to be discharged to the outdoors. Exhaust air ductwork extends from the registers or grills at the end of the ductwork to the fan. From the fan the exhaust ductwork extends to the discharge point, exhaust air damper, or exhaust air plenum, whichever comes first.

Relief Air Ductwork - Ductwork carrying air from a space without a fan to be discharged to the outdoors. Relief air ductwork extends from the registers or grills at the end of the ductwork, the discharge point, relief air damper, or relief air plenum, whichever comes first.

Outdoor Air Ductwork - Ductwork carrying untreated air from the outside to a fan or air handling unit. Outdoor air ductwork starts at the intake point, outdoor air damper, or outdoor air plenum, whichever comes last. The outdoor air ductwork extends to the fan, air handling unit, or connection with a return air duct, whichever comes first.

Mixed Air Ductwork - Ductwork that can carry either return air or outdoor air or a combination of both. Mixed air ductwork starts at the connection of the return air and outdoor air ducts and extends to the fan or air handling unit.

Outdoor Air Plenum - A plenum that extends from the opening in the skin of the structure to the outdoor air duct. If the outdoor air damper is directly at the intake or there is no outdoor air damper, the plenum will extend to the first size reduction. If the outdoor air damper is not at the intake, the plenum will extend to the outdoor air damper.

Exhaust Air Plenum - A plenum that extends from the opening in the skin of the structure to the exhaust air duct. If the exhaust air damper is directly at the discharge or there is no exhaust air damper, the plenum will extend from the last size reduction. If the exhaust air damper is not at the discharge, the plenum will extend to the exhaust air damper.

Relief Air Plenum - A plenum that extends from the opening in the skin of the structure to the relief air duct. If the relief air damper is directly at the discharge or there is no relief air damper, the plenum will extend from the last size reduction. If the relief air damper is not at the discharge, the plenum will extend to the relief air damper.

Ventilated Spaces - Areas supplied with outdoor air on a continuous or intermittent basis. The outdoor air may be heated and/or cooled or untreated.

Heated Spaces - Areas where heat is supplied to maintain a minimum temperature during the heating season.

Unheated Spaces - Areas where heat is not applied and there is no minimum temperature during the heating season.

Conditioned Spaces - Areas that are provided with heating and mechanical cooling.

Non-Conditioned Spaces - Areas that are not provided with mechanical cooling.

Thermal Conductivity - The rate of heat flow through unit area of a homogeneous substance under the influence of unit temperature gradient in the direction perpendicular to the area. Units-BTU per (hour)(sq ft)(degrees F temperature difference)(per inch thickness).

Indoor Ductwork - Ductwork within a building that is not exposed to the weather.

Outdoor Ductwork - Ductwork that is not within a building and is exposed to the weather.

Hot Ductwork - Ductwork carrying air with a temperature above the surrounding space temperature.

Cold Ductwork - Ductwork carrying air with a temperature below the surrounding space temperature.

Hot/Cold Ductwork - Ductwork carrying air with a temperature that can be either above or below the surrounding space temperature.

Flues/Stacks/Breeching - Ductwork carrying products of combustion to atmosphere.

1.9 COORDINATION. The Drawings indicate the extent and general arrangement of the systems. If any departures from the drawings or specifications are deemed necessary, details of such departures and the reasons therefore shall be submitted as soon as practical for review. No such departures shall be made without the prior written concurrence of the Engineer.

The Contractor shall coordinate the location and placement of all concrete inserts and welding attachments with the structural engineer.

The Contractor shall assume full responsibility for coordination of the HVAC systems, including; scheduling, and verification that all structures, ducts, piping and the mounting of equipment are compatible.

The Contractor shall not install any equipment or materials until the Owner and Engineer have approved all submittals. If any equipment or materials are installed prior to approval of the submittals, it shall be at the Contractor's risk.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATION FOR DUCTWORK. Flexible connections for conventional air conditioning systems shall be glass fabric coated with polychloroprene. Fabric must comply with Underwriters Laboratories Standard UL214 and NFPA Bulletin 90A. Connections shall be Ventglas by Ventfabrics or equal.

Flexible connections for process exhaust systems shall be fiberglass fabric coated with Duponts teflon. Fabric must be resistant to Sodium Hypochlorate. Fabric must comply with Underwriters Laboratories Standard UL181 and NFPA Bulletin 102. Connections shall be Ventel by Vent Fabric or equal.

Furnish flexible connectors at each inlet and outlet of fan and in the duct runs where required for expansion, contraction and movement, and where called for on the Drawings. Flexible connections shall be integrally flange molded arch type units constructed of EPDM rubber 1/4-in thick, reinforced with a strong synthetic asbestos-free fabric suitable for corrosive service. The flexible connections shall be designed to minimize the transmission of vibration from the fans to the ductwork at the suction and discharge connections. Expansion or contractor flexible connections shall be designed to allow 1-in movement. Working length or “live” length shall be as designed by the manufacturer to allow up to 1-in of movement.

Ends shall be flanged, with flanges matching duct connection flanges. Corners on rectangular expansion joints shall be molded and free of patches or splices. The flexible connections shall be suitable for outdoor service and temperature ranges from minus 10 up to 125 degrees F, and pressure to 5 psig. Specially fabricated split Type 316 stainless steel retaining back-up bars shall be supplied to prevent damage to the EPDM rubber flanged with Type 316 stainless steel bolts are tightened. Acceptable Manufacturer: Holz Rubber Company, Mercer Rubber, Company, Proco Products Incorporated, or approved equal.

2.2 FLAME AND SMOKE RATINGS. All materials, including adhesives, surface coatings, sealers, assemblies of several materials, insulation, jacketing, finish, etc, shall have flame spread ratings not over 25 (fire resistive) and smoke development ratings not over 50 and fuel contributed rating not over 50, as established by tests conducted in accordance with the Federal Standard 00136B, National Bureau of Standards Radiant Energy Fire Test and the National Fire Code of the NFPA. These requirements apply to all circumstances whether the materials are field applied or applied by a manufacturer in his/her shop, or elsewhere, prior to delivery to the project.

2.3 SOUND CONTROL. The selection of ductwork and accessories shall be such as not to create noise that will exceed the levels of permissible noise exposures for occupational areas as established by the OSHA and other Federal, State and local safety and health standards, codes and ordinances. Acoustical Lining - Internal sound attenuation and insulation (for air conditioning ductwork) shall be 1-in thick bonded fiberglass mat coated with black pigmented fire resistive coating on the air stream side. Liner shall comply with NFPA 90A requirements. Flame spread and smoke development ratings shall be 25 and 50 respectively. Material shall be Owens Corning; Aeroflex or equal.

2.4 HANGERS, SUPPORTS AND ANCHORS. Furnish supports, hangers and other devices necessary to support firmly and substantially the equipment and ductwork described in this Section. Ductwork support systems shall include restrains as required by the applicable building codes to withstand seismic loading. All equipment, ductwork, and supports that are installed outdoors shall be designed and installed to meet wind loadings as required by the International Building Code, all other applicable codes, and the requirements specified herein. Design shall be provided by a professional engineer hired by the Contractor as specified in other sections of the specification. Signed and sealed calculations shall be submitted for record purposes.

Rectangular, Round and Flat-Oval Ductwork - Spacing and size of hangers shall be as called for in the SMACNA standards, except as limited below.

Rectangular ductwork 48-in wide and larger shall be supported by adjustable threaded rod hangers.

Round ductwork 37-in and larger shall be supported by two adjustable threaded rods at each support.

All hangers shall be of same material as ductwork which they serve, e.g., galvanized, aluminum, black steel, etc, except for PVC ductwork which shall be Type 304 stainless steel.

All hanger hardware and fasteners shall be of the same material as the duct they serve or shall be of a material with equal or greater corrosion resistance. Where materials other than the duct material are used, they must be approved by the Engineer before installation.

Perforated band iron or wire for supporting ducts shall not be permitted.

Where C-clamp type hangers are used, furnish with a retainer strap.

Support flexible duct withType 304 stainless steel band hangers, 1-in wide minimum, attached so as not to crush the ductwork. The use of wire to hang flexible ductwork shall not be permitted.

The following methods of hanger attachment to the building structure are NOT allowed. The numbers and letters refer to hanger methods shown in Figure 4-1, 4-2 and 4-3 of the 1985 edition of the HVAC Duct Construction Standards Metal and Flexable as published by SMACNA.

"T"- wrap around strap on open web joist.

"W" - bent over band on open web joist.

"14" - friction clamps.

"17" - bent wire in metal deck.

Design of hangers shall include the effect of all loads applied to the duct as well as the load of the duct. These loads include, but are not limited to wind, snow and internal dirt or liquid buildup.

Hangers shall not be supported from roof decking or bulb tees. Where required, provide supplemental steel to span between the building structures.

2.5 DUCTWORK MATERIAL. Ductwork shall be constructed of the materials specified using the gauges or thicknesses, reinforcing and construction methods in accordance with SMACNA standards. Unless otherwise specified, all components of the duct systems shall be constructed of the same material as the ductwork. This is to include braces and turning vanes.

Galvanized steel ductwork shall be constructed of hot-dip galvanized sheet steel, per ASTM A653.

Stainless steel ductwork shall be constructed of Type 316 stainless steel.

Aluminum ductwork.

2.6 DUCTWORK CONSTRUCTION DETERMINANTS. Low pressure ductwork shall be constructed of the following materials and to the SMACNA standards:

The following is to be used as a general guide for duct material select.

Galvanized Steel – shall be used for normal heating, cooling, and ventilation applications where the air handled in surrounding the duct is relatively dry, and there are no corrosives.

Stainless Steel – shall be used in areas that galvanized steel and aluminum are not suitable and as shown on the drawing.

Aluminum – shall be used in areas where shown on drawing.

Design of ductwork shall include all loads applied to the ductwork, in addition to the load of the duct. These loads include but are not limited to wind, snow and internal dirt or liquid build up.

2.7 DUCTWORK CONSTRUCTION. All ductwork shall be substantially built with joints and seams smooth on the inside and given a neat appearance on the outside. Inside surfaces and joints shall be smooth and free from pockets, burrs and projections. All joints shall be substantially airtight with laps made in the direction of air flow and no flanges projecting into the air stream.

2.7.01Pressure Classes. Pressure classes for determination of sheet metal gauge and reinforcing shall be as defined by the latest issue of the SMACNA - Industrial Duct Construction Standards. For systems with fans with a shut off static pressure higher than 2-in w.g., design pressure shall be as listed in Paragraph 2.06 above. For systems with fans a shut off static pressure 2-in w.g. or less design pressure shall be equal to the maximum pressure indicated for the fans or air handling units on the Schedules and the pressure class shall be the same for the entire length, including branches, of the specific duct system.

2.7.02 Rectangular Ductwork (Sheet Metal). Ductwork shall be constructed as shown on the Drawings in accordance with the specified SMACNA - Construction Standard. Cross-breaking shall conform to SMACNA standard. Cross-breaking shall be applied to the sheet metal between the standing seams or reinforcing angles. The center of the cross-break shall be of the required height to assure rigidity for each panel.

Alternate Construction - Factory fabricated joint systems may be offered as an alternate form of construction. The system offered shall meet all requirements of SMACNA. Alternate joint systems shall be "Ductmate System" as manufactured by Ductmate Industries, Inc., installed in accordance with the manufacturer's recommendations. The system shall be sealed for zero leakage and angle attachment to the main duct section shall be by tack welding. The use of screws is not allowed.

2.7.03 Round Ductwork (Sheet Metal). Ductwork shall be constructed as shown on the Drawings in accordance with the specified SMACNA - Construction Standard.

Round ductwork longitudinal seams shall be either lock type or continuous welded construction. Slip joints shall be used on ductwork and fittings up to 36-in in diameter and Vanstone flanges shall be used on ducts over 36-in in diameter.

Fittings shall be fabricated with continuous welds. 90 degree elbows shall have a turning radius of 1.5 times the fitting diameter. 90 degree elbows shall be mitered construction with five segments. All fittings in the round duct system shall be of the male and female type. Mechanically fasten the conduits together using sheet metal screws not less than four per fitting 6-in on centers maximum and equally spaced around the circumference of fitting.

