

February 8, 2008

MECHANICAL- DIVISION 1500

ELECTRICAL- DIVISION 1600

PROJECT MANUAL

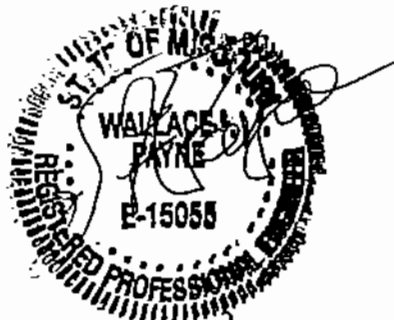
FOR

OAKTON, UNITED METHODIST CHURCH

CLASSROOM ADDITION FOR:

OAKTON UNITED METHODIST CHURCH

OAKTON, MISSOURI



8/FEB/08

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State of Missouri

#1



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SECTION 15050

BASIC MATERIALS AND METHODS

PART 1

1.1 SECTION INCLUDES

- A. General Conditions,
- B. Supplementary Conditions
- C. Division 1
- D. Mechanical basic requirements.
- E. Electric Motors.
- F. Pipe, Valve, & Equipment Identification.
- G. Pipe Hangers & Accessories
- H. Access Boxes & Panels
- I. Vibration Isolators
- J. Flashing & Sleeves
- K. Painting of Equipment

1.2 SYSTEM DESCRIPTION

- A. Provide complete and fully operational systems with facilities and services to meet requirements indicated and in accord with applicable codes and ordinances.

1.3 REGULATORY REQUIREMENTS

- A. Fire Protection: Conform to NFPA 13.
- B. Plumbing: Conform to latest International Plumbing Code (International Code Council, ICC)
- C. Obtain permits, and inspections from authority having jurisdiction.
- D. HVAC: Conform to latest International Mechanical Code (International Code Council, ICC), NFPA 90A (Air Conditioning & Ventilating Systems) and NFPA 90B (Warm Air Heating & Air Conditioning Systems).
- E. Conform to all Local, City, & State codes as well as requirements of Fire Marshall, governmental agencies and Fire Rating Bureau having jurisdiction.

1.4 SUBMITTALS

- A. Submit under provisions of Division 01000 (Section 01001).
- B. Submit shop drawings and product data grouped to include complete submittals of related systems, Products, and accessories in a single submittal.
- C. Mark dimensions and values in units to match those specified.

PART 2 PRODUCTS

2.1 ELECTRIC MOTORS

- A. Each contractor to provide motor starters and transfer switches for motors & pumps under their contract.
- B. Electric Service: Refer to Division 16000 for required electrical characteristics.
- C. Motors: For continuous operation in 40 degrees C environment, and for temperature rise to ANSI/NEMA MG 1 limits. Motor will operate satisfactorily without failure for a period of two (2) hours or more at ambient temperature of 120 °F & with a minimum service factor of 1.5.
- D. Single Phase Motors: Split phase, Permanent split capacitor, or Capacitor start as required.
- E. Three Phase Motors: Squirrel cage motors to ANSI/NEMA MG 1 Class B, high efficiency type with thermistor system for motor frame sizes 254T and larger, ball bearings.
- F. Motors to be squirrel-cage type drip-proof enclosure unless otherwise indicated, constant speed, & across-the-line normal starting torque designed for quiet operation. Where T-frame motors are used, oversize motor by at least 10%.
- G. Motors to be sized to develop the required brake horsepower & to operate satisfactorily with a

voltage variation of $\pm 10\%$, conforming to NEMA motor standards, dynamically balanced, & held to commercial tolerance.

2.2 PIPE, VALVE, & EQUIPMENT IDENTIFICATION

- A. Equipment Nameplates: Laminated three-layer plastic (Bakelite) with engraved black letters on light background color. Or aluminum with etched or engraved lettering on black background. 2.5"x.75" size, securely fastened to the equipment.
- B. Valve Tags: 18-gage polished brass, 1.5" in diameter & stamped for the appropriate service in .25" backfilled letters & stamped with 1.75" brass S-Hook.
- C. Pipe Labels: Plastic clamp on legend & arrows, indicating contents of pipe & direction of flow. Identification shall be color coded per A-13.1 "Scheme of Identification of Piping Systems."

2.3 PIPE HANGERS AND ACCESSORIES

- A. Manufacturers: Equal Fee & Mason
- B. Locations and Models:
 - 1. Water & Hydronic piping - #212 split ring hangers with support rods & Semco "Isolators".
 - 2. Soil & Waste piping - #212 adjustable ring hangers with support rods & #241 riser clamps at each floor and as required.
 - 3. Gas piping - #212 split ring hangers with support rods.

2.4 ACCESS BOXES & PANELS

- A. Walls: Equal Smith #4730 or Josam #8650 with polished chrome plate face in tile walls. Equal Smith #4730-AKL, or Josam #SLA or #SLB, with bonderized prime-coated steel face & Allen lock in walls of other finished rooms.
- B. Ceilings: Equal Acom #8211-3-AKL or Josam #SLA bonderized prime-coated steel face with Allen lock.
- C. Floors: Equal Smith #4910 or Josam #8630-5 with XH plain aluminum or nickel-bronze non-skid top. Equal Smith #4920 for floors covered with vinyl reinforced or pure vinyl tile.
- D. Yard Boxes: Equal Brooks 36 HF or Frazer #2 cast concrete boxes with cast iron rim & hinged self-closing cast iron lid marked for function (gas shutoff, water, etc.), size to 12"x18"x12". Set flush with finished grade with 4" thick concrete pad under perimeter (but not under interior) of box.

2.5 VIBRATION ISOLATORS

- A. Equipment: Thy Curb Vibrocurbs or equal
- B. Ducts: Vent-fabric flexible connections with minimum of 6" full length.
- C. Piping: Flexible connections, isolation hangers & expansion/contraction connectors.
- D. All devices shall not exceed a noise criterion curve of 35 db SPL when measured on the flat response "C" scale, in occupied spaces.

2.6 FLASHING & SLEEVES

- A. Concrete: Equal "Sperzel", rust-proof, "Crete-Sleeve" at all penetrations through concrete, masonry, studs walls, or finished ceiling sized as required.
- B. Drywall, wood, synthetic stucco, etc: Provide sheet metal sleeves with minimum of 1/2" lip for all exposed locations. Prefinished backed enamel finish on exterior & chrome or painted finish on interior (verify colors with Architect).
- C. Roof: By metal building supplier, coordinate with same for installation.

2.7 PAINTING OF EQUIPMENT:

- A. See Division 09000 for painting standards & requirements, Verify colors with Architect.

PART 3

3.1 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.

- B. Install equipment & accessories to permit access for maintenance. Relocate items as necessary to provide such access & without cost to the Owner.
- C. Examine the areas & conditions under which work of this section will be performed. Correct conditions detrimental to timely & proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.
- D. Proceed in a timely & proper manner as rapidly as the building construction will permit.
- E. Thoroughly clean items before installation.
- F. Each contractor (Plumbing, HVAC) shall be responsible to provide & install the required identification, hangers, vibration isolators, flashing, sleeves, motors, access panels & accessories as required for the installation of their systems under their applicable sections.
- G. Each Contractor shall be responsible to provide concrete thrust blocks, supports, vaults/pits, condenser pads, etc. as required for equipment under their contract.

3.2 INSTALLATION OF IDENTIFICATION SYSTEMS

- A. Pipe: Clamp on legend & arrows, indicating contents of pipe & direction of flow located as follows:
 - 1. Adjacent to each valve.
 - 2. At each branch & riser takeoff.
 - 3. At least once in each area that a pipe passes through (except finished areas) & at least every 40 feet.
- B. Valves: Identify valves by distinguishing numbers & letters assigned to them & listed on a valve chart. Attach a brass tag on each valve with 1" to 3/4" #10 Brass-S-Hooks. Furnish 3 copies of printed valve list showing tag letter-number, service, & location. Include in each maintenance manual.
- C. Equipment: Identify equipment with nameplates securely fastened to the equipment. Install nameplates with adhesive or screws. Install metal tags with corrosion resistant metal chains. Install material in accordance with manufacturer's instructions.