Round ductwork and fittings shall be manufactured by United Sheet Metal; SEMCO or equal.

2.7.04 Insulated Round Flexible Ducts. Round flexible ducts shall comply with specified SMACNA - Construction Standards and be constructed of corrugated ductile aluminum that can be bent and rebent by hand and is self-supporting. 1-in insulation shall be applied around the outside and be finished with a vinyl cover.

Thermal conductivity of the insulation shall not exceed 0.27 BTU/hr/sq ft/1 degree F at 75 degree mean temperature. Duct shall be Class I, per UL 181.

Maximum length shall be 5-ft. The remainder shall be galvanized sheet metal. Duct run shall be as short and straight as possible to minimize static resistance.

Ducts shall be Bendway as manufactured by Flexaust Company or approved equal.

2.8 VOLUME AND SHUT OFF DAMPERS. Rectangular dampers shall be multiple blade type with channel frame, exterior linkage and position indicator and locking device. Blades shall not exceed 6-in in width.

Round or oval dampers and splitters shall be shop fabricated, single blade type with position indicators and locking device. For galvanized sheet metal systems, material shall be two gauges heavier than ductwork or 18 gauge, whichever is heavier.

Dampers shall be constructed of the same material as the ductwork.

Shut off dampers shall have replaceable neoprene seals. Leakage rates shall not exceed 7 cfm/sq ft at 4-in w.g. for rectangular dampers and 0.15 cfm/in of perimeter at 4-in w.g. for round or oval dampers.

Dampers shall be supplied with locking quadrants. Quadrants in galvanized steel and black steel ductwork shall be galvanized steel. All other duct systems shall have stainless steel locking quadrants. Locking quadrants shall have a positive method of holding the damper in its selected position such as a bolt through both the quadrant and the lever arm. Systems using springs or other devices that can vibrate loose are not acceptable.

All dampers shall be flanged connections unless otherwise noted.

All dampers shall be selected for a rating that equals or exceeds the specified system pressure and velocity. Manufacturer shall be Ruskin or equal.

Balancing and balancing/shut off dampers shall be opposed blade. Shut off dampers shall be parallel blade.

2.9 ACCESS DOORS. Access doors shall be minimum 24-in by 24-in in ducts 26-in and larger. Where the duct size is less than 26-in, the largest door that can be accommodated shall be used. Access doors shall be of the same material as the duct, pan type construction for metal ductwork, with smooth edges and fitted seals, constructed and installed for air-tight fit with ease of opening and closing. Doors shall be substantially butt hinged, with heavy sash locks and substantial door pulls. Door openings and door frames shall be reinforced with bar stock or angle. Where ductwork is installed with duct liner or exterior duct insulation, the access door shall be of the insulated type. Access doors shall be factory fabricated. Where ductwork is constructed of aluminum or stainless steel, access door and hardware shall be of similar material.

Hand hole access panels shall be 12-in by 12-in, constructed of the same material as the ductwork, with peripheral gaskets and sash locks. Provide hinges or chain for attachment to duct.

2.10 FASTENERS. Sheet metal screws, drive cleats, cinch bands and other fasteners shall be fabricated from materials with an equal or greater corrosion resistance than the ductwork in which they are installed. Where a material other than the duct material is used, it shall be approved by the Engineer before installation

2.11 RELIEF DAMPERS. Relief dampers shall be manually operated or automatic gravity-type used for exhaust of air. Dampers shall be constructed of the same material as the ductwork with flanged connection and blades set in parallel-bladed position and gang operated by exterior linkage. Dampers shall have a shop coat of primer or aluminum finish as specified. Relief dampers shall be of size, type and capacity as specified on the Drawings. Adjustable counter-balanced gravity dampers shall be provided where indicated on the Drawings. Manufacturer shall be Ruskin or equal.

2.12 LABELS. The service of each duct along with and arrow indicating direction of flow shall be provided on each duct system. Labels shall be located not more than 26 linear feet apart and shall also be provided at both sides of wall penetrations, at each damper, and each equipment connection.

Labels shall contain the service spelled out, the duct size, and the equipment number of the equipment served. Label locations shall have unobstructed view from normal viewing locations.

Numbers and letters shall be die-cut from 3.5 mil vinyl film and pre-spaced on carrier film. Adhesive and finish shall be protected with one piece removable liners. Colors shall be white letters on black backgrounds.

The system for preparation and application of letters shall be Type B a.s.i./2 by ASI Sign Systems; Architectural Graphics Inc. or equal. Letters shall be 3-in high Optima Bold, upper case using Grid 2 spacing. Direction arrows are to match. The instructions of the manufacturer shall be followed in respect to storage, surface preparation and application of letters.

Each piece of equipment is to be provided with an identification label listing the unit number and the areas served. Labels shall be as specified above.

2.13 DIFFUSERS, REGISTERS AND GRILLES. All diffusers, registers and grilles shall be of the shape, sizes, capacity and type as shown on the Drawings. On all duct openings that do not have a specific diffuser, register, grill or mesh cover provide a wire mesh cover.

Finish - Unless otherwise specified, diffusers, registers and grilles shall have the following finish. All diffusers, registers and grilles located in ceilings shall have a baked white enamel finish except where the ceiling system has an exposed aluminum support grid. Where the ceiling has an exposed aluminum support grid the diffusers, registers and grilles shall have a baked aluminum enamel finish. All diffusers, registers and grilles not located in ceilings shall have baked aluminum enamel finish.

2.13.01 Supply Air Diffusers. General - Diffusers shall be a factory-assembled unit of welded steel construction consisting of a housing with built-in louvers, cones, vanes or other means of directing discharge of air in a particular pattern principally for overhead or ceiling air diffusion. All diffusers shall be equipped with a volume control device. Distribution of air may be adjustable if so specified.

2.13.02 Exposed Duct Mounted Diffusers. Diffusers shall be of the adjustable type for ease of horizontal and vertical adjustment of air pattern. Refer to Drawings for direction of air throw. Each diffuser shall be equipped with an equalizing grid, baffles as required and extended bottom plate flange designed specifically for air diffusion from diffusers mounted on exposed ductwork. Acceptable manufacturers shall be Titus, Krueger and Price.

2.13.03 Supply Air Grilles. In general, grilles shall be a factory-assembled unit consisting of a grille with double deflecting adjustable airfoil vanes to diffuse supply air in the various directional patterns as shown on the Drawings. Grilles shall be of aluminum frame and border with aluminum louver blades. All grilles shall be furnished with a sponge rubber gasket to prevent streaking. Front and rear louver blades shall be individually adjustable. Where wall mounted, front blades shall be vertical and rear blades shall be horizontal. Where ceiling mounted, front blades shall be parallel to long dimension. Grilles shall be Series 272F by Titus Manufacturing Corp.; Krueger and Price.

2.13.04 Supply Air Registers. General - Registers shall be a factory-assembled unit consisting of a grille with adjustable vanes to diffuse supply air in the various directional patterns as shown on the Drawings and a damper. Grilles shall be of aluminum frame and border with aluminum louver blades. All registers shall be furnished with a sponge rubber gasket to prevent streaking. Supply air registers shall have aluminum opposed-blade dampers. Front and rear louver blades shall be individually adjustable. Where wall mounted, front blades shall be vertical and rear blades shall be horizontal. Where ceiling mounted, front blades shall be parallel to the long dimension.

2.13.05 Exhaust Air Grilles / Registers. Acceptable manufacturer shall be Titus Manufacturing Corp.; Krueger and Price

2.13.06 Return Air Grilles / Registers. Louver-Faced Return Air Grilles. In general, grilles shall be a factory-fabricated unit of aluminum frame border and louver blades. All grilles shall be furnished with a sponge rubber gasket to prevent streaking. Acceptable manufacturer shall be by Titus Manufacturing Corp.; Krueger and Price.

2.13.07 Eggcrate Type Return Air Grilles. Return air grilles shall be of all aluminum construction consisting of 1/2-in thick cores with 1/2-in square grid size. The square grid pattern shall provide maximum free area with minimum "see through." Acceptable Manufacturers shall be: Titus Manufacturing Corp., Price, Krueger Manufacturing Co., Inc., or approved equal.

2.13.08 Wire Mesh Covers. Where wire mesh covers are called for on the Drawings, the wire mesh and support frame shall be the same material as the duct where the cover is installed. Unless otherwise noted the wire mesh shall be 0.5-in mesh. The wire mesh shall be contained in a metal frame. The mesh shall be firmly attached to the frame to prevent it being pulled out of the frame by casual contact. The frame shall be a minimum of 16 gauge sheet metal or the minimum gauge for a flange based on SMACNA, whichever is greater. The frame shall be on both sides of the mesh creating a sandwich with the mesh in the middle. Fastenings shall go through the frame on both sides of the cover.

2.14 ROOF CURBS. Roof curbs shall be furnished for all roof mounted HVAC equipment including fans and relief or intake vents. Roof curbs shall be pre-fabricated type, minimum 12-in height and sized to match the dimensions of the equipment base supported. Roof curbs for fans are specified under Section 15860. Curbs shall be straight sided type of all aluminum welded construction with nominal 2-in thick acoustical/thermal insulation in curb walls. A perforated metal liner shall be provided to protect the insulation. Curbs shall provide a flat top surface regardless of the roof slope. Curb interiors shall be provided with protective coatings when a coating is specified.

2.15 TURNING VANES. Turning vanes shall be shop fabricated and installed in all abrupt rectangular elbows. Single thickness or airfoil type double thickness blades shall be chosen based on SMACNA recommendations.

Vanes shall be fabricated from the same material as the ductwork and manufactured by Elgen; Duro-Dyne; Aero/Dyne or equal.

2.16 VOLUME EXTRACTORS. Volume extractors shall be shop fabricated with synchronized curved extractor blades, heavy side rails and screw operator.

Extractors shall be fabricated from the same material as the ductwork and manufactured by Carnes; Titus or equal.

2.17 FIRE DAMPERS. Fire dampers shall meet local codes and the requirements of the NFPA Pamphlet No. 90A. Dampers in systems constructed of materials other than galvanized steel shall be constructed of Type 316 stainless steel.

Dampers shall be sized so that the free air space is not less than the connected duct free area. Location shall be as shown on the Drawings and required by code. Dampers shall have a minimum 1-1/2 hour standard fire protection rating in accordance with NFPA Pamphlet No. 252 and UL 555. Where the fire protection rating of the partition exceeds 2 hours, multiple dampers in series may be used to provide a rating equal to the partition.

Fusible Links - Dampers shall be arranged to close automatically and remain tightly closed upon the operation of a UL approved fusible link or other approved heat actuated device, located where readily affected by an abnormal rise of temperature in the duct. Fusible links shall have a temperature rating of 50 degrees F above the maximum normal duct operating temperature, but not less than 165 degrees F.

Workmanship - Install dampers in sleeve unless noted otherwise on the Drawings or in the case of dampers listed for installation without sleeves after specific approval from the Engineer. Fire dampers shall be installed to provide a positive barrier to passage of air when in a closed position. Dampers shall be installed so they will be self-supporting in case of duct destruction due to heat. Care shall be exercised that the frame be set so that the closing device will not bind.

Factory fabricated, steel-curtain type, UL approved fire dampers, with damper blades out of the air stream, are acceptable. These fire dampers shall be installed in accordance with the manufacturer's instructions and UL 555.

Access Doors - Tight fitting access doors shall be provided for accessibility to dampers and fusible links for inspection and maintenance.

All fire dampers shall have written approval from local authorities.

PART 3 - EXECUTION

3.1 INSTALLATION OF DUCTWORK. Fabricate and erect all ductwork where shown on the Drawings, as specified herein, and in accordance with SMACNA standards. Rigidly support and secure ductwork.

The Contractor shall not install any equipment or materials until the Owner and Engineer have approved all submittals. If any equipment or materials are installed prior to approval of the submittals, it shall be at the Contractor's risk.

Wherever ducts are divided, maintain the cross-sectional area. All such changes must be approved and installed as directed by the Engineer or as approved on shop or erection drawings.

During installation, temporarily close the open ends of ducts to prevent debris and dirt from entering. Install work in accordance with the overall approved progress schedule and in cooperation with all other trades so there will be no delay to other trades.

Install louver blank off panels provided by the louver manufacturer as specified under Section 10200. Provide louver manufacturer the louver blank off panel dimension requirements. Secure blank off panels to the building structure using aluminum angles and rustproof fasteners. Caulk perimeter completely to eliminate water penetration.

Cross-break sheet metal in accordance with SMACNA duct construction standard. Apply cross-breaking to the sheet metal between the standing seams or reinforcing angles. The center of the cross-break shall be of the required height to assure each panel section being rigid.

Cross-break streamlined ducts on top only and adequately brace internally.

Beading as specified in SMACNA will be acceptable in lieu of cross-breaking.

The Drawings of the air ducts and air risers show the general location for installation of the ducts and risers. Should additional offsets or changes in direction be made, these changes must be considered in the original bid and shall be installed at no additional cost to the Owner.

All necessary allowances and provisions shall be made in the installation of the ducts for the structural conditions of the building. Ducts shall be transformed or divided as may be required. Wherever this is necessary, maintain the cross-sectional area. All of these changes, however, must be approved and ducts installed as directed by the Engineer or as approved on shop or erection drawings.

The taper of all transformations shall be not more than 15 degrees.

Secure casing to curbs according to SMACNA "Duct Construction Standards."

Provide baffle plates as required to prevent stratification and to provide proper operation of controls.

Where ducts are constructed of materials other than galvanized steel the reinforcing members shall be of the same material as the ductwork.

The use of button punching or snap locks on ductwork constructed of aluminum shall not be permitted.

Ducts carrying moist air that pass through areas that could cause condensation shall be pitched to facilitate condensate removal. Low points of such ducts shall be provided with drains.

Ductwork connections to units that require corrosion resistant coatings shall be made with flanges. Flanges shall be factory drilled before coating. Resilient washers suitable for the environment shall be used to protect the coating from the bolts in the flange. The use of self tapping screws or other fastening methods that will damage the coating are not acceptable.

3.2 HANGERS. Rectangular, Round and Flat-Oval Ductwork - Spacing and size of hangers shall be as recommended in the SMACNA standards except as noted in PART 2.

Install hangers plumb and securely suspended from supplementary steel or inserts in concrete slabs. Sufficiently thread lower ends of hanger rods to allow adequate vertical adjustment. Do not use building siding or metal decking to hang ductwork.

Ducts shall not be supported from furring, hung ceilings or from another duct or pipe.

C-clamp type hangers shall be supplied with a retainer strap.

Ductwork shall not come in contact with any of the ceiling construction or any other equipment in the ceiling cavity.

Duct support at flexible connections shall be adjustable for ease of aligning the duct to the piece of equipment.

3.3 SEALING OF DUCTWORK. General - Unless otherwise indicated, seal all ductwork joints and seams using sealant in accordance with the instructions of the sealant manufacturer and this Section. All transverse seams, joints and fitting connections, both shop and field assembled, shall be sealed in accordance with this Section. Longitudinal seams shall be sealed on all duct systems with a design operating pressure greater than 2-in w.g.

Application of Sealant - Thoroughly clean all seams, joints, etc, of dirt, oil, grease, or other coatings which might interfere with the adhesion of the duct sealant before the sealant is applied.

Uncured sealant may be forced into the slotted side of the seam or joint before shop or field assembly and the joint or seam completed while the sealant is still uncured. Excess sealant shall be removed from both the inside and outside of the duct before it sets.

Duct Tape - The use of duct tape alone for sealing ductwork is prohibited. Duct tape may be used primarily for the purpose of retaining the uncured duct sealant in seams and joints until it has cured. Duct tape shall not be applied to the inside of any duct nor shall it be applied to standing type joints at any time. All duct tape used shall be compatible with the sealant. The use of sealant saturated tape is acceptable when part of an integrated sealing system.

Sealant shall be either in liquid form or a mastic with a maximum flame spread of 25 and a maximum rate of fuel contributed and smoke developed of 50 when tested in accordance with ASTM E84, NFPA 255 and UL 723.

Sealing systems shall be suitable for the environment. The following schedule is to be used to select the sealant.

Indoor, dry galvanized round and rectangular duct is to be sealed with Iron Grip 601 or equal.

Indoor, dry, stainless steel, aluminum and PVC coated is to be sealed with FTA 20 adhesive and DT-Tape gypsum or equal.

All other areas unless otherwise noted are to be sealed with FTA 50 adhesive and DT-Tape gypsum or equal.

All sealers listed are manufactured by Hardcast Inc and are to define the type of sealer. Other equal sealants are acceptable.

3.4 DUCTWORK FITTINGS AND ACCESSORY ITEMS. Duct Elbows - Changes in direction and offsets shall be made in a gradual manner to facilitate streamline flow of air. All elbows shall have a centerline radius of not less than 1-1/2 times the width of the duct in the plane of the elbow. For rectangular ductwork where full radius elbows cannot be installed, provide abrupt elbows equipped with shop-installed turning vanes unless noted otherwise on the Drawings.

Flexible Fabric Connectors

Install flexible connectors for vibration isolation at all duct connections to fans, fan units or blowers, air handling units and air conditioning units. Make connections substantially airtight at all seams and joints.

Where the construction of the flexible connection or vibration isolator results in a cross sectional area of the connection which is less than 90 percent of the adjacent ductwork, the size of the connection shall be increased to provide a cross sectional area equal to or greater than 90 percent of the adjacent duct.

Provide flexible duct connections at both the intake and discharge connections for all fans and air handling units except as noted below.

Wall and roof fans that have integral motor/fan wheel isolation.

Air handling units where the fan is isolated from the intake and discharge connections by internal flexible connections or separations, and the unit is mounted without vibration isolators between the unit and the support structure.

Ductwork spacing and alignment for flexible connections shall be aligned to the tolerances of the flexible connection manufacturer, or plus/minus 1/4-in whichever is less. Bolts shall be torqued to the manufacturer's recommendations. Do not over tighten.

Where flexible connections are used as expansion joints, the manufacturer's precompression recommendations must be followed. When the temperature at installation differs from the temperature in the precompression recommendation, a correction shall be made.

Dampers

Install manual volume control dampers wherever it may be necessary to regulate air volume for system air balancing and where shown on the Drawings.

Install splitter dampers, where shown on the Drawings, to regulate air volume for system air balancing.

Install motorized and pneumatic actuated dampers when supplied by other trades.

Volume Extractors

Factory-fabricated volume extractors shall be installed at all main duct takeoffs to supply air diffusers.

Access Doors

Hinged access doors shall be installed where listed below, wherever shown on the Drawings and wherever access may be required for service, maintenance and adjustment.

Provide access doors at the following locations (minimum requirements):

Coils in ducts - both entering and leaving side.

Motorized or pneumatic actuated dampers - linkage side.

Duct mounted temperature controllers.

Freeze-stats.

Smoke detectors.

Plenums.

Fire dampers.

Smoke dampers.

Electric duct heaters.

Filter banks.

Manual dampers and splitters.

Inlet side of centrifugal fans.

Volume extractors.

As necessary or required.

Inlet and outlet ducts to fans and air handlers.

Where access doors are required in ductwork located above ceilings, coordinate the location of the access doors to clear the ceiling support system and to be accessible through the ceiling grid.

Duct Liner - Duct liner shall be shop installed on the interior surfaces of ductwork, where shown on the Drawings or as specified herein. Installation shall be made using a single thickness of duct liner and shall be in accordance with Duct Liner Application Standard by SMACNA. Liner shall be adhered with adhesive having a minimum of 90 percent coverage. Fasteners shall be spaced in accordance with SMACNA. After the duct has been formed the leading edges of the insulation that will be abutting another lined duct shall be spray-coated with fire-resistive adhesive. For ductwork with velocities exceeding 4000 fpm a metal nosing shall be installed at all transverse edges to secure the duct liner.

Blast Gates – Blast Gates shall be installed where shown on the Drawings. After final balancing of the system, drill a hole through both the frame and gate and insert a positive locking device, such as a pop rivet, to prevent moving the gate.

3.5 GRILLES, REGISTERS AND DIFFUSERS. The location of diffusers, registers and grilles shall be as shown on the Reflected Ceiling Plans and as shown on the ductwork drawings. The exact location of these devices shall be determined in the field in cooperation with the other trades. Install all devices in an approved manner in accordance with the manufacturer's recommendation.

3.6 FLEXIBLE DUCTWORK. Make connections, joints and terminations air tight as recommended by the manufacturer. Where joints are made to rigid sheet metal ductwork, apply 3M Company EC-800 sealer and the joint shall be drawn tight with a drawband. Collars shall be 2-in long minimum and sleeves shall be 4-in long minimum. Install flexible ducts with one duct diameter-radius elbows and cut as short as possible. Duct shall not be compressed and the length shall be kept short so minimum hangers or supports are required and static pressure losses are kept to a minimum. Sag in flexible duct shall not exceed 1/2-in/ft between duct supports.

3.7 FILLING IN SPACE AROUND DUCTWORK. To prevent sound passing through the area between the duct and the framed or cut opening in the floors, walls or partitions, pack mineral wool to completely fill the space the full depth of the opening. Whenever a fire-rated wall or floor is penetrated and a fire damper is not required, fill the space around the duct with a locally approved fireproof rope. At penetration, apply escutcheon plates on both faces of the wall to close the gap between the structure and the sides of the insulated or bare duct. Escutcheon plates shall be the same material as the duct for metal ducts and stainless steel for PVC ducts.

3.8 DUCT SUPPORTS AT FLOOR PENETRATION. Where vertical ducts pass through floor openings and a fire damper is not required, rigidly attach supporting angles to the ducts and anchor with expansion bolts to the floor or curb. Angles shall be of the same material as the duct for metal duct and stainless steel for PVC ducts, placed on the two long sides of the duct extending 3-in over edge of opening and shall not be less than the sizes recommended by SMACNA.

Remaining open area in the floor opening shall be sealed with a plate of the same material as the angle.

3.9 SUPPORTING OUTDOOR DUCTS. Roof top ductwork shall be installed using structural steel angles for support. Sizes of angles shall be as shown on the Drawings.

The vertical supporting angles shall be continuous full height of the duct and shall be bolted to same. Intermediate duct supporting angles and bottom plates shall be welded to the vertical angles. Weld all of these angles together to form a stiff continuous supporting unit for the duct. Paint angles with rust inhibitive primer after welding.

Slope ductwork to shed water.

3.10 DUCTWORK TERMINATIONS AT MASONRY OR CONCRETE. Where ducts terminate at masonry or concrete openings, place a continuous 2-1/2-in by 2-1/2-in by 3/16-in angle of the same material as the duct around the ductwork. Use stainless steel angles for PVC ductwork. Bolt the angle to the construction and make airtight by applying caulking compound on the angle before it is drawn down tight to construction.

Fasten plenums to concrete curbs with 3-in by 3-in by 1/4-in continuous angle. Concrete curbs are provided under another Division. Mount angle on a continuous bead of caulking compound and anchor to the curb on 16-in centers. Terminate duct at the curb and bolt to the angle. Seal the duct to the curb with a continuous bead of caulking compound. Apply neoprene filler strip to level curb surface as necessary

3.11 DUCTWORK GENERATED NOISE. All ductwork shall be free from pulsation, chatter, vibration or objectionable noise. After system is in operation, should these defects appear, correct by removing, replacing or reinforcing the work. No discreet tones will be allowed.

3.12 PLENUMS. Seal fresh air inlet and exhaust air plenums watertight at louvers or otherwise subject to water entrainment at all bottom joints and seams and up all vertical seams for a minimum of 12-in. Remove excess sealant before it sets hard. Where possible, pitch fresh air inlet and exhaust air plenums down towards the louver. Where it is not possible to pitch the plenum, provide a 1-in capped drain connection at the low point of the plenum.

3.13 TEST PORTS. Where shown on the Drawings and where required for testing and balancing, provide instrument insertion ports. Size and location of ports shall be coordinated with the Contractor performing air balancing. Seal ports with plastic snap lock plugs. When the ductwork will be insulated, extend the port to the face of the insulation and seal the vapor barrier to the port. When the ductwork is lined, extend the port into the duct to the inner surface of the duct liner.