3.3 INSTALLATION OF PIPE SUPPORTS

- A. Support suspended piping with clevis or trapeze hangers & rods.
- B. Space hangers & supports for horizontal steel or PVC pipes according to the following schedule:

| Pipe Size: | Maximum Spacing on Centers: |
|------------------|-----------------------------|
| 1.25" or smaller | 8'-0" |
| 1.5" to 3" | 10'-0" |
| 4" or larger | 14'-0" |
- C. Space hangers & supports for horizontal copper tubing according to the following schedule:

| Tube Size: | Maximum Spacing on Centers: |
|---------------|-----------------------------|
| 1" or smaller | 6'-0" |
| 1.5" | 7'-0" |
| 2" | 8'-0" |
| 2.5" | 9'-0" |
| 3" or larger | 10'-0" |
- D. Provide sway bracing on hangers longer than 18". Support vertical piping with riser clamps secured to the piping & resting on the building structure. Provide at each floor unless otherwise noted.
- E. Provide insulation continuous through hangers & rollers. Protect insulation by galvanized shields.
- F. Arrange pipe supports to prevent excessive deflection, & to avoid excessive bending stress.
- G. Support piping from inserts or anchors in concrete slabs. Provide the inserts under this Section.
- H. Hubless Piping: Provide hangers on the piping at each side of, & within 6" of, hubless pipe coupling so the coupling will bear no weight. Do not install hangers on couplings. Provide hangers adequate to maintain alignment & to prevent sagging of the pipe. Make adequate provision to prevent shearing & twisting of the pipe & the joint.

3.4 INSTALLATION OF ACCESS BOXES & PANELS

- A. Install access boxes or panels as required where piping, valves, equipment, etc. is concealed in walls, floor, or ceilings & will require maintenance or service.
- B. Boxes or panels to be flush with surfaces - level, square, & plumb, installed per manufacturer's

requirements.

3.5 INSTALLATION OF VIBRATION ISOLATORS

- A. Provide isolators at all connections of duct work to equipment (except rangehoods).
- B. Mount vibrating equipment on "Thy-Curb Vibrocurbs" with a minimum static deflection of 1".
- C. Isolate piping from structure in a manner to prevent transmission of vibration.
- D. Eliminate the source of any objectionable noise or vibration, or completely isolate it, without cost or inconvenience to the Owner.
- E. Provide expansion/contraction joints or fittings to allow perfect freedom of movement of piping during expansion & contraction without buckling. Erect piping so the strain & weight does not come upon apparatus.

3.6 INSTALLATION OF SLEEVES & OPENINGS

- A. Provide sleeves for each pipe passing through walls, partitions, floors, roofs, & ceilings. Set pipe sleeves in place before concrete is placed. (Alternate method to core drill after concrete placement).
- B. For uninsulated pipe, provide sleeves two pipe sizes larger than the pipe passing through, or provide a minimum of 1/2" clearance between inside & outside of the pipe. For insulated pipe, provide sleeves of adequate size to accommodate the full thickness of pipe covering, with clearance for packing & caulking.
- C. Coordinate the caulking of the space between sleeve & pipe, equipment, pipe covering or duct by the fire-proofing contractor, see Division 07000.
- D. Caulk the space between sleeve & pipe, equipment, pipe covering or duct, using a non-combustible, permanently plastic, waterproof, non-staining compound which leaves a smooth finished appearance, or pack with noncombustible material to within 1/2" of both surface faces, & provide the waterproof compound described above. See Division 07000 - Firestopping, for requirements & materials. Provide "ProSet" firestop systems for all PVC piping applications.
- E. Where items under your contract penetrate the roof, outer walls or waterproofing of any kind, provide under this Section, all base flashing & counterflashing required at such penetrations.

3.7 TRENCHING & BACKFILLING

- A. Perform trenching & backfilling required for work under each section .
- B. Cut bottom of trenches to grade. Make trenches 12" wider than the greatest dimension of the pipe.
- C. Bedding & backfilling:
 - 1. Install piping promptly after trenching. Keep trenches open as short a time as practicable.
 - 2. Under the building & parking, install pipes on a 6" bed of damp sand. Backfill to bottom of slab or paving with damp sand.
 - 3. Outside the building, install underground piping on a 6" bed of damp sand. Backfill to 12" above pipe with damp sand & backfill remainder with native soil. Tamp in firmly in lifts to achieve uniform compaction.
 - 4. Do not backfill until installation has been approved & until Project Record Documents have been properly annotated.

3.8 FIELD QUALITY CONTROL

- A. Upon completion of the project, provide the Architect/Engineer with a certification that the installation has been inspected for proper operation & that it complies with all applicable codes.

END OF SECTION

SECTION 15400

PLUMBING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Section 15050 - Basic Material & Methods
- B. Pipe and pipe fittings, valves.
- C. Plumbing Specialties: Floor drains, interceptors, cleanouts, backflow preventers, water hammer arrestors, hose bibs/hydrants.
- D. Plumbing Fixtures & Equipment.
- E. Sprinkler Heads for Storage # 2 [124] Only - NFPA 13 light hazard occupancy requirements off domestic water distribution system.

1.2 SUBMITTALS

- A. Product Data: For review provide manufacturers literature for plumbing specialties, fixtures, and equipment.
- B. Operation & Maintenance Instructions: Comply with Division 01000. Include within each manual a copy of the Project Record Documents showing all work of this Section. Include relevant instructions & data.

1.3 QUALITY ASSURANCE

- A. Testing & Adjusting: Test pipe installation as indicated, & obtain Architects inspection & approval of installation prior to burial or concealment by further construction.
- B. Sterilization Certificate: Upon completion of water line sterilization, deliver to the Architect two (2) copies of an acceptable "Certificate of Performance" for that activity.
- C. Cathodic Protection: Upon completion of the work of this Section, deliver to the Architect sufficient data to prove that wrapping of steel piping has been tested & meets the specified requirements. Show date of inspection, voltages used, & name & address of the inspector.

PART 2 PRODUCTS

2.1 SANITARY SEWER PIPING, BURIED BEYOND BUILDING

- A. PVC Pipe: ASTM D3033 or D3034, SDR 35, with elastomeric gaskets.

2.2 SANITARY SEWER PIPING, BURIED UNDER & ABOVE GRADE, WITHIN BUILDING

- A. PVC Pipe: ASTM D2729 with solvent weld joints, Schedule 40 PVC.

2.3 WATER PIPING, BURIED BEYOND BUILDING

- A. Copper Tubing: ASTM B88, Type K, or ASTM B42, annealed with wrought copper fittings and compression joints.
- B. PVC Pipe: AWWA C902, or ASTM D1785, Schedule 40, or ASTM D2241, minimum 150 psig pressure rating with solvent weld joints.

2.4 WATER PIPING, BURIED UNDER BUILDING

- A. Copper Tubing: ASTM B88, Type K, annealed without fittings.

2.5 WATER PIPING & SPRINKLER PIPING, ABOVE GRADE

- A. Copper Tubing: ASTM B88, Type L, hard drawn, with cast brass or wrought copper fittings and Grade 95TA solder joints.

2.6 NOT USED

2.7 LPG GAS PIPING, BURIED

- A. Steel Pipe: ASTM A53, Schedule 40 black with polyethylene jacket and welded joints.

2.8 LPG GAS PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53 or A120, Schedule 40 black (galvanized where exposed to weather), with malleable iron or forged steel fittings, screwed or welded.

2.9 FLANGES, UNIONS, AND COUPLINGS

- A. Pipe Size 2 Inches and Under: malleable iron unions for threaded ferrous piping; bronze unions for soldered copper pipe joints.
- B. Pipe Size Over 2 Inches: forged steel flanges for ferrous piping; bronze flanges for copper piping; neoprene gaskets.
- C. Grooved and Shouldered Pipe End Couplings: Malleable iron housing; "C" shape composition sealing gasket; steel bolts, nuts, and washers.
- D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.10 GATE VALVES

- A. Up to 2 Inches: Bronze body, non-rising stem & handwheel, inside screw, single wedge or disc, solder or threaded ends.
- B. Over 2 Inches: Iron body, bronze trim, rising stem & handwheel, OS&Y, single wedge, flanged or grooved ends.