In round ductwork provide 2 ports 90 degrees on centers. In rectangular ductwork provide ports as required by AABC or NEBB for a full traverse measurement.

As a minimum, ports shall be provided in the following connections:

All duct mains.

All duct branches unless all connections are diffusers, registers, or grilles and the total can be calculated by summing the readings for all of the connections.

All connections to tanks or hoods where there is no other access for taking a measurement.

A main duct is defined as one of the following:

A duct serving five or more outlets.

A duct serving two or more branch ducts.

A duct emanating from a fan or plenum.

All remaining ducts are considered branch ducts.

3.14 ADJUSTMENT. Start-Up and Temporary Operation

Properly maintain and service all equipment and systems until the particular equipment or the system has been accepted by the Owner.

3.15 PAINTING. Paint the outside face of all louver blank off panels and the interiors of unlined plenums and ductwork where connected to louvers. Prime and paint with two coats of flat black exterior paint. Painting shall be performed under this Section and shall be as specified in Division 9.

3.16 CLEANING OF DUCTWORK. Maintain all ductwork, fans, coils, air filters, outlets and other parts of the ductwork systems in a clean condition during installation. Clean complete ductwork systems prior to testing and air balancing. Secure cheese cloth over all openings of the ductwork system for entrapment of dirt during the cleaning operation.

3.17 INSTALLATION OF DUCTWORK INSULATION.

A.Provide ductwork insulation as specified under Section 15250 and with thickness as specified under this Section.

Ductwork Insulation - Blanket Type (Type I-5)

Hot Ductwork (Heating and Ventilation)

Insulation Thickness - Concealed round and rectangular hot ductwork.

Supply ducts in heated spaces 1-1/2-in

Supply ducts in unheated spaces 2-in

Return ducts 1-1/2-in

Mixed air ducts 1-1/2-in

Cold and Hot/Cold Ductwork

Insulation Thickness - Concealed round and rectangular cold and hot/cold ductwork and exposed round cold and hot/cold ductwork.

All ducts in non-conditioned spaces 2-in

All ducts in conditioned spaces 1-1/2-in

Outdoor air ducts and plenums 2-in

Exhaust air ducts and plenums between

shut-off damper and outdoors 1-1/2-in

Ventilation supply air ducts and plenums

between shut-off damper and outdoors 2-in

Ductwork Insulation - Fiberglass Board Type (Type I-6)

Hot Ductwork

Insulation Thickness - Exposed rectangular hot ductwork.

Supply ducts in heated spaces 1-1/2-in

Supply ducts in unheated spaces 2-in

Return ducts 1-1/2-in

Mixed air ducts 1-1/2-in

Cold and Hot/Cold Ductwork

Insulation Thickness - Exposed rectangular cold and hot/cold ductwork.

All ducts in non-conditioned spaces 2-in

All ducts in conditioned spaces 1-1/2-in

Outdoor air ducts and plenums 2-in

Exhaust air ducts and plenums between

shut-off damper and outdoors 1-1/2-in

Ventilation supply air ducts and plenums

between shut-off damper and outdoors 2-in

Ductwork Insulation - Closed Cell Foam Type (Type I-7)

Insulation Thickness

Outdoor mounted round and rectangular hot, cold and hot/cold ductwork.

All air ducts 2-in

Weatherproof all outdoor ductwork.

All ductwork, except as specifically noted below, shall be insulated unless approved in writing by the Engineer.

Exposed supply and return air ductwork located in the area it serves.

Exposed ventilation exhaust and relief ductwork located in the area it serves.

Exposed ventilation and relief ductwork located in areas that are neither heated nor cooled.

Exposed outdoor air intake ductwork and plenums located in areas that are neither heated nor cooled.
Return air ductwork located in return air ceiling spaces above the area it serves, except where the return ductwork is installed in ceiling spaces with a roof above.

End of Supplemental Section

SECTION 15950 - SUPPLEMENTAL

ELECTRIC AUTOMATIC TEMPERATURE CONTROL SYSTEM

PART 1 - GENERAL

1.1 SCOPE. Furnish and install a complete electric automatic temperature control system as manufactured by Honeywell, Inc., Johnson Controls, Andover Controls or equal. The automatic temperature control (ATC) shall be as specified herein and shall perform the functions specified and shown on the Drawings. The control system shall be installed by competent mechanics, technicians and electricians approved by the automatic temperature control manufacturer. The manufacturer shall be fully licensed at the time of bid to do business in the job site area for each type of subsystem. Wholesalers, contractors, franchisers, dealers, or any firm whose principle business is not that of manufacturing and installing DDC controls will not be acceptable. The manufacturer shall provide a system to meet requirements of NFPA-72A, 72B, 72C and 72D, and shall be listed by UL. Each component of the system shall be, where applicable, UL listed for the intended service. All materials and equipment used shall be standard components, regularly manufactured for this and/or other systems, and not custom designed especially for this project. All systems and components shall have been thoroughly tested and proven in actual use.

The control system shall consist of all thermostats, temperature transmitters, flow switches, flow elements, transformers, alarms, flow transmitters, local flow controllers, ionization type smoke detectors, automatic valves and dampers, damper operators, control panels, electric relays, and other accessory equipment along with a complete system of wiring and conduit to fill the intent of the specification to provide for a complete and operable system. All control equipment shall be fully proportioning, except as noted otherwise.

HVAC equipment remote monitoring coordinate with Owner's ovation facility management system contractor and fire alarm system contractor. Provide necessary equipment to achieve required control operation. Control sequences shall be as shown on the Drawings to be Automatic Temperature Control System. Coordinate with HVAC equipment manufacturers for controls furnished with the equipment.

1.2 RELATED REQUIREMENTS. The following shall be furnished and/or installed, under other sections:

Separable thermometer wells are included under Division 15.

All necessary valve pressure taps, water drain and overflow connections and piping are included under Division 15.

On magnetic starters the necessary auxiliary contacts, with buttons and switches in the required configurations are included under Division 15 and Division 16.

The necessary sheet metal baffle plates to eliminate stratification and provide air volumes specified is included under Division 15. Locate baffles by experimentation and affix and seal permanently in place only after stratification problem has been eliminated.

Access doors or other approved means of access through ducts for service to control equipment is included under other Sections.

The installation of the following shall be under Division 15:

Automatic valves. Section 15950

Automatic dampers. Section 15950

The following are to be furnished and installed under other sections of Division 15, but will be integrated with the work of this Section:

Air Handling Units Section 15855.

Centrifugal Fans Section 15860

Heating Equipment Section 15550.

1.3 SUBMITTALS. Submit, in accordance with Section 01080, shop drawings and product data for the following:

Control drawings with composite wiring diagrams, and description of operation for all systems.

Panel layouts and nameplates lists for all local and central panels.

Valve and damper schedules showing size, configuration, sizing, pressure vs. flow diagrams for the fluid used, capacity, and location of all equipment.

Data sheets for all control system components.

Provide a recommended list of spare parts to be provided.

Sequence of operation descriptions.

Technical specification data sheets of each system component and device with indication of its use.

Complete listing of deviations from the system as specified.

Training manuals for each of the subjects required to be covered in training to include teaching plans, duration of each class, and maximum size of each class are to be submitted for review a minimum of three months prior to starting training. The manuals are to be broken down into the material required for each of the various courses. The submittal shall also include supplemental materials that will be used in the class and copies of overheads or slides if they are not in the preceding material.

All submittals shall contain a statement that Section 15501, and all other Sections have been read and complied with. The certification statement shall be made by all of the following that are applicable; the Contractor, sub-contractor and the vendor. The statement shall be an individual statement for each party involved, and shall be included with every submittal and resubmittal. In general, corrections or comments or lack there of, made relative to submittals during review shall not relieve the Contractor from compliance with the requirements of the drawings and specifications. Submittals are for review of general conformance with the design concepts of the project and general compliance with the contract documents. The Contractor is responsible for the final design conforming and correlating all quantities and dimensions, selecting fabrication processes and techniques of construction, coordinating the work of all trades, and performing the work in a safe and satisfactory manner.

1.4 QUALITY ASSURANCE. The manufacturer must have a branch office facility with 50 miles of the project for at least 5 years, with technical staff and complete spare parts inventory and test and diagnostic equipment to keep systems in operation 24 hours per day 7 days per week. He/She shall have emergency service available in the local area for temperature control systems for which he/she is currently performing on-call emergency service 24 hours per day 7 days per week with a maximum response time of 4 hours. The automatic temperature control contractor shall have in his/her direct employ the personnel capable of detailed engineering, coordination, drafting, procurement, and expediting, scheduling construction, testing, inspection, installation, startup, calibration, and commissioning. The equipment to be furnished under this Section shall be essentially the standard product of the manufacturer. Where two or more units of the same class of

equipment are required, they shall be the product of a single manufacturer; however, all the component parts of the system need not be the products of one manufacturer.

Several manufacturers are indicated as acceptable for some items of equipment in these specifications. The contractor shall be responsible for determining that all equipment supplied for this project is suitable for installation and proper operation in the space provided with fully adequate operating and maintenance access space.

The equipment furnished for installation under this Section shall be tested at the factory as standard with the manufacturer of the equipment. Unless otherwise indicated, the controls shall maintain space temperatures within plus or minus 0.5 degrees F, and space relative humidity within plus or minus 5 percent of their set points. Inspection by the Engineer's representative or failure to inspect shall not relieve the Contractor of responsibility to provide materials and perform the work in accordance with the documents. The Owner and Engineer reserve the right to sample and test any materials after delivery and to reject all components represented by a sample that fails to comply with the specified requirements. All work to applicable codes and Owner's standard practice.

1.5 COORDINATION. All coordination responsibility is vested on the General Contractor.

1.6 DELIVERY, STORAGE AND HANDLING. All materials shall be inspected for size, quality and quantity against approved Shop Drawings upon delivery. Delivery schedule of all equipment shall be coordinated with the Contractor. Equipment ready for shipment prior to the agreed on shipping date shall be stored without cost to the Owner by the manufacturer. All materials shall be suitably packed for shipment and long term storage. Each package shall be labeled to indicate the project and the contents of each package. Where applicable, equipment numbers shall be marked on the container. Instructions for servicing and startup of equipment in long term or prolonged storage shall accompany each item. All materials shall be stored in a covered dry location off of the ground. When required to protect the materials they shall be stored in a temperature-controlled location.

1.7 ENVIRONMENT. All components, including data processing equipment, shall be suitable for operating in a normal plant environment without requirements for special temperature and humidity control.

1.8 WARRANTY. Provide one gear part and labor warranty after the completion of the project. Meet the requirements of Section 01170.

1.9 SPARE PARTS. Spare parts shall include all special items on the manufacturer's standard list of spare parts. In addition to special items, the following spare parts shall be provided:

Furnish all special tools required for normal operation and proper servicing of the equipment.

Spare parts shall include all items on the manufacturer's standard list of spare parts and the following for each unit:

One complete set of gaskets for each sealed unit.

Provide a minimum of 1 or 5 percent of the total units rounded to the next full unit whichever is greater for each size and rating of the following components:

Thermostats

Humidistat

Thermometers

Pressure gages

Control relays

Damper operators

Valve operators

Control transmitters

Control transformers

Photo-electric type smoke detectors

Ionization type smoke detectors

Provide a minimum of 4 or 10% of the total units rounded to the next full unit whichever is greater for each size and rating of the following components:

Panel light bulbs

Fuses

Pack spare parts in containers suitable for extended storage without deterioration of the parts. Containers shall be clearly labeled designating contents, pieces of equipment for which intended and equipment identification numbers. Spare parts shall meet the requirements of Sections 01180.

PART 2 - PRODUCTS

2.1 MATERIALS. All products and materials used in this project shall be new and currently under manufacture and shall have been applied in similar installations for a minimum of two years. This installation shall not be used as a test site for any new products unless explicitly approved in writing. Spare parts shall be guaranteed to be available for a minimum of five years after the completion of the project.

2.2 ATC EQUIPMENT. Area Classification - Where specific area classifications are called for or shown on the electrical drawings, all equipment and wiring shall be in conformance with the requirements for that classification. Special attention shall be given to hazardous areas specifically "Class I, Group D, Div. 1" and "Class I, Group D, Div. 2" to comply with code requirements for equipment selection and installation procedures. The type of enclosure shall be as specified in Division 16.

Room Thermostats - Temperature sensors shall be provided with concealed adjustment, exposed thermometer for displaying room temperature. All temperature sensors shall have an end to end (element to readout display) accuracy of plus or minus 0.5 degree F. Temperature sensors shall be of the wire-wound resistive element type (RTD) using either nickel or platinum alloy as the resistive element. All temperature sensors shall have an end to end (element to readout display) accuracy of plus or minus 0.5 degree F. Thermostats shall be of the heavy duty all metal type 24 volt, provided with concealed adjustment and exposed thermometer. Provide rugged clear plastic-locking cover and steps of control as required. Room thermostat and temperature sensors mounted on exterior walls shall be provided with insulated mounting plates. All room thermostats and sensors shall be mounted 4-ft-0-in above finish floor except where otherwise indicated on the Drawings or specified herein or as required by code. Electric thermostats in corrosive areas shall be installed in electric boxes with remote stainless steel bulbs.

Low Temperature Duct Mounted Safety Thermostat - Electric low temperature thermostats shall be duct mounted probe type. These thermostats shall be two-position with manual reset.

High Temperature Safety Thermostat - Electric high temperature thermostats shall have a bimetal type sensing element with at least a 10-in insertion length. These thermostats shall be two-position manual reset type.

Static Pressure Sensors - Shall be adjustable, set point proportional type, with adjustable range in inches of water to meet the performance or function specified.

Ionization Type Smoke Detectors (Four Wire Type)

Furnish and install ionization type smoke duct detectors downstream of the air filters and ahead of any branch connections in air supply systems wastewater process areas as shown on the Drawings and having a capacity greater than 2,000 cfm. In addition, furnish and install ionization type smoke detectors all exhaust systems serving wastewater process areas as shown on the Drawings and having a capacity greater than 2,000 cfm. Smoke detectors shall also be installed where shown on the Drawings and where called for on the control sequences.

Duct smoke detector shall be suitable for expected air velocity range, temperature range, humidity range, and contaminant range in the airstream as indicated on the associated HVAC Equipment Unit Schedules. The detector housing shall be listed per UL 268A specifically for use in air handling systems. The detector housing shall be equipped with an integral mounting base capable of accommodating either photo electronic or ionization detector heads. It shall be capable of local testing via remote testing station. The duct detector housing shall incorporate an airtight smoke chamber in compliance with UL 268A, Standard for Smoke Detectors for Duct Applications. The housing shall be capable of mounting to either rectangular or round ducts without brackets. An integral filter system shall be included to reduce dust and residue effects on detector and housing, thereby reducing maintenance and service. Detectors shall be provided with two sets of DPDT 10 amp dry contacts in the smoke detector housing to provide smoke alarm signals. One contact is to be used by the ATC systems, and the second is for use by Division 16 for interface to the fire alarm systems.

Remote test switch and alarm indicator stations shall be furnished for all duct smoke detectors as specified above. The installation and wiring of the remote stations will be provided under this Section. The remote test stations shall be wall mounted within the visible location of the smoke detector and easily accessible from the floor.

Motorized Control Dampers - Source Quality Control: Motorized dampers for air intake shall allow a maximum air leakage of 5 cfm per square foot at 4 inches water gage static pressure. Design for maximum 6 inches water gage static pressure differential and 4,000 feet per minute approach velocity.

Type: Parallel Blade similar to Ruskin CD36.

Reference: SMACNA Standards.

Construction: Tight seal ultra low leakage construction.

Galvanized steel

Blades

Blade Shafts: 1/2-inch plated steel

All stainless steel construction where shown

Provide thermal blade edge seals for air tight damper closure.

Blade ends shall be sealed with spring loaded continuous strips fastened to frame.

Bearings: Bearings at each end of shaft.

Blades to be designed for minimal resistance to air flow.

Linkage brackets, connecting rods an mounting hardware. Provide bird screen where required.

Approved Manufacturer shall be:

Ruskin

Louvers and Dampers

American Warming

Arrow

or equal

Electronic Damper Actuators - Electronic actuators, less than 600 in-lb of rated torque, shall have ISO 9001 quality certification and be UL listed under standard 873, CSA C22.2 No. 24 and have CE certification. Electronic actuators used on valves shall be designed to directly couple and mount to a stem, shaft or ISO style-mounting pad. Actuator mounting clamps shall be a V-bolt with a toothed V-clamp creating a cold weld, positive grip effect. Single point, bolt or single screw actuator type fastening techniques or direct-coupled actuators requiring field assembly of the universal clamp is not acceptable. Actuators shall be two position as required and be factory or field selectable. Actuators shall have visual position indicators and shall operate in sequence with other devices if required.

Two sets of DPDT switches with fully adjustable set points shall be provided to activate panel indicators and provide signals for equipment operation. Actuator shall have an operating range of minus 22 to 122 degrees F. Proportional actuators shall accept a 0 to 10 VDC or 0-20 mA input signal and provide a 2 to 10 VDC or 4-20 mA (with a load resistor) operating range. Actuators shall be capable of operating on 24, VAC and Class 2 wiring as directed by the application. Power consumption shall not exceed 10 VA for AC, including 120 VAC actuators and 8 watts per actuator for applications. Provide transformer as required. NEMA 2 rated actuators shall be provided with a three foot (minimum), prewired, electrical cable. Actuators requiring removal of the actuator cover for access to wiring terminals, exposing electronics, printed circuit boards to damage, are unacceptable. Actuators shall have electronic overload protection or digital rotation sensing circuitry to prevent actuator damage throughout the entire rotation. End switches to deactivate the actuator at the end of rotation or magnetic clutches are not acceptable.

For power-failure/safety applications, an internal mechanical spring return mechanism shall be built into the actuator housing. Spring return actuators shall be capable of CW or CCW mounting orientation. Spring return models >60 in-lb will be capable of mounting on shafts up to 1.05-in diameter. Spring return actuators with more than 60 in-lb of torque shall have a manual override metal crank. Upon loss of control signal, a proportional actuator shall fail open or closed based on the minimum control signal. Upon loss of power, a non-spring return actuator shall maintain the last position.

Actuators using “on-board” chemical storage systems, capacitors or other “on-board” non-mechanical forms of fail-safe operation are unacceptable.

Actuators shall be capable of being mechanically and electrically paralleled to increase torque if required. Dampers requiring greater torque or higher close off may be assembled with multiple low torque actuators. Dual mounted actuators using additional anti-rotation strap mechanical linkages, or special factory wiring to function are not acceptable. Actuators in a tandem pair must be “off the shelf” standard actuators ready for field wiring. Damper actuators will not produce more than 62 dbA when furnished with a mechanical fail-safe spring. Non-spring return actuators shall conform to a maximum noise rating of 45 dbA with power on or in the running or driving mode. Where special classifications are shown on the electrical drawings damper actuators shall be provided with suitable enclosures. NEMA 4X enclosures shall be as specified in Division 16 and shall have a shaft seal and all electrical connections shall be suitable for the space classification. Enclosure shall be UL listed.

Explosion-proof enclosure shall be suitable for Class I, II and III as specified in Division 16. A suitable shaft seal must be provided. Housing shall be cast copper fill aluminum with stainless steel fasteners and shall be UL listed. Housing shall be suitable for NEMA 4, 7 and 9.

Local Direct Digital Control (DDC) Panels - General: Local DDC panels shall be standalone microprocessor based, multi-tasking, multi-user, real-time digital control processors. Each local DDC panel shall consist of modular hardware with plug-in enclosed processors, communication controllers, power supplies, and input/output modules. A sufficient number of controllers shall be supplied to fully meet the requirements of this specification and the control functions. Local panel shall be capable of communicating with Owner's Ovation Facility Management system

Hardware Override Switches: As indicated in the control sequences, the operator shall have the ability to manually override automatic or centrally executed commands and reset alarms at the DDC panel via local, point discrete, onboard hand/off/auto operator override switches for binary control points and gradual switches for analog control type points. These override switches shall be operable whether the panel is powered or not.

Local Status Indicator Lamps: The DDC panel shall provide local status indication for each binary input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device. Indicator lights called for on the control sequence shall be on the face of the panel. Also provide audible alarm where shown.

Integrated On-line Diagnostics: Each DDC panel shall continuously perform self-diagnostics, communication diagnosis and diagnosis of subsidiary equipment. The DDC panel shall provide both local and remote annunciation of any detected component failures, or repeated failure to establish communication. Indication of the diagnostic results shall be provided at each DDC panel, and shall not require the connection of an operator I/O device.

Surge and Transient Protection: Isolation shall be provided at all network terminations, as well as all field point terminations to suppress induced voltage transients consistent with IEEE Standard 587-1980.

Power Failure Restart: In the event of the loss of normal power, there shall be an orderly shutdown of all standalone DDC panels to prevent the loss of database or operating system software. Non-Volatile memory shall be incorporated for all critical controller configuration data, and battery back-up shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours. Upon restoration

of normal power, the DDC panel shall automatically resume full operation without manual intervention.

All panels shall be provided with lugs, brackets or field supplied devices to allow the panel to be firmly fastened to the structure. The lugs, brackets or field supplied devices shall be sized to withstand the expected seismic loads for the area and type of application.

Miscellaneous Devices - Provide all the necessary relays, limit switches, positioners, valves, clocks, transformers, etc, to make a complete and operable system. Locate these devices on local ATC panel unless specified otherwise.

Set points on thermostats, temperature controllers, humidistats, humidity controllers and static pressure controllers shown on the Drawings are indicative only and devices shall be adjustable above and below such set points. If a set point is not stated, the control range of devices shall be suitable for the intended service. Range of devices shall be approximately 50 percent greater in both directions than span of variable, with a minimum of 25 degrees and a maximum of 100 degrees F for air systems. Thermometers - Thermometers shall be flush mounted on local panels. These thermometers shall be of the dial type, minimum 3-in diameter.

Flow Switches and Sensors - Duct air flow elements for modulating control shall be of the multipoint, self-averaging pitot tube, differential pressure type. Each element shall have air straightening vanes. These elements shall be fabricated of heavy-gauge, galvanized steel welded casing with 90 degree connecting flanges in a configuration and size equal to that of the duct it is mounted into. The maximum allowable unrecovered pressure loss through the element shall not exceed 0.065-in w.c. at 1000 fpm. Element accuracy shall be plus or minus 1 percent of actual flow rate over the flow range. Repeatability shall be plus or minus 0.1 percent of the actual flow rate over the flow range. Rangeability shall be guaranteed to meet flows as specified. Flow switches for clean air applications to include supply and makeup air systems shall be adjustable differential pressure type with an adjustment range suitable for the application including pressure range, temperature range, and expected containment range. Switches shall be arranged for sensing system velocity pressure through the use of a pitot tube arrangement. Pitot tubes shall be accessible and removable for inspection and maintenance without disturbing wiring connections or transmitters. Tube shall be stainless steel. Flow switches for general HVAC exhaust applications shall be vane (paddle) type switches suitably selected for the expected duct velocity, pressure range, temperature range, humidity range, and expected contaminants in the air stream. Positioned in the ductwork to be accessible and located so as to avoid nuisance tripping and unreliable operation due to flow turbulence. Vane and vane blocks shall be Type 316 stainless steel.

Switches and control wiring shall be arranged so switch is easily removable from ductwork to permit vane inspection, without disconnecting the wiring.

Thermal dispersion flow sensors shall be set and calibrated after air balancing has been completed. Unless otherwise noted, the set points for high or low shall be plus/minus 10 percent. For high high, or low low shall be plus/minus 15 percent. When the sensor has a varying speed response for start up and shut down, the shorter time response shall be used for the system alarm or shut down signal.

Where specifically called for on the Drawings or in the control sequences, current measuring devices shall be used for flow monitoring. Devices shall measure the actual current for the fan motor and compare it to a predetermined range. The range is to be determined by measurement during system balancing. The use of sensors that only respond to a condition of current or no current are not acceptable.