2.11 GLOBE VALVES

- A. Up to 2 Inches: Bronze body, rising stem and handwheel, inside screw, renewable composition disc, solder or screwed ends, with back seating capacity.
- B. Over 2 Inches: Iron body, bronze trim, rising stem & handwheel, OS&Y, plug-type disc, flanged ends.

2.12 BALL VALVES

- A. Up to 2 Inches: Bronze or stainless steel body, stainless steel ball, teflon seats and stuffing box ring, lever handle, solder or threaded ends.
- B. Over 2 Inches: Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, flanged.

2.13 PLUG VALVES or GAS COCKS

- A. Up to 2 Inches: Bronze body, bronze tapered plug, non-lubricated, teflon packing, threaded ends. B. Over 2 Inches: Cast iron body and plug, non-lubricated, teflon packing, flanged ends.

2.14 WATER PRESSURE REDUCING VALVES

- A. Up to 2 Inches: Bronze body, stainless steel and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded and single or double union ends.
- B. Over 2 Inches: Cast iron body, bronze fitted, elastomeric diaphragm and seat disc, flanged.

2.15 RELIEF VALVES

- A. Bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated, capacities

ASME certified and labelled.

2.16 FLOOR DRAINS

- A. See plans for Manufacturer:
Equal Zurn ZN-415 floor & Shower drain, Dura-Coated cast iron body with bottom outlet, combination invertible membrane clamp & adjustable type B polished bronze strainer. Install with standard P-trap & in size as noted on plans.
- B. At all slab on grade locations install backwater valve to equal a Zurn Z-199.
- C. At all location where an equipment condensate drain DOES NOT run into floor drain install automatic trap primer to equal a Zurn Z-1022 automatic trap primer & Z-1023 trap primer connector.

2.17 GREASE INTERCEPTORS

- A. Construction: concrete fabricated for exterior installation, with multi-weir baffle assembly, integral deep seal trap, and epoxy coated steel cover with gasket, securing handle.
- B. Unit Rating: See plans for gpm flow and lbs grease capacity.

2.18 CLEANOUTS

- A.

| Manufacturers: | | Exterior | MODEL NUMBERS | | |
|----------------|-------|-----------|-----------------|-------------------|----------|
| | | | Finished Floors | Unfinished Floors | Walls |
| 1. | Smith | 4253 | 4023 | 4223 | 4532 |
| 2. | Josam | 58860 | 58010 | 56050-22 | 58790-4 |
| 3. | Zurn | Z-1460-15 | Z-1400-2 | Z-1420-25 | Z-1445-1 |
- B. Floor: Lacquered cast iron, two piece body with double drainage flange, weep holes, reversible clamping collar, and adjustable nickel-bronze strainer, round scoriated cover in service areas and round or square depressed cover to accept floor finish in finished floor areas.
- C. Wall: Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.
- D. Coverplates: heavy polished stainless steel, wall & floor cover plates, installed flush with floor or wall, with adjustable watertight covers in floors & round chrome plated or stainless steel access plate & screw in walls.
- E. Cleanout plugs of extra heavy bronze.
- F. All exterior coverplates & cleanouts to have stainless steel screws.

2.19 BACKFLOW PREVENTERS

- A. Manufacturers & Type:
 - 1. Atmosphere Type: Febco # 710A or G for hot & cold water
 - 2. Pressure Type: Febco # 765
 - 3. Reduced Pressure Type: Hersey or Febco # 825Y
 - 4. Double Check Detector Type: Febco # 806YD DCDA
- B. Reduced Pressure Backflow Preventers: ANSI/ASSE 1013; bronze body with bronze and plastic internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve which opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.
- C. Double Check Valve Assemblies: ANSI/ASSE 1012; Bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent. Install with OS&Y gate valves each side to meet UL/FM fireline service requirements.
- D. Chromium plated finish required in finish spaces. For flush valves, provide diaphragm type, complete with approved vacuum breaker provided by the manufacturer. Pressure & Reduced Pressure Valves to be supplied with ball valve shut-off valves & test cocks to meet USC FCCC & HR approval.

2.20 WATER HAMMER ARRESTERS

- A. Manufacturers:
 1. Smith, Model 5000 series
 2. Josam, Model 1585
 3. Sioux Chief, Model "Hydra-Rester"
- B. Type To PDI WH-201, precharged suitable for operation in temperature range -100 to 300°F & maximum 250 psig working pressure.

2.21 HOSE BIBS/HYDRANTS

- A. See plans Manufacturers & Model numbers.
- B. Interior Hose Bib: Bronze or brass, replaceable hexagonal disc, hose thread spout, chrome plated with vacuum breaker.
- C. Wall Hydrant: Non-freeze, anti-siphon, automatic self-draining type with chrome plated with wall plate hose thread spout, [removable key], and vacuum breaker.

2.22 SCHEDULED EQUIPMENT ON PLANS

- A. See Plans for list of equipment

2.23 WATER HEATERS

- A. See plans for Manufacturers & Models.
- B. Maximum working pressure: 150 psig

2.24 PIPE & VALVE INSULATION

- A. Glass Fiber Insulation: ANSI/ASTM C547; 1" to 3" thick Owens/Corning fiberglass, noncombustible insulation, 3 lb. density, "25 ASJK/SSL-11" for Hot & Cold Water lines.
- B. Cellular Foam: Flexible, plastic; 1/2" Armstrong "Armaflex sealed with Armstrong adhesive for condensate lines above ceilings or concealed in walls.
- C. Jacket:
 1. Vapor Barrier Jackets: Factory applied fiberglass reinforced vinyl 25ASJ vapor barrier with self-sealing adhesive joints.
 2. PVC Jackets: One piece, pre-molded type, Manville "Zeston 25/50"
- D. Accessories:
 1. Insulation bands: 3/4" wide, galvanized steel.
 2. Fibrous Glass Cloth: Untreated; 9 oz/sq.yd. weight.
- E. Safety Insulation: Equal "Handy Shield" foam insulated, vinyl jacked relaseable protective covers.

PART 3 EXECUTION

3.1 PREPARATION.

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt, on inside and outside piping before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Coordinate cutting or forming of roof or floor construction to receive drains to required invert elevations.
- E. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.
- F. Verify adjacent construction is ready to receive rough-in work of this Section.
- G. Examine the areas & conditions under which work of this section will be performed. Correct conditions detrimental to timely & proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.
- H. Thoroughly clean items before installation.

3.2 INSTALLATION

- A. Proceed as rapidly as the building construction will permit.
- B. Provide dielectric connections wherever jointing dissimilar metals.
- C. Install piping to conserve building space and not interfere with use of space. Group piping whenever practical at common elevations.
- D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- E. Provide clearance for installation of insulation and access to valves and fittings.
- F. Slope water piping and arrange to drain at low points.
- G. Install under slab water piping without joints.
- H. Install bell and spigot pipe with bell end upstream.
- I. Install specialties in accordance with manufacturer's instructions.
- J. Cut square, remove burrs, & clean inside of female copper tubing, filing to a bright finish. Apply solder flux with brush to tubing. Remove internal parts of solder-end valves prior to soldering.
- K. Soil piping shall be graded a minimum of 1/8" per foot & a maximum of 1/2" per foot in the direction of flow.
- L. Cutting & Patching: Provide cutting, patching, hangers, foundation openings & bucks, including cutting & patching of concrete, brick, paving, & curbs.
- M. Install Los Angeles pattern cast brass traps with brass nuts (chrome plated) for lavatories & sinks, except service sinks.
- N. Install all water piping within the building insulation envelope. No piping is to be on the cold side of the vapor barrier or in unheated attic spaces. Keep all piping concealed in walls, mechanical chases & spaces. Plumbing contractor to coordinate work with insulation contractor to assure location of insulation envelope. The Architect shall promptly be notified of any difficulties in accomplishing this. Any deviations from this will be grounds for rejecting work.
- O. Minimum size of all waste, drain, and vent lines under slab shall be as follows: 2" diameter for all lines 2" or less, & 4" diameter for all lines larger than 2" diameter.
- P. Install water heaters in accordance with manufacturer's instructions and to AGA, NSF, NFPA, & UL requirements. Coordinate with plumbing piping and related fuel piping, gas venting, or electrical work to achieve operating system.
- Q. Layout the plumbing system in careful coordination with the drawings, determining proper elevations for all components of the system & using only the minimum number of bends to produce a satisfactory functioning system.
- R. Layout pipes to fall within partition, wall or roof cavities, & to not require furring other than as shown on the drawings.
- S. Show no tool marks or threads on exposed plated, polished, or enameled connections from fixtures. Tape all finished surfaces to prevent damage during construction.
- T. Make changes in directions with fittings, make changes in mains sizes with eccentric reducing fittings. Unless otherwise noted, install water supply & return piping with straight side of eccentric fittings at top of the pipe.
- U. Screwed piping joints deburr cuts & treads to requirements of ANSI B2.1. Do not ream exceeding internal diameter of the pipe. Use teflon tape on male thread prior to joining other services.
- V. Remake leaky joints with new material, removing leaking section and/or fitting as directed. Do not use thread cement or sealant to tighten joint.