Electronic Sensors - All mixed air and coil discharge sensors shall utilize industry standard 4-20 mA sensors with averaging elements. Sensing elements shall be a minimum of 25-ft and temperature sensed shall be averaged over the entire length of the element. Thermistor type sensors will not be acceptable for this application. Space type sensors shall have an accuracy of plus/minus .5 degrees over sensed temperature range (20 to 120 degrees F).

Well type sensors used for liquid immersion shall have stainless steel removable wells. Sensing element shall have an accuracy of plus/minus .5 degrees over range (70 to 220 degrees F or 20 to 120 degrees F) of the sensor. Each sensor shall have a suitable electrical box to enclose all wiring connections.

Temperature control wells shall be installed according to manufacturers recommendations.

2.3 ELECTRIC WIRING. All field wiring (other than power wiring) between control cabinets, control devices, unitary control panel and control terminals in motor control centers shall be furnished under this Section and shall conform to the requirements of Division 16. Wiring to suspended and cabinet unit heaters and their thermostats shall be considered power wiring. All interlocking wiring within MCC shall be done by Division 16. Refer to the electrical drawings for NEMA enclosure types.

Installation of all conduit, wire, sleeves, outlet boxes, insulating bushings, system cabinets, terminal boxes, pull boxes, junction boxes, inserts, anchors, system devices, etc, shall be in accordance with the appropriate requirements of Division 16, and in accordance with sections of the current edition of the local codes for signal systems and electrical systems.

Wiring shall be run in rigid steel conduit except in dry locations above ceilings and wood or metal stud framed partition walls, where EMT may be used. Conduit, boxes and fittings and their installation and testing shall be as specified in Section 16110.

In the event of any conflict among referenced codes, current editions of the applicable local codes shall take precedence for interpretation of "Signal System" installation requirements.

Installation of sensor wiring in finished areas shall be concealed whenever possible. Where concealed wiring is not possible, written approval for exposed work must be obtained from the Engineer prior to installation.

A power supply 115V, single phase, 60 Hz, 20 Amp circuit for ATC, requirements will be taken from local control panel. Power shall not be taken from the control power transformers of the motor control center. All low-voltage wiring shall meet NEC Class 2 requirements. (Low-voltage power circuits shall be subfused when required to meet Class 2 current limit.) All wiring in mechanical, electrical or service rooms or where subject to mechanical damage shall be installed in conduit at levels below 10-ft. Do not install Class 2 wiring in conduit containing Class 1 wiring. Boxes and panels containing high voltage wiring and equipment may not be used for low voltage wiring except for the purpose of interfacing the two (e.g., relays and transformers).

All wire to device connections shall be made at a screw type terminal block or screw type terminal strip. All wire to wire connections shall be at a screw type terminal block. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals. All wiring shall be installed as continuous lengths, with no splices permitted between termination points. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations. Size of conduit and size and type of wire shall be the responsibility of the Contractor, in keeping with the manufacturer’s recommendations and code requirements, except as noted elsewhere. Include one pull string in each conduit (1-in) or larger. Use coded conductors throughout with conductors of different colors.

Control and status relays are to be located in designated enclosures only. These enclosures include packaged equipment and control panel enclosures unless they also contain Class 1 starters.

Conceal all conduits, except within mechanical, electrical or service rooms. Install conduits to maintain a clearance of 6-in from high temperature equipment. Secure conduits with conduit clamps fastened to the structure and spaced accordingly to code requirements. Conduits and pull boxes may not be hung on flexible duct strap

or tie rods. Conduits may not be run on or attached to ductwork. Comply with Division 16 requirements where conduit crosses building expansion joints. Install insulated bushings on all conduit ends and openings to enclosures. Seal top end of all vertical conduits. The Contractor shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site. Flexible metal conduits and liquid tight, flexible metal conduits shall not exceed 3-ft in length and shall be supported at each end. Flexible metal conduits less than 1/2-in electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid tight, flexible metal conduits shall be used. Conduits must be rigidly installed, adequately supported, properly reamed at both ends and left clean and free of obstructions. Conduit sections shall be joined with couplings (according to code). Terminations must be made with fittings at boxes.

PART 3 - EXECUTION

3.1 INSTALLATION. The Contractor shall not install any equipment or materials until the Owner and Engineer have approved all submittals. If any equipment or materials are installed prior to approval of the submittals, it shall be at the Contractor's risk.

3.2 INSTRUCTION AND ADJUSTMENT. Upon completion of the project:

Completely adjust and calibrate, ready for use, all thermostats, valves, damper operators, relays, thermometers and recorders, etc, provided under this Section.

Furnish four instruction manuals covering the function and operation of the control and automation systems on the project for the use of the Owner's operating personnel. A competent technician shall be provided for a period of 16 hours for instruction purposes.

The system contractor shall provide complete system documentation at acceptance time, as specified herein. Documentation shall be provided in four sets, unless otherwise elsewhere in this Section. Documentation shall include the following:

> All data specified in the Paragraph 1.03 above, in its final as-built approved form.

As-built interconnection wiring diagrams, or wire lists, or list of the complete field installed system with complete, properly identified, ordering number of each system component and device.

3.3 CONTROL SEQUENCES. HVAC equipment will operate with the sequences of operation shown on the drawings. The following will apply to all sequences.

All sequences are reversible unless otherwise noted.

Manual reset of control functions with manual reset will be at the local control panel unless otherwise noted.

Where required to prevent nuisance shut downs of systems, provide time delay of sensors to allow system start up before the sensors are activated. This would include, but not be limited to low temperature freeze protection on 100 percent outdoor air units.

The ATC contractor shall provide all connections, relays and other devices required to operate the system under the control of the firefighter control panel.

End of Supplemental Section

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SECTION 15991 – SUPPLEMENTAL

HVAC SYSTEMS TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 SCOPE. Furnish the necessary labor, materials, instruments, transportation and devices required and test, adjust and balance the total heating-ventilating-cooling systems and air systems. Each as specified and detailed herein, or as required to cause the systems to perform in accordance with the intent of the Drawings and this Section.

Testing, balancing and operation of the systems shall be performed by competent and experienced personnel, having formerly done similar work and whose qualifications and performance shall be subject to the approval of the Engineer. Test and balance air and water system and submit testing and balancing reports to the Engineer for review and approval. Re-balance when required by the Engineer, incorporating all changes and certify the systems have been tested and balanced to meet specified requirements. The tests shall demonstrate the specified capacities and operation of equipment and materials comprising the systems. Such tests other than as described herein, which are deemed necessary by the Engineer to indicate the fulfillment of the Contract, shall be made.

When the work includes modifications to existing systems, the entire system including existing portions shall be rebalanced. Where capacities of existing components are not shown as changed, the original capacities shall be used for balancing. Data required by this Section shall receive complete approval before final payment is made.

If, in the opinion of the Engineer, the Contractor has not, will not, or cannot comply with the testing, balancing and adjusting requirements of this Section, he may advise the Owner to employ a qualified firm to perform such work at Contractor's sole expense.

1.2 SUBMITTALS. Submit, in accordance with Section 01080, the following:

Qualifications and experience information and data as detailed under Paragraph 1.3.

Proposed testing schedules and procedures.

Preliminary draft "system" balancing reports as systems are completed and tested.

Final systems and Project balancing reports as final system adjustments are made as systems are accepted by the Owner.

All submittals shall contain a statement that Section 15501, 15991 and all other Sections have been read and complied with. The certification statement shall be made by all of the following that are applicable; the contractor, manufacturer or testing engineers. The statement shall be an individual statement for each party involved, and shall be included with every submittal and resubmittal.

In general, corrections or comments or lack there of, made relative to submittals during review shall not relieve the Contractor from compliance with the requirements of the drawings and specifications. Submittals are for review of general conformance with the design concepts of the project and general compliance with the contract documents. The Contractor is responsible for the final design conforming and correlating all quantities and dimensions, selecting fabrication processes and techniques of construction, coordinating the work of all trades, and performing the work in a safe and satisfactory manner.

1.3 QUALITY ASSURANCE. Qualifications standards for this work - Affiliation with manufacturers, installing contractors or engineering firms will not preclude acceptability. Submit qualifications within 60 days after Contract award. Membership in the AABC or NEBB for air and water testing is required. Testing and balancing shall be performed by the Owner approved Independent Agencies. Contractor shall submit, the Independent Agencies credential, to the Owner for approval.

The balancing contractor shall be prepared to submit credentials and other evidence of qualifications, and work experience, following receipt of, but prior to award of filed subbids.To perform required professional services, the balancing agency shall have a minimum of two test-and-balance engineers certified by the AABC or NEBB. This certified test-and-balance engineer shall be responsible for supervision and certification for the total work specified herein. The balancing agency shall submit records of experience in the field of air balancing or any other data as requested by the Engineer. The supervisory personnel for the firm shall have at least 5 years experience and all the employees used in this project shall be qualified technicians in this specific field.

The balancing agency shall furnish all necessary calibrated instrumentation to adequately perform the specified services. An inventory of all instruments and devices in possession of the balancing agency may be required by the Engineer to determine the balancing agency's performance capability.

1.4 SCHEDULE AND PROCEDURES. A complete schedule of balancing procedures for each of the buildings or systems shall be submitted in sufficient time in advance so that the Engineer might arrange to observe these procedures as they progress. Before commencing with the balancing of the systems submit the methods and instruments proposed to be used to adjust and balance the air and water systems. Submit proposed testing programs at least 2 weeks prior to the scheduled test to assure agreement as to personnel and instrumentation required and scope of each testing program.

1.5 DRAWING REVIEW. The balancing organization shall thoroughly review the location of all fresh air dampers, return dampers, spill dampers, quadrant dampers, splitter dampers, bypass dampers, face dampers, fire dampers, registers, grilles, diffusers, VAV boxes, troffers, etc. The purpose of the review is to finalize the optimum locations for dampers, test ports and balancing valves shown on the

1.6 EQUIPMENT CURVES. Fan Characteristics Charts: The Contractors shall provide to the Balancing Organization any required characteristic curve charts for all fans to include air conditioning units and air handling units. Characteristic curve charts shall be not less than 8-1/2-in by 11-in and shall show the static pressure, capacity horsepower and overall efficiency for operating conditions from no load to 130 percent of specified load. The minimum size of the actual fan curve shall be no less than 6-in by 8-in. The use of faxed copies of curves is not acceptable.

1.7 GUARANTEE. The balancing work shall be guaranteed to be accurate and factual data, based on readings in the field. All typewritten data shall be submitted within 14 working days of the performance of the test. Test data shall not be held until final completion, but shall be submitted on an interim basis as soon as the test or appropriate groups of tests are finished.

PART 2 - PRODUCTS

2.1 MATERIALS. Furnish gaskets, lubricants and other expendable materials required to be replaced during the execution of this work. Fixed-pitched pulleys required for fan adjustments shall be furnished on an exchange basis by the party responsible for the fan installation. Where test results indicate that air quantities at any system fan are below or in excess of the specified amount, the Contractors, at their own expense, shall change driving pulley ratio or shall make approved changes to obtain the specified or scheduled air quantities. Testing apparatus: Furnish plugs, caps, stops, valves, pumps, compressors, blowers and similar devices required to perform this work. Furnish anemometers, thermometers, gauges, voltmeters, ammeters, lachometers and similar instruments, not part of the permanent installation, but required to record the performance of the equipment and systems.

Testing apparatus, not part of the permanent installation, shall remain the property of the Contractor, but made available to the Engineer.

Instruments used for testing shall be certified accurate to within plus or minus 0.10 degrees F for temperature or plus or minus 0.10-in wc for pressure. Calibration of the instruments shall be done within 7 days of testing for this project and henceforth every 30 days thereafter for the duration of the testing period. Certification of calibration shall be submitted to the engineer prior to starting the work.

2.2 TESTING REPORTS. Forms: Furnish test report data on 8-1/2-in by 11-in bond AABC or NEBB form paper in accordance with Section 01300. Submit format for recording data and receive approval prior to use.Reports shall be excel spread sheets format and shall be submitted in both hard copy and as a data file. The report shall contain the following general data in a format selected by the balancing agency:

Project number

Contract number

Project title

Project location

Project architect

Project mechanical engineer

Test and balance agency

Test and balance engineer

General contractor

Dates tests were performed

Certification

At a minimum, the report shall include:

Preface. A general discussion of the systems, any abnormalities and problems encountered. Instrumentation list. The list of instruments including type, model, manufacturer, serial number and calibration dates.

System Identification. In each report, the VAV boxes, zones, supply, return and exhaust openings and traverse points shall be numbered and/or lettered to correspond to the numbers and letters used on the report data sheets and on the report diagrams.

Prepare 11-in by 17-in single line diagrams or 12-in by 18-in half size drawings showing all duct systems indicating all terminal air outlets including diffusers, grilles and registers, perforated plates, nozzles and other types of air supply, exhaust or return outlets. The minimum scale for diagrams showing the measurement points shall be 1/8-in=1-ft-0-in in the final form as submitted. The use of faxed copies of diagrams is not acceptable. Location of test points shown on the diagrams shall be clear and easy to locate on the diagram. The identification mark of the test points shall be the same as is shown on the test report showing the test data. The identification for test points shall include indication of the units served, and shall not have a duplicate in the project. All supply outlets shall be adjusted so that there are no drafts. Grille and register readings may be made by a vane anemometer, but diffuser readings shall be made by a flow hood or a velometer, using the tip recommended by the diffuser manufacturer. Each test sheet shall include the following data:

Job name and address.

Name of HVAC Contractor.

Name of balancing organization.

Instruments used to perform the test.

Name of test technician or test engineer.

Fan system and/or zone number.

Room number or area name.

Size of outlet.

Type outlet.

Manufacturer of outlet.

The cfm at each outlet on system and corresponding cfm at each outlet as noted on the plans.

Percent deviation of the measured flow versus the design flow.

Indication of the branch and terminal that are the open/low that are the basis for balancing the remainder of the system

PART 3 - EXECUTION

3.1 START OF BALANCING. The General Contractor shall notify the Balancing Organization and Engineer when systems become operational and ready for preliminary and final testing, adjusting and balancing. Final balancing shall not begin until system has been installed complete and is capable of normal operation. Provide personnel to assist in rough balance and calibration. All grilles, dampers, fans, coils, pumps, valves and linkages shall be verified to be installed and operating. System shall be capable of operating under control as specified on Drawings and/or contained herein.

Visually inspect all fire dampers on branch take-offs to each floor to ensure that they are fully open.

Verify with straight edge that fan/pump and motor shafts are parallel and that sheaves are in proper alignment.

Verify that belts are properly tensioned when unit is operating with no excessive squeal at startup. If not correct, adjust sheaves or motor base accordingly.

Start fans and pumps, verify that rotation is correct. If rotation is incorrect coordinate with electrical contractor to switch power leads such that the motor rotates correctly.

Check nameplate voltage on motor, compare to scheduled voltage. Notify the Engineer immediately of any discrepancies. Measure and record actual voltage across all power leads. Notify the Engineer of discrepancies immediately.

Check motor nameplates full load amps, measure and record amperage across all power leads. If there are marked discrepancies in amperage draws between legs, notify the Engineer immediately. Measure and record fan/pump and motor rpm. Check that motor rpm agrees with nameplate and scheduled rpm.

If, upon commencing the work, the balancing contractor finds that the systems are not ready, or if a dispute occurs as to the readiness of the systems, the balancing agency shall request an inspection to be made by the Engineer. This inspection shall establish to the satisfaction of the represented parties whether or not the systems meet the basic requirements for testing and balancing. Should the inspection reveal the notification to have been premature, all costs for the inspection and work previously accomplished by the balancing agency shall be paid for by the General Contractor. Furthermore, such items that are not ready for testing and balancing shall be completed and placed in operational readiness before testing and balancing services shall be recommenced.

Leaks, damage and defects discovered or resulting from startup, testing and balancing shall be repaired or replaced to like-new condition with acceptable materials. Tests shall be continued until system operates without adjustments or repairs.

3.2 REQUIRED ACCURACY. Systems shall be balanced to be within the following limits of the capacity shown on the Drawings. Limits shall be applied to both individual components and to the system totals. General Systems (plus/minus 10 percent).

3.3 TESTING. HVAC Air Systems: Balance the supply return and exhaust air systems in accordance with AABC or NEBB Standards by the use of direct reading instruments such as an "anemotherm" or velometer which has been properly calibrated. Temporarily add static pressure to the system, to simulate the effect of dirty filters, by blanking off portions of the filter section, covering filter section with cheesecloth or other suitable means. Confirm static has been added with new static pressure reading across fan. Remove cheesecloth, etc, after traverses are complete.

The sequence of air balancing shall be as follows:

First, establish air flow quantity at supply fan by main duct traverse.

Next, establish air flow quantities in main ducts and branches.

Finally, establish air flow quantities at outlets, using proportional balancing among branch outlets. All multiple opening systems shall be left with at least one "open low" inlet or outlet, to which all other system openings shall be proportionally balanced. The "open low(s)" on each system shall be indicated in the report. After all outlets are adjusted to within the tolerances specified elsewhere in this Section, remeasure all system outlets, and retraverse all branch and main ducts to establish final "as balanced" flows. All main air ducts shall be traversed, using a Pitot tube and manometer. The manometer shall be calibrated to read two significant figures in all velocity pressure ranges. The static pressure reading at the traverse point shall be recorded for each successive traverse. A main duct is defined as either of the following: A duct serving five or more outlets. A duct serving two or more branch ducts. A duct emanating from a fan or plenum. All other ducts are branch ducts. The intent of this operation is to measure by traverse, the total air quantity handled by the fan and to verify the distribution of air to zones and to adjust system pressure to minimum level required to satisfy the farthest air outlet. Adjust fan speeds if results of system capacity tests are not within tolerances specified and repeat Paragraphs 3.03A4c, d and e above, as required. Mark all final balancing damper positions with a permanent marker. For systems which modulate between different flow modes (e.g. minimum outside air to 100 percent outdoor air or 100 percent return air to 100 percent exhaust) measure and report system flow under both extremes of modulation and check for excessive system flow deviation above design, when system is modulating between its end points.

Furnish data in Excel spread sheet format tabulating the following:

Opening number, type, size and design flow rate.

Quantity of air in cfm at each air outlet and inlet.

Dry bulb temperature in each room.

Dry bulb temperature of the supply air.

Outdoor dry and wet bulb temperature at the time the above tests are conducted. (Wet bulb temperature only required for AC systems)

Adjust belts, sheaves and the alignment of air handling equipment. Where various combinations of sheaves must be installed on fan systems to achieve the correct air delivery, change the sheaves and continue to take successive readings until the correct combinations are installed. Furnish data in excel spread sheet format taken at each air moving device, to include fans, packaged units and air handling units, tabulating the following:

Manufacturers, model number and serial number of units.

All design and manufacturer's rated data.

Total quantity of supply air in cfm.

Total quantity of return air in cfm.

Total quantity of exhaust or relief air in cfm.

Total quantity of outside air in cfm.

Outlet velocity - fpm.

The rpm of each fan or blower.

Maximum tip speed - fpm.

The rpm of each motor.

Voltage and ampere input of each motor (one reading for each phase leg on 3 phase motors).

Pressure in inches w.g. at inlet of each fan or blower.

Pressure in inches w.g. at discharge of each fan or blower.

Pressure drops across system components such as louvers, filters, coils and mixing boxes.

Submit the actual fan operating point on a copy of the fan shop drawing showing operating curve. List the following data from all fan motors installed.

Manufacturer model and size.

Motor horsepower, service factor and rpm.

Volts, phases, cycles and full load amps.

Equipment locations.

Electric Heating Coils

3.4 STANDBY EQUIPMENT. Where systems are provided with standby equipment, the system shall be balanced for operation in standby as well as normal operation.

3.5 FINAL ACCEPTANCE. At the time of final inspection, the balancing agency shall recheck, in the presence of the Engineer, specific and random selections of data recorded in the certified test-and-balance report. Points and areas for recheck shall be selected by the Engineer. Measurements and test procedures shall be the same as the original test and balance. Selections for recheck, specific plus random, shall not normally exceed 15 percent of the total number tabulated in the report, except where special air systems require a complete recheck for safety reasons.

Specific systems for recheck shall include the following:

Supply and exhaust in chemical storage areas

If the specific rechecks are more than 5 percent deviation from the report or specified flows, all of the systems, that require specific recheck, shall be rebalanced. If 5 percent or 5 of the random checks, which ever is less, exceeds a 10 percent deviation from the specified flows, the report shall be rejected. In the event the report is rejected, all systems shall be readjusted and tested, new data recorded, a new certified test-and-balance report submitted, and a new inspection test made, all at no additional cost to the Owner.

3.6 OPPOSITE SEASON TEST. The balancing agency shall perform an inspection of the HVAC system during the opposite season from that in which the initial adjustments were made. The balancing agency shall make any necessary modifications to the initial adjustments to produce optimum system operation.

End of Supplemental Section

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SECTION 16430 – PROVISIONAL

LOW VOLTAGE METAL ENCLOSED SWITCHGEAR

PART 1 - GENERAL

1.1 SCOPE. This section covers low voltage metal enclosed switchgear equipment that shall be furnished, installed, and tested as specified herein and as indicated on the drawings. Equipment shall meet the following requirements, and the design conditions and features as indicated.

Low voltage metal enclosed switchgear equipment shall meet the design conditions and features indicated.

Low voltage metal enclosed switchgear equipment shall be designated and shall be located as indicated.

1.2 GENERAL. Equipment furnished under this section shall be fabricated, assembled, and placed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

1.2.01 General Equipment Requirements. The General Equipment Stipulations in Master Specification Section 01180, Equipment, Materials, Parts, and Tools shall apply to all equipment furnished under this section.

1.2.02 Dimensional Restrictions. Layout dimensions will vary between manufacturers and the layout area indicated on the drawings is based on typical values. The supplier shall review the contract drawings, the manufacturer's layout drawings and installation requirements, and make any modifications required for proper installation subject to acceptance by Engineer. Working space in front of the unit substations shall meet the minimum requirements of the 2008 NFPA 70: National Electrical Code.

1.2.03 Workmanship and Materials. Equipment supplier shall guarantee all equipment against faulty or inadequate design, improper assembly or erection, defective workmanship or materials, and leakage, breakage, or other failure. Materials shall be suitable for service conditions.

All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable engineering and shop practice. Individual parts shall be manufactured to standard sizes and thickness so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate units shall be interchangeable. Equipment shall not have been in service at any time prior to delivery, except as required by tests.

1.2.04 Abbreviations. Reference to standards and organizations in the Specifications shall be by the following abbreviated letter designations:

ANSI	American National Standards Institute
AWG	American Wire Gage
FS	Federal Specifications
IEEE	Institute of Electrical and Electronics Engineers
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
UL	Underwriters' Laboratories

1.2.05 Governing Standards. All equipment to be furnished under this section shall be designed, constructed, and tested in accordance with the following standards:

ANSI C26.1 and NEMA LA1 (lightning arresters)

NEMA SG-5, and UL 1558 (low-voltage switchgear)

NEMA ICS 6 (enclosures)

The equipment shall also conform to all the applicable standards of ANSI, NEMA, UL, and NEC.

Equipment covered by this section shall be listed by UL or a nationally recognized third-party testing laboratory. All costs associated with obtaining the listing shall be the responsibility of Contractor. In the event no third-party testing laboratory provides the required listing, an independent test shall be performed at Contractor's expense. Before the test is conducted, Contractor shall submit a copy of the testing procedure that will be used.

1.2.06 Nameplates. When indicated, nameplates with unit description and designation of each control or indicating device shall be mounted on all hinged doors and rear cover plates. Nameplates shall have black baked enamel 3/4 inch (19 mm) high letters for section identity and 1/8 inch (3 mm) letters for other information on anodized aluminum plate.

Each control device and each control wire terminal block connection inside the units shall be identified with a permanent nameplate or painted legend to match the identification on the manufacturer's wiring diagram.