3.4 APPLICATION

- A. Use grooved mechanical couplings and fasteners, and dielectric connections only in accessible locations.
- B. Install unions downstream of valves and at equipment or apparatus connections.
- C. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to

- pipe.
- D. Install pressure regulators as required for each system or piece of equipment on all air, gas & water services
- E. Install piping, equipment, & accessories to permit access for maintenance. Relocate items as necessary to provide such access & without cost to the Owner.
- F. Provide access doors where valves, motors, or equipment requiring access for maintenance are located in walls or chases above ceilings. Coordinate location of access doors with other trades as required.

3.5 SERVICE CONNECTIONS

- A. Provide new sanitary sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.
- B. Provide new water service complete with water meter with by-pass valves with backflow preventer.
- C. Provide new gas service & coordinate with Gas Service Company the installation of gas meter and regulators. Gas service distribution piping to have initial minimum pressure of 7" wg (4oz). Provide regulators as required on each line serving gravity type appliances, sized in accordance with equipment.

3.6 INSTALLATION OF PLUMBING FIXTURES

- A. Set fixtures level and in proper alignment with respect to walls & floors, & with fixtures equally spaced.
- B. Install each fixture with chrome plated rigid or flexible supplies in proper alignment with fixtures & with each other, & with screwdriver stops, reducers, & escutcheons.
- C. Install flush valves in alignment with the fixture, without vertical or horizontal offsets.
- D. Grout or caulk wall and floor mounted fixtures watertight where the fixtures are in contact with walls & floors.
- E. Caulk deck-mounted trim at the time of assembly, including fixture and casework mounted. Caulk selftrimming sinks installed in casework.
- F. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.
- G. Cap pipe openings to exclude contaminants (dirt, bugs, etc.) until fixtures are installed & final connections made.

3.7 INSTALLATION OF FINISH & ESCUTCHEONS

- A. Smooth up rough edges around sleeves with plaster or spackling compound.
- B. Provide 1" wide chrome or nickel plated escutcheons on all pipes exposed to view where passing through walls, floors, partitions, ceilings & similar locations. Size the escutcheons to fit pipe & coverings. Hold escutcheons in place with set screw.

3.8 INSTALLATION OF VALVES

- A. Provide valves in water, air, & gas systems. Locate & arrange so as to give complete regulation of apparatus, equipment, & fixtures. Locate valves for easy accessibility & maintenance.
- B. Provide valves in a least the following locations:
 - 1. In branches &/or headers of water piping serving a group of fixtures.
 - 2. On both sides of apparatus & equipment.
 - 3. For shutoff of risers & branch mains.
 - 4. For flushing & sterilizing the system.
 - 5. Where shown on plans.
- C. Install gate or ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- D. Install globe, ball or butterfly valves for throttling, bypass, or manual flow control services.

3.9 INSTALLATION OF PIPING INSULATION

- A. Install materials in accordance with manufacture's instructions.
- B. Maintain ambient temperatures & conditions required by manufacturers of adhesive & insulation.
- C. Continue insulation vapor barrier through penetrations.

- D. Piping Insulation:
1. Locate insulation & cover seams in least visible places.
 2. Neatly finish insulation at supports, protrusions, & interruptions.
 3. Insulation with Vapor Barrier: Insulate fittings, valves, unions, flanges, strainers, flexible connections, & expansion joints.
 4. Insulation without Vapor Barrier: Bevel & seal ends of insulation at equipment, flanges, & unions.
 5. Provide insert between support shield & piping, under the finish jacket, on piping 2" diameter or larger. Fabricate of cork or other heavy density insulating material suitable for temperature, not less than 6" long, of same thickness & contour as adjoining insulation.
 6. Insulate all hot & cold water supply & return lines with glass fiber with thickness as follows: 1"ø or less with 1", 1.25" to 4"ø with 1.5", & greater than 4"ø with 2". Insulate condensate lines above ceilings or concealed in walls with cellular foam.
 7. Insulate all exposed drain & supply lines exposed under wall hung fixtures & lavatories with safety insulation to meet ANSI A177 & ADA codes for protection & accessibility of physically handicapped persons.
- E. Pipe Insulation Jackets:
1. Indoor, Concealed Hot Pipes: Furnish standard factory applied jackets with or without vapor barrier. Finish fittings, joints, & valves with glass cloth & adhesive. PVC jackets may be used.
 2. Indoor, Concealed Cold Pipes: Furnish with vapor barrier jackets, factory applied. Furnish fittings, joints, & valves with glass cloth & vapor barrier adhesive.
 3. Indoor, Exposed Pipes: Finish with PVC jackets.

3.10 INSTALLATION OF CLEANOUTS

- A. Secure the Architect's approval of locations for cleanouts in finished areas prior to installation. Locate at intervals of not more than 100 feet.
- B. Provide cleanouts of same nominal size as the pipes they serve, except where cleanouts are required in pipes 4" & larger provide 4" cleanouts unless otherwise noted.
- C. Make cleanouts accessible & ensure clearance at cleanout for rodding of drainage system.
- D. Extend cleanouts to finished floor or wall surface & provide cover plates as required.
- E. After pressure testing thoroughly lubricate threaded cleanout plugs with mixture of graphite and linseed oil.
- F. Provide exterior cleanouts with stainless steel screws and set in 4" thick concrete poured 12" around all sides, flush with finish grade.

3.11 INSTALLATION OF WATER HAMMER ARRESTERS

- A. Provide water hammer arresters on hot & cold water lines.
- B. Install in upright position at all quick closing valves, solenoids, isolated plumbing fixtures, & supply headers at plumbing fixture groups. Install water hammer arresters behind access panels.
- C. Locate & size as specified or as shown on the Drawings, & where not shown locate in accordance with Plumbing & Drainage Institute Standard WH-201. Locate water hammer arresters on all flushometer valves, showers, shower/tubs, sinks, & electronic solenoid valves.
- D. Where fixtures are not protected by water hammer arresters, provide 24" high air chambers on each water supply, properly sized & designed for maintenance & drainage.
- E. Install water hammer arresters complete with accessible isolation valve.

3.12 INSTALLATION OF BACKFLOW PREVENTION

- A. Protect plumbing fixtures, faucets with hose connections, & other equipment having plumbing connection, against possible back-siphonage.
- B. Arrange testing of backflow devices as required by the governmental agencies having jurisdiction. Provide both the Owner & Architect of a copy of test & approval.
- C. Install backflow preventers to meet the Safe Drinking Water & Public Drinking Water Regulations as required by the State.

3.13 DISINFECTION/STERILIZATION OF DOMESTIC WATER PIPING SYSTEM

- A. Prior to starting work, verify system is complete, flush & clean. Notify the Architect at least 48 hours

prior to start of the disinfection process & perform disinfection process under Architect's observation. Ensure PH of water to be treated is between 7.4 & 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

- B. Inject disinfectant, free chlorine in liquid, powder, tablet, or gas form, throughout system to obtain 50 to 80 mg/L residual. Bleed water from outlets to ensure distribution.
- C. Maintain disinfectant in system for 24 hours. If final disinfectant residual test less than 25 mg/L, repeat treatment.
- D. Flush disinfectant from system. Take samples no sooner than 24 hours after flushing, & analyze in accordance with AWWA C601.
- E. Upon completion of sterilization, & 24 hours after final flushing, secure an analysis by a laboratory approved by the Architect, based on water samples from the system, showing test negative for coli-aerogene organisms. Provide a total plate count of less than 100 bacteria per cc, or equal to the control sample. Take a minimum of 4 samples from the building system as remote from each other as possible.
- F. Upon completion of sterilization, secure & submit a Certificate of Performance required under Article 1.4 of this Section, stating system capacity, disinfectant used, time & rate of disinfectant applied, & resultant residuals in ppm at completion. Also give the results of coli-aerogene tests.
- G. If analysis results are not satisfactory, repeat the disinfection procedures & retest until specified standards are achieved.

3.14 FIELD QUALITY CONTROL

- A. Upon completion of the plumbing installation the plumbing contractor shall provide the Architect/Engineer with the certifications that the installation has been inspected for proper operation & that it complies with all applicable codes including the BOCA National Plumbing Code.
- B. Plumbing system including, but not limited to, plumbing fixtures & trim, water piping (supply & DWV), etc. shall be tested & inspected.
- C. Plumbing Contactor shall submit the following:
 - 1. Sterilization Certificate per 1.04 of this Section
 - 2. Plumbing Certificate of Performance
 - 3. Certification of Backflow Prevention devices by state certified tester.
 - 4. As built/record drawings of actual installation to the Architect after completion of the project.
- D. Testing & Adjusting
 - 1. Temporary plug waste, vent, & roof drain lines fill with water to the roof level, & allow to remain so for 24 hours without leakage.
 - 2. Test hot & cold water lines at 125 psi for a period of 12 hours without leaking/
 - 3. On all piping systems, a final test shall be made upon completion of system piping. The test pressure shall be the maximum operating pressure of the system. No leaks shall be detected. Comply with all local codes & ordinances & make all tests required by governing bodies.
- E. Where tests show material or workmanship to be deficient, replace or repair as necessary, & repeat the tests until the specified standards are achieved.
- F. Adjust systems to optimum standards of operation.

END OF SECTION

SECTION 15600

FURNACES & CONDENSING UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Section 15050, Basic Material & Methods
- B. Forced air furnaces.
- C. Refrigerant cooling coils and condensing units.

1.2 SUBMITTALS

- A. Shop Drawings: Indicate dimensions, connections, arrangement, accessories, and controls.
- B. Product Data: Provide manufacturer's installation instructions.
- C. Operating and Maintenance Instructions: Include relevant instructions.

1.3 WARRANTY

- A. Provide one year manufacturer's warranty under provisions of Division 01000 including 20 year coverage for heat exchangers.
- B. Provide one year manufacturer's warranty under provisions of Division 010000 including 5 year coverage for refrigeration compressors.

PART 2 PRODUCTS

2.1 CONTROLS

- A. Units shall have required operating controls, starters, motor over-load protection & safety controls.
- B. Thermostats:
 - 1. Programmable features - two separate temperatures per 24 hours & seven day programmable feature.
 - 2. System Control: Heat, Off, Cool
 - 3. Fan Control: Automatic, On
 - 4. 24V Transformer (6VA Load), Honeywell R8222 relay, & battery backup.

2.2 FORCED AIR FURNACES

- A. Type:
 - 1. Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heat exchanger, burner, controls, air filter, 40-VA transformer, humidifier, refrigerant cooling coil and outdoor package containing compressor, condenser coil and condenser fan.
 - 2. Up, Counter, or Horizontal flow with gas burner and electric refrigeration.
- B. Heating & Cooling Performance: See plans for outputs, performance & model numbers.
- C. Heat Exchanger: Primary - Stainless steel, welded construction, Secondary - laminated polypropylene steel.
- D. Combustion Chamber: Welded stainless steel.
- E. Supply Fan: Centrifugal type, rubber mounted with direct drive with multispeed motor.
- F. Air Filters: One inch thick glass fiber disposable type.
- G. Gas Burner: Induced combustion type with combination gas valve and pressure regulator, manual shut-off, pilot valve, electronic pilot ignition, thermocouple pilot safety device, & 100% outdoor combustion air. A.G.A. design certified.
- H. Burner Operating Controls: Low voltage, adjustable room thermostat controls burner via printed circuit board control in furnace; high limit control with fixed stop de-energizes burner on high bonnet temperature. Control supply fan in accordance with bonnet temperature. Include manual switch for continuous fan operation.
- I. Evaporator Coil: Copper tube aluminum fin coil assembly, with one piece molded high-impact plastic drain pan, drain connection, refrigerant piping connections, and factory installed thermostatic

- expansion valve.
- J. PVC schedule 40 vent & combustion piping for gas-fired condensing furnaces.

2.3 CONDENSING UNITS

- A. See plans for Manufacturer, Model, sizes, & performance.
- B. Units: Self-contained, split system package factory assembled & pre-wired units for outdoor installation & consisting of cabinet, compressors, condensing coil & fans, integral sub-cooling coil, controls, & liquid line receiver.
- C. Cabinet: Galvanized steel with baked enamel finish & removable access door or panels with quick fasteners.
- D. Compressor: Hermetic, 1750 rpm, resiliently mounted integral with condenser, with positive lubrication, crankcase heater, high pressure control, motor overload protection, service valves and filter drier.
- E. Air Cooled Condenser: Aluminum fin seamless copper tube coil, direct drive vertical discharge propeller fan resiliently mounted, galvanized fan guard, permanently lubricated ball bearing motors built-in current & overload protection.
- F. Controls: High & low pressure cutouts for compressor, oil pressure control, non-recycling pump-down & reset relay. Low ambient controls to permit operation down to 35°F ambient temperature. Timer circuits to prevent rapid loading & unloading of compressor.

2.4 FLUE SYSTEMS

- A. For gas equipment exhaust 550°F or less use double wall construction Type B gas vent pipe. Equal Selkirk Metalbestos model QC or RV vent pipe.
- B. For gas equipment exhausts up to 1000°F continuous/1400°F intermittent use double wall construction with 0.035" stainless steel interior & 0.025" aluminum external skin under positive pressure. Equal Selkirk Metalbestos model PC vent pipe.
- C. Flue systems to include all piping, breeching, support brackets, fire stops, terminators, caps, attic insulation shields, etc. for complete system. All component parts to be metalbestos recommended use for the type of flue system.
- D. For condensing furnaces use PVC schedule 40 vent & combustion piping with piping sloped toward furnace with drain at low points.

2.5 INFRA-RED HEATERS

- A. Tube Heaters: Schwank extended tube gas fired Infra-red heaters. See plans for models & sizes. Units to have ceramic burner, aluminized steel burner housing, ACA/CGA certified, direct spark ignition, aluminized reflector.
- B. High Intensity Heaters: Schwank gas-fired luminous infra-red heaters. See plans for models & sizes. Units to have Ceramic Tile burner, aluminized steel burner housing, ACA/CGA certified, direct spark ignition, aluminized reflector.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install equipment & specialties in accordance with manufacturer's instructions.
- B. Install in accordance with manufacturer's instructions.
- C. Mount air cooled condenser package on concrete pad. Install exterior concrete equipment pads for condensing units.
- D. Tough-up scratches & abrasions to be invisible to the unaided eye from a distance of 5'-0".
- E. Provide for connection to electrical service. Refer to Division 16000.
- F. Route piping in orderly manner, plumb and parallel to building structure, and maintain gradient. Install piping to conserve building space, and not interfere with use of space and other work. Group piping whenever practical at common elevations. Conceal piping in walls, mechanical rooms, or attic spaces.
- G. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- H. Provide clearance for installation of insulation, and access to valves and fittings.