1.3 SUBMITTALS. Complete assembly, foundation requirements, and installation drawings, together with complete engineering data covering the materials used, parts, devices, and accessories forming a part of the substation, shall be submitted in accordance with Master Specification Section 01080, Project Submittals. The drawings and data shall include, but shall not be limited to, the following:

Elevation, plan, weight, and bill of material.

Single-line, control schematic, wiring connection, and wiring interconnection diagrams.

Circuit breaker time-current characteristic curves.

1.3.01 Operation and Maintenance Data and Manuals. Adequate operation and maintenance information shall be supplied. Operation and maintenance manuals shall be submitted in accordance with Master Specification Section 01160, Training and Operation & Maintenance Manuals.

Operation and maintenance manuals shall include the following:

Assembly, installation, alignment, adjustment, and checking instructions.

Lubrication and maintenance instructions.

Guide to troubleshooting.

Parts lists and predicted life of parts subject to wear.

Outline, cross section, and assembly drawings; engineering data; and wiring diagrams.

Test data and performance curves, where applicable.

The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered.

1.4 SHIPPING, STORAGE, AND HANDLING. All equipment shall be suitably packaged to facilitate handling and to protect against damage during transit and storage in accordance with the requirements of Master Specification Section 01180, Equipment, Materials, Parts, and Tools. All equipment shall be boxed, crated, or otherwise completely enclosed and protected during shipment, handling, and storage. All equipment shall be protected from exposure to the elements and shall be kept dry at all times.

Painted surfaces shall be protected against impact, abrasion, discoloration, and other damage. Painted surfaces that are damaged prior to acceptance of equipment shall be repainted to the satisfaction of Engineer.

Grease and lubricating oil shall be applied to all bearings and similar items.

Each item of equipment shall be tagged or marked as required. Complete packing lists and bills of material shall be included with each shipment.

1.5 SPARE PARTS. Spare parts shall be provided as indicated on the Contract Documents.

Spare parts shall be suitably packaged with labels indicating the contents of each package and shall meet all the requirements of Master Specification Section 01180, Equipment, Materials, Parts, and Tools.. Spare parts shall be delivered to Owner as directed.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS. The equipment shall be as manufactured by Square D, General Electric, Siemens Energy & Automation, ABB or approved equal.

2.2 DESIGN AND CONSTRUCTION. Each switchgear shall conform to the arrangement, one-line diagram, schematics, and requirements indicated on the drawings or specified herein.

2.2.01 Sills and Anchors. Contractor shall furnish steel channels, floor sills, and anchor bolts as required for proper installation.

2.2.02 Switchgear Construction. The switchgear section shall be a main-tie-main configured low voltage, metal-enclosed switchgear with draw-out type power circuit breakers. The sides and rear of the enclosure shall be covered with removable bolt-on plates. Bus bars shall be tin-plated copper with bolted connections at joints and sized for the ampere ratings indicated on the design drawings. The switchgear assembly including all breakers, buses, terminations and any other power distributing conductors shall be rated to withstand and interrupt an available fault current of 65,000 amps.

2.2.03 Busway Connections. The switchgear shall be furnished with provisions for connections to the 2500A metal enclosed busways providing power from the outdoor substation transformers to the main breakers in the switchgear. The Manufacturer shall coordinate the proper conductor phase connections between the transformer and the switchgear.

2.6.04 Draw-out Circuit Breakers. Low voltage draw-out power circuit breakers shall be provided in the frame ratings, quantities and configurations shown on the design drawings. Electronic trip units shall be provided with each breaker according to the requirements of subsection 2.6.04. Power monitoring devices shall be provided where indicated on the design drawings.

2.6.05 Electronic Trip Units. Each trip unit shall be supplied with a trip plug sized to the trip rating indicated on the design drawings. The trip units shall have adjustable time-overcurrent settings that include: long-time pickup and time delay, short-time pickup and time delay, and an instantaneous pickup capable of being turned off.

Each trip unit shall also be provided with ground fault protection with an adjustable pickup not exceeding 1200 A, and adjustable time delay. A neutral current transformer shall be included where required for proper ground fault protection.

Each breaker trip unit shall be capable of communicating the status of the breaker (Open/Closed/Tripped), trip settings and trip event data through the plant's existing process network using either a direct Ethernet connection or by sending the information through its associated power monitoring device as described in section 2.6.07.

2.6.06 Automatic Transfer System. An automatic transfer system shall be provided to facilitate automatic or manual operation of the main-tie-main configuration of the switchgear. The system shall be controlled through a PLC with a touch-screen

interface for manual control of the system. The transfer system shall be capable of monitoring the synchronization of the two main power feeds and performing a closed transition when safe to do so without damaging any equipment. The Owner shall be provided with backup copies and loading procedures for any software programs used to control or interface with the system.

2.6.07 Power Monitoring. Information from all power monitoring devices located within the switchgear shall be made available for communication through the plant's existing Ethernet process network utilizing an open data format compatible with the Ovation DCS system.

Each main and feeder breaker shall include power metering devices capable of measuring the voltage, phase currents, frequency, kilowatts, (kilo)watt-hours, power factor, total harmonic distortion, and the first seven harmonics as a minimum.

Trip units with integral power metering that are capable of providing all required functions listed in the paragraph above may be supplied for the feeder breakers. Separate power monitoring units shall be provided for the incoming feeds to the main breakers. If capable, the power metering units may be used to communicate information from their associated breaker's trip unit to the network.

2.6.08 Control/Auxiliary Power. The switchgear shall be provided with any automatic transfer, battery and/or UPS power systems required for proper operation of the switchgear. Power to any auxiliary systems within the switchgear should not be disrupted as long as power is available from one of the main incoming feeds. Backup battery systems shall be capable of supplying power for a minimum of eight hours to any devices required for maintenance, recovery or troubleshooting procedures.

2.8 SHOP PAINTING. All iron and steel surfaces, except machined surfaces and stainless steel, shall be shop painted with the manufacturer's standard coating. Finish color shall be ANSI 61 for indoor equipment, ANSI 61 or 70 for outdoor equipment, or another color as required. Field painting, other than touch up painting, will not be required. Quantities of coating material and thinner, as required, shall be furnished to permit field touch up painting of damaged coatings.

The underside of equipment installed in exposed outdoor locations shall be thoroughly cleaned and coated with an automotive type undercoating material. The coating shall be thick enough to withstand normal handling during shipping and installation. The underside is considered to be the surfaces in contact with the floor or pad and other surfaces not readily accessible for field painting.

2.9 SHOP TESTS. After the equipment has been completely assembled, it shall be shop tested for general operating condition, circuit continuity, high potential, and other standard tests for the particular class of equipment, as defined by industry standards.

PART 3 - EXECUTION

3.1 INSTALLATION. The equipment shall be installed in accordance with the drawing specifications and the manufacturer's recommendations.

3.2 FIELD QUALITY CONTROL.

3.2.01 Installation Supervision. When indicated, the equipment manufacturer shall furnish a qualified field installation supervisor during the equipment installation. Such services shall be included in the contract price. Manufacturers' installation supervisor shall observe, instruct, guide, and direct Contractor's erection or installation procedures as required. The equipment manufacturer will be provided with written notification 10 days prior to the need for such services.

3.2.02 Installation Check. An experienced, competent, and authorized representative of the manufacturer shall visit the site of the Work and inspect, check, adjust if necessary, set all relays in accordance with the settings designated in the coordination study, and approve the equipment installation in accordance with Master Specification Section 01180, Equipment, Parts, and Tools. The representative shall be present when the equipment is placed in operation. Such services shall be included in the contract price.

The manufacturer's representative shall furnish a written report certifying that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping or anchor bolts; and has been operated under full load conditions and that it operated satisfactorily.

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SECTION 17201 – SUPPLEMENTAL

REMOTE OPERATOR STATION (ROS)

PART 1 - GENERAL

1.1 SCOPE. This section covers the design, furnishing and installation of a new Remote Operator Station (ROS) to be located in Sludge Pumping Station #2 of DWSD's Waste Water Treatment Plant.

1.2 GENERAL. The items required to be provided under this section include all hardware, software, network connections and power feeds required for the complete integration of the new ROS into the existing system.

1.3 RELATED SECTIONS. The work and equipment provided under this section shall conform to the requirements of the following sections where applicable unless superseded by this section or the design drawings. The related specification sections include: Section 16050 – General Electrical Requirements, Section 17200 – Computer System Hardware, and Section 17250 – Computer System Hardware.

1.4 SUBMITTALS. Submittals shall be submitted in accordance with Section 01080 – Project Submittals and any additional requirements of the related sections listed above in paragraph 1.3.

PART 2 - PRODUCTS

2.1. MANUFACTURER. The Remote Operator Station (ROS) shall be a product of Emerson Process Control.

2.2. DESIGN REQUIREMENTS. The ROS shall be configured to work properly with DWSD's existing Ovation system. Additionally, selection of the ROS computer hardware, operating system, and network interface shall be compatible with any Ovation system or process network upgrades planned for the near future. All hardware and software shall be from Emerson Process Control's standard product offering or off-the-shelf products from a third-party manufacturer. All equipment supplied shall be the latest version available at the time of construction.

2.2.1. Equipment Enclosure. The ROS equipment shall be enclosed in a cabinet designed to protect the equipment from physical damage, electrical noise, and

unauthorized access. The cabinet door shall have a key lock on the handle matched to the keys used for the existing cabinets at the Waste Water Treatment Plant. Emerson Process Control shall design the cabinet to provide proper ventilation or cooling to meet the recommended environment temperature range for the equipment.

2.2.2. Computer System. The Remote Operator Station computer system shall be a rack mounted industrial computer with the following features:

- Intel based processor and chipset
- Microsoft Windows operating system
- CD-RW Drive
- USB ports that can be easily accessed with the enclosure door open
- 13” or larger rack mounted LCD monitor
- Industrial keyboard with integrated track-ball or pointing device

2.2.3. Process System Software. The ROS shall be provided with an installed licensed copy of the latest version of the Ovation operator workstation software compatible with the existing system.

2.2.4. Process Network Interface. Connection of the Remote Operator Station to the existing process network shall be provided through a network interface card and an external copper to fiber media converter. The network interface card shall be fully compatible with IEEE 802.3x standards for 10BaseT, 100BaseTX and 1000BaseT Ethernet communications. The media converter shall be capable of converting from the copper-based network interface card to the current fiber optic Ethernet process network at the plant. Connection between the network interface card and the media converter shall be provided through RJ-45 ports at each device connected with Cat-5e cable.

2.2.5. Auxiliary Equipment. Additional equipment provided with the ROS shall include:

- Door alarm switch
- Lighting
- Receptacles
- Terminal blocks

PART 3 – EXECUTION

3.1. INSTALLATION REQUIREMENTS. Equipment shall be installed as shown on the design drawings and according to the requirements or recommendations of Emerson Process Control.

3.1.1. Equipment Enclosure. The ROS enclosure shall be a pad mounted vertical enclosure installed in the location shown on the design drawings. Holes, conduits or other penetrations shall not be allowed through the top of the enclosure. All equipment located within the enclosure shall be securely mounted to the enclosure structure.

3.1.2. Wiring. All wires and cables within the ROS enclosure shall be neatly routed and secured in place utilizing raceways, cable ties, clamps or other devices intended for the purpose. Any wiring for electrical power or alarm circuit connections shall connect through a terminal block before exiting the enclosure. Electrical power for critical equipment such as the ROS computer, monitor, and media converter shall be supplied from the existing Ovation UPS located in the Sludge Pumping Station #2 Control Room. Power for auxiliary lighting and receptacles shall be provided through a separate lighting panel circuit as designated in the design drawings. The door alarm switch shall be wired into the existing alarm circuit for the RIO and UPS cabinet door alarms.

3.1.3. Process Network Connection. The ROS shall be connected to the process network using the existing spare fiber optic cable available in the RIO cabinet.

3.2. Process System Software. The Ovation system software installed in the new ROS shall be configured to have capabilities identical to the existing ROS located in Sludge Pumping Station #1. Control strategy and existing methods of remote and local operations shall be maintained.

End of Section

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