- I. Provide non-conducting dielectrical connections when joining dissimilar metals.
- J. Pressure test system with dry nitrogen to 200 psig. Perform final test at 27" vacuum and 200 psig. Test to no leakage.
- K. Charge system with refrigerant & put into operation, test equipment performance. Provide cooling season start-up & heating season shut-down for first year of operation.
- L. Do not operate fans until ductwork is clean, filters are in place, bearings lubricated, & fans have been test run under observation.
- M. Where piping, flues, ductwork etc. pass from heated spaces into non-heated spaces (attics, outside, etc.) all openings must be caulked & made airtight around penetrations. Provide metal fire stops on steel metal flues rather than caulk.
- N. Caulk around all piping, flues, ductwork, etc. that pass through fire-rated assemblies (walls, ceilings, etc.) using a non-combustible, permanently plastic, waterproof, non-staining compound which leaves a smooth finish appearance. See Division 07000 - Firestopping, for requirements & materials.

3.2 APPLICATION

- A. Provide line size liquid indicators in main liquid line leaving condenser, or if receiver is provided, in liquid line leaving receiver.
- B. Provide refrigerant charging valve connections in liquid line between receiver shut-off valve & expansion valve.
- C. Utilize flexible connectors at or near compressors where piping configuration does not absorb vibration.
- D. Provide vent terminal kits for vent & combustion air for each condensing furnace installed per manufacturers instructions.
- E. Verify electrical service characteristics before ordering equipment.
- F. Air handling units to be mounted within 1/2" of level, for proper condensate drainage. The condensate drainage is NOT to be externally trapped (drain assembly is internally trapped). On condensing furnaces the condensate drain can NOT be run to exterior of building it must be internally plumbed.
- G. Verify physical size of equipment to fit in space provided with space allowed for service prior to ordering equipment.
- H. Where items of this Section penetrate roof, outer walls, or waterproofing of any kind, provide under this Section, all base flashing & counterflashing required at such penetration.
- I. Systems to be balanced per Section 15990 - once for heating season & once for cooling season, must be balanced twice within the first year. Owner to be instructed on different settings for each season.

3.3 FIELD QUALITY CONTROL & INSTRUCTIONS

- A. Upon completion of this portion of the Work, & prior to its acceptance by the Owner, provide a qualified engineer & fully instruct the Owner's maintenance personnel in the proper operation & maintenance of all items provided under this Section.
- B. Demonstrate the contents of the approved operation & maintenance manual required under this Section.
- C. Upon completion of the HVAC system installation, the HVAC contractor shall provide the Architect/Engineer with certification that the installation has been inspected for proper operation & that it complies with all applicable codes.
- D. The HVAC contractor shall submit the following:
 1. HVAC Certificate of Performance
 2. Air Flow test results per Section 15990
 3. As-build/record drawings to the Architect of completed systems.

END OF SECTION

SECTION 15880
AIR DISTRIBUTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Section 15050, Basic Materials & Methods
- B. Filters.
- C. Ductwork & ductwork accessories.
- D. Volume control dampers.
- E. Fire dampers.
- F. Flexible duct connections.
- G. Diffusers, boots, registers, grilles.
- H. Louvers & roof hoods.
- I. Exhaust Fans

1.2 SUBMITTALS

- A. Shop Drawings: Indicate for manufactured products & assemblies, & include electrical characteristics & connection requirements.
- B. Product Data: Provide for manufactured products & assemblies, & include electrical characteristics & connection requirements.
- C. Operating & Maintenance Instructions: Include instructions for lubrication, filter replacement, spare parts lists, & wiring diagrams.

PART 2 PRODUCTS

2.1 FILTERS

- A. Washable Permanent Panel Filters: 14 mesh steel screen, zinc electroplated, stainless steel, or aluminum, rod reinforced; enclosed in galvanized steel or stainless steel frame. Size as required with thickness of 1/2 inch to one inch.
- B. Disposable Panel Filters: Fiber blanket, factory sprayed with flameproof, non-drip, non-volatile adhesive. Size as required with 1" thickness set in casing of cardboard frame with perforated metal or plastic retainer. Galvanized steel frame with expanded metal grid on outlet side & steel rod grid on inlet side required on filter larger than 30"x30". Performance Rating to be 500 FPM face velocity.

2.2 DUCTWORK

- A. Materials
 - 1. Steel Ducts: Galvanized steel sheet, lock-forming quality.
 - 2. Insulated Flexible Ducts: Flexible duct wrapped with flexible 1" thick glass fiber insulation, enclosed by seamless vapor barrier jacket.
 - 3. Stainless Steel: 0.043" (18MSG) thickness, unlined for rangehood exhaust systems, lock-forming quality, & watertight construction for dishwasher hoods.
 - 4. Sealant: Non-hardening, water resistant, fire resistive, used alone or with tape.
- B. Metal Ductwork
 - 1. Fabricate & support in accordance with SMACNA HVAC Duct Construction Standards - Metal & Flexible except as indicated.
 - 2. Construct T's, bends, & elbows with radius of 1-1/2 times width of duct on center line. Where not possible provide turning vanes.
 - 3. Increase duct sizes gradually, not exceeding 30 degrees divergence & 45 degrees convergence.
 - 4. Connect flexible ducts to metal ducts with liquid adhesive plus tape or adhesive plus sheet metal screws.
 - 5. Use crimp joints with or without bead for joining round duct sizes 8 inch & smaller with crimp in direction of air flow.
- C. Kitchen Hood Exhaust Ductwork: Fabricate in accordance with NFPA 96 using stainless steel

ductwork.

2.3 VOLUME CONTROL DAMPERS.

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal & Flexible, & as indicated.
- B. Fabricate splitter dampers of material same gage as duct to 24 inches size in either direction, & two gages heavier for larger sizes. Secure with continuous hinge or rod. Operate with minimum 1/4 inch diameter rod.
- C. Fabricate single blade dampers for duct sizes to 12 x 30 inch.
- D. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 12 x 72 inch. Assemble center & edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
- E. Except in round ductwork 12 inches & smaller, provide end bearings.
- F. Provide locking, indicating quadrant regulators on single & multi-blade dampers. Where width exceeds 30 inches provide regulator at both ends.

2.4 FIRE & SMOKE DAMPERS

- A. All fire dampers must be dynamic rated & fabricated in accordance to meet UL-55 &/or NFPA-90A, & as indicated.
- B. Equal these Manufacturers:
 - 1. Ruskin, Model IBD2 style A,B, or C (interlocking blade fire damper).
 - 2. Greenheck, Model DFD-150 (less than 3 hour rated barriers).
 - 3. Greenheck, Model DFD-350 (3 or more hour rated barriers).
 - 4. Ruskin, Model FSD35 with 120V actuator (combination fire & smoke).
 - 5. Safe-Air "Thermo/Guard", Model A240R(Combination fire & volume control).
- C. Fabricate curtain type dampers with blades out of air stream except for 1.0 inch pressure class ducts up to 12 inches in height.

2.5 BACKDRAFT DAMPERS.

- A. Gravity backdraft dampers, size 18 x 18 inches or smaller, furnished with air moving equipment, may be air moving equipment manufacturers standard construction.
- B. Fabricate multi-blade, parallel action gravity balanced backdraft dampers of galvanized steel, or extruded aluminum, with center pivoted blades, with sealed edges, linked together, steel ball bearings, & plated steel pivot pin.

2.6 AIR TURNING DEVICES/EXTRACTORS

- A. Multi-blade device with blades aligned in short dimension; steel or aluminum construction; with individually adjustable blades, mounting straps.
- B. Multi-blade device with radius blades attached to pivoting frame & bracket, steel or aluminum construction, with push-pull operator strap.

2.7 FLEXIBLE DUCT CONNECTIONS

- A. UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, approximately 3 inches wide, crimped into metal edging strip.

2.8 DUCT ACCESS DOORS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal & Flexible.
- B. Access doors smaller than 12 inches square may be secured with sash locks. Access doors with sheet metal screw fasteners are not acceptable.

2.9 AIR OUTLETS & INLETS

- A. Equal these Manufacturers:
 - 1. Anemostat
 - 2. Carnes

- | | | | |
|----|----------------|----|------------------|
| 3. | Hart & Cooley | 6. | Lima |
| 4. | J & J Register | 7. | Metalaire |
| 5. | Krueger | 8. | Price Industries |
| | | 9. | Tuttle & Bailey |
- B. Ceiling Diffusers: Round or Rectangular adjustable pattern, stamped or spun, multi-core type diffuser to discharge air with sectorizing baffles where indicated; radial opposed blade damper & equalizing grid; baked enamel off-white finish.
- C. Modified Light Troffer Diffusers: Single or Double plenum type constructed of galvanized steel with welded or soldered joints & finish matte black inside, with volume & pattern controllers, 5 inch round or oval top or side air inlet.
- D. Registers/Grilles: Streamlined & individually adjustable blades, with baked enamel off-white finish.
- E. Exterior Louvers: Weatherproof & minimum 4 inches deep with blades on 45 degree slope, heavy channel frame, birdscreen with 1/2 inch square mesh for exhaust & 3/4 inch for intake.
1. Material: 12 gage thick extruded aluminum.
 2. Finish: Factory anodized finish to match adjacent surfaces, verify color with Architect/Engineer.

2.10 DUCTWORK INSULATION

- A. Flexible Glass Fiber: ASTM C612; flexible, non-combustible blanket, 'K' Value of 0.29 at 75 °F, Density of 1.5 lb/cu ft, & Vapor Barrier Jacket of Kraft paper reinforced with glass fiber yarn & bonded to aluminized film, secured with pressure sensitive tape.
- B. Rigid Glass Fiber: ASTM C612; rigid, noncombustible blanket. 'K' Value of 0.29 at 75 °F, Density of 2.0lb/cu ft, & Vapor Barrier Jacket of Kraft paper reinforced with glass fiber yarn & bonded to aluminized film, secured with pressure sensitive tape.
- C. Canvas Jacket: UL listed fabric, 6 oz/sq yd ,plain weave cotton treated with dilute fire retardant lagging adhesive.
- D. Duct Liner: ASTM C553; flexible, noncombustible blanket, 'K' Value of ASTM C518, 0.28 at 75 °F, Density of 1.5 lb/cu ft, Maximum Velocity on Coated Air Side: 6,000 ft/min, use waterproof fire retardant type Adhesive, with Liner Fasteners of galvanized steel, self adhesive pad or welded with press on head.

2.11 FIRE PROOFING INSULATION

- A. Equal "FireMaster" Duct Wrap Blanket of refractory ceramic fiber encapsulated in aluminum foil scrim, 1½ " thickness, UL-classified, non-combustible, 2300°F service limit. Minimum 2 hour fire rating required.

2.12 CABINET & CEILING EXHAUST FANS

- A. See plans for Manufacturers, Models & Performance to equal.
- B. Centrifugal Fan Unit: V-belt or direct driven with galvanized steel housing lined with 1/2 inch acoustic insulation, resilient mounted motor, gravity backdraft damper in discharge.
- C. See plans for Electrical Characteristics & Components. Disconnect Switch via cord & plug in housing for thermal overload protected motor & wall mounted switch, timer, multiple speed switch, or solid state speed controller as noted.
- D. Grille: Molded white plastic or aluminum with baked white enamel finish.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install fans on vibration isolators.
- C. Provide drain pans & down spouts for cooling coil banks more than one coil high. Provide eliminators mounted over drain pan.
- D. Do not operate fans for any purpose until ductwork is clean, filters are in place, bearings lubricated, & fan has been test run under observation.
- E. Install fans with resilient mountings & flexible electrical leads. Install flexible connections specified between fan inlet & discharge ductwork. Flexible connectors shall not be in tension while running.

- F. Provide fixed sheaves required for final air balance.
- G. Provide safety screen where fan inlet or outlet is exposed.
- H. Provide backdraft dampers on discharge of exhaust fans & as indicated.
- I. Install flexible connections specified between fan inlet & discharge ductwork. Flexible connectors shall not be in tension while running.
- J. Prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.
- K. Install filter gage static pressure taps upstream & downstream of filters. Mount filter gages on outside of filter housing or filter plenum, in accessible position. Adjust & level.
- L. Provide openings in ductwork where required to accommodate thermometers & controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage.
- M. Locate ducts with sufficient space around equipment to allow normal operating & maintenance activities.
- N. Connect diffusers or troffer boots to low pressure ducts with 5 feet maximum length of flexible duct. Hold in place with strap or clamp.
- O. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- P. Provide fire dampers at locations indicated. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings & hinges.
- Q. Provide vent-fabric flexible connections immediately adjacent to equipment in ducts associated with fans & motorized equipment, of minimum 6" full length.
- R. Provide duct access doors for inspection & cleaning before & after filters, coils, fans, automatic dampers, at fire dampers, & elsewhere as indicated. Provide minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access.
- S. Check location of air outlets & inlets & make necessary adjustments in position to conform with architectural features, symmetry, & lighting arrangement.
- T. Provide balancing dampers on duct take-off to diffusers, & grilles & registers, regardless of whether dampers are specified as part of the diffuser, or grille & register assembly. Also provide manual dampers on Fresh Air (FA) ducts at connection to Return Air (RA) ducts to balance F.A. from 0 to 100% of duct cap.
- U. Paint ductwork visible behind air outlets & inlets matte black. Refer to Division 09000.
- V. Connect branch take-offs to include prefabricated air scoops or air take-offs formed of galvanized sheet metal. Provide operating handles when required.

3.2 INSTALLATION OF DUCTWORK INSULATION

- A. Provide insulation with vapor barrier when air conveyed may be below ambient temperature.
- B. Secure insulation with vapor barrier with wires & seal-jackets joints with vapor barrier adhesive or tape to match jacket.
- C. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging.
- D. Seal vapor barrier penetrations by mechanical fasteners, with vapor barrier adhesive. Stop & point insulation around access doors & damper operators to allow operation without disturbing wrapping.
- E. Secure insulation without vapor barrier with staples, tape or wire.
- F. Interior supply, return, & fresh air ductwork shall have coated 1/2" duct liner with adhesive applied to cover 100% of duct interior, for all rectangular ducts.
- G. All fresh air & make-up air ducts shall be wrapped with 2" duct insulation.
- H. Round sheet metal ducts shall be wrapped with 1", 3/4 lb. R=3.5 foil backed duct insulation.

3.3 FIRE PROOFING INSULATION INSTALLATION

- A. Install in accordance with manufacture's instructions.
- B. Install two (2) layer wrap with 3" perimeter & longitudinal overlap on both layers. Filament tape is to used only as a temporary hold until banding is in place on the exterior wrap. For duct spans of greater than 24", insulation pins are required on the bottom of horizontal & on vertical duct runs to prevent sags. Install carbon steel or stainless steel banding around exterior wrap.
- C. Install fire proofing insulation on all of exhaust duct from rangehood (make-up air does not require fire proof wrap, just standard 2" duct insulations).

END OF SECTION

SECTION 15990

TESTING, ADJUSTING, & BALANCING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Air systems.

1.2 SUBMITTALS

- A. Draft Reports: Submit for review prior to final acceptance of Project.
- B. Test Reports: Submit prior to final acceptance of project & for inclusion in operating & maintenance manuals. Provide in soft cover, letter size, 3-ring binder, with index page & tabs, & cover identification. Include reduced scale drawings with air outlets & equipment identified to correspond with data sheets, & indicating thermostat locations.
- C. Report Forms: to equal AABC National Standards for Total System Balance forms or Forms prepared following ASHRAE 111.

PART 2 PRODUCTS - not used

PART 3 EXECUTION

3.1 EXAMINATION & PREPARATION

- A. Before commencing work, verify that systems are complete & operable.
- B. Report any defects, deficiencies, or abnormal conditions in mechanical systems which prevent system balance.
- C. Beginning of work means acceptance of existing conditions.
- D. Recorded data shall represent actually measured or observed condition.
- E. Permanently mark settings of valves, dampers, & other adjustment devices. Set & lock memory stops.

3.2 INSTALLATION TOLERANCES

- A. Air Handling Systems: Adjust to within $\pm 5\%$ for supply systems & $\pm 10\%$ for return & exhaust systems of design.
- B. Air Outlets & Inlets: Adjust to within $\pm 10\%$ of design.

3.3 AIR SYSTEM PROCEDURE

- A. Adjust air handling & distribution systems to provide required or design supply, return, & exhaust air quantities.
- B. Make air quantity measurements in ducts by traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets & outlets.
- D. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers.
- E. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- F. Measure static air pressure conditions on air supply units, including filter & coil pressure drops, & total pressure across the fan. Allow for 50 % loading of filters.
- G. Adjust automatic outside air, return air, & exhaust air dampers for design conditions.
- H. Measure temperature conditions across outside air, return air, & exhaust air dampers to check leakage.
- I. Where modulating dampers are provided, take measurements & balance at extreme conditions.

END OF SECTION



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SECTION 16050

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General & Supplementary Conditions, & Division 1
- B. Temporary Electrical Service per Section 01500 (See Requirements)
- C. Grounding and bonding.
- D. Connection of utilization equipment.
- E. Supports.
- F. Identification.

1.2 SUBMITTALS

- A. Product Data: Provide catalog data for grounding and bonding devices.

1.3 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70 (NEC)
- B. Conform to all Local, City & State Codes
- C. Furnish products listed by Underwriters Laboratories, Inc. or other testing firm acceptable to authority having jurisdiction.
- D. Certify inspection & approval from authority having jurisdiction.

1.4 PROJECT CONDITIONS

- A. Existing project conditions indicated on Drawings are based on casual field observation or existing record documents.
- B. Verify field measurements and circuiting arrangements are as shown on Drawings.
- C. Verify removal of existing electric work.
- D. Report discrepancies to Architect/Engineer before disturbing existing installation or commencing work.

1.5 QUALITY ASSURANCE & COORDINATION

- A. Perform Work to requirements of NECA Standard of Installation.
- B. Obtain and review shop drawings, product data, and manufacturer's instructions for equipment furnished under other Sections to determine connection locations and requirements.
- C. Sequence rough-in of electrical connections to coordinate with installation and start-up of equipment furnished under other Sections.

PART 2 PRODUCTS

2.1 GROUNDING MATERIALS

- A. Ground Rod: Copper, minimum 5/8" diameter x 10 feet length.
- B. Provide active electrodes as required to perform work. Metallic-salt-filled copper-tube electrode, length & shape as required; with U-bolt pressure plate connector or connector for exothermic welded connection.
- C. Mechanical Connectors: Bronze.

2.2 BASIC MATERIALS

- A. Steel channel: Galvanized or painted steel.
- B. Miscellaneous Hardware: Treat for corrosion resistance.
- C. Nameplates: Engraved three-layer laminated plastic, black letters on white background or embossed adhesive tape labels, with 3/16 inch white letters on black background.

- D. Wire and Cable Markers: Cloth markers, split sleeve or tubing type.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install Products in accordance with manufacturer's instructions.
- B. Install ground electrodes at locations indicated & additional rod electrodes as required to meet Regulatory Requirements.
- C. Provide grounding electrode conductor and connect to reinforcing steel in foundation footing as required by code & bond steel together, & to ground rod(s).
- D. Provide bonding to meet Regulatory Requirements.
- E. Provide isolated equipment grounding conductor for circuits supplying electronic cash registers, personal computers and in all licensed areas of Health Care Facilities.
- F. Make electrical connections to utilization equipment in accordance with equipment manufacturer's instructions.
 - 1. Verify that wiring and outlet rough-in work is complete and that utilization equipment is ready for electrical connection, wiring, and energization.
 - 2. Make wiring connections in control panel or in wiring compartment of pre-wired equipment. Provide interconnecting wiring where indicated.
 - 3. Install and connect disconnect switches, controllers, control stations, and control devices as indicated.
 - 4. Make conduit connections to equipment using flexible conduit. Use liquid-tight flexible conduit in damp or wet locations.
 - 5. Install pre-fabricated cord set where connection with attachment plug is indicated or specified, or use attachment plug with suitable strain-relief clamps.
 - 6. Provide suitable strain-relief clamps for cord connections to outlet boxes and equipment connection boxes.
 - 7. Use wire & cable with insulation suitable for temperatures encountered in heat-producing equipment.
- G. Install support systems sized and fastened to accommodate weight of equipment and conduit, including wiring, which they carry.
 - 1. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors, preset inserts, or beam clamps.
 - 2. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.
 - 3. Do not fasten supports to piping, ceiling support wires, ductwork, mechanical equipment, or conduit.
 - 4. Do not use powder-actuated anchors.
 - 5. Do not drill structural steel members.
 - 6. Fabricate supports from structural steel or steel channel.
 - 7. Install free-standing electrical equipment on concrete pads.
 - 8. Install surface-mounted cabinets and panelboards with minimum of four anchors.
 - 9. Provide steel channel supports to stand cabinets 1 inch off wall in wet locations.
 - 10. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.
- H. Identify electrical distribution and control equipment, and loads served, to meet regulatory requirements and as indicated or scheduled.
 - 1. Degrease and clean surfaces to receive nameplates and tape labels.
 - 2. Secure nameplates to equipment fronts using screws, rivets, or adhesive, with edges parallel to equipment lines. Secure nameplate to inside face of recessed panelboard doors in finished locations.
 - 3. Use nameplates with 1/8" lettering to identify individual switches & circuit breakers, wall switches, receptacle circuits, & loads served.
 - 4. Use nameplates with 1/4" lettering to identify distribution and control equipment.
- I. Install wire markers on each conductor in panelboard gutters, pull boxes, and at load connections.
 - 1. Use branch circuit or feeder number to identify power and lighting circuits.

2. Use control wire number as indicated on equipment manufacturer's shop drawings or schematic & interconnection diagrams to identify control wiring.

3.2 TRENCHING & BACKFILLING

- A. Perform trenching & backfilling associated with the work of this Section in strict accordance with the provisions of Division 02000 of these Specifications.
- B. Cut bottom of trenches to grade. Make trenches 12" wider than the greatest dimension of the conduit.
- C. Install conduit promptly after trenching. Keep trenches open as short a time as practicable.
- D. Under the building or parking, install conduit on a 2" bed of damp sand. Backfill to bottom of slab or paving with damp sand, or crushed - gravel, stone, or slag.
- E. Outside the building, install underground conduit on a 2" bed of damp sand. Backfill to 6" above conduit with damp sand or crushed slag. Backfill to within 12" of finish grade with acceptable fill material. Backfill remainder with native soil. Tamp in firmly in lifts to achieve uniform compaction.
- F. Do no backfill until installation has been approved & until Project Record Documents have been properly annotated.

3.3 FIELD QUALITY CONTROL

- A. Upon completion of the electrical & communication installation, the electrical & communication contractors shall provide the Architect / Engineer with a certificate the installation has been inspected for proper operation & that it complies with all applicable codes including NFPA 70 (National Electrical Code) & NFPA 72 (National Fire Alarm Code).
- B. The electrical & communication contractors shall submit certificates of performance for:
 1. Electrical lighting & power distribution systems including, but not limited to, distribution equipment, wiring, conduit, light fixtures, switches, receptacles, motor starters, & junction boxes.
 2. Emergency lighting & power systems including, but not limited to, wiring, conduit, light fixtures, junction boxes, etc.
 3. Telephone Systems including, but not limited to, telephone outlets with jacks & wire.
 4. Fire Alarm System including, but not limited to, annunciator panel, smoke detectors, manual stations, heat detectors, horn/strobes, strobes, etc.

END OF SECTION

16100 - WIRING METHODS

PART 1 GENERAL

1.1 SUMMARY

- A. Section 16050 - Basic Electrical Materials & Methods
- B. Conduit and fittings.
- C. Electrical Metallic Tubing.
- D. Electrical boxes & Service fittings..
- E. Wire and cable.
- F. Wiring devices.
- G. Rough-in Only For:
 - 1. Telephone Systems & Service
 - 2. Cable TV

1.2 SUBMITTALS

- A. Product Data: For review.
 - 1. Provide wiring device configurations, ratings, dimensions, and color selections.
 - 2. Provide service fitting configurations, dimensions, and finish and color selections.

1.3 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed by UL or other testing firm acceptable to authority having jurisdiction

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with NECA Standard of Installation.

PART 2 PRODUCTS

2.1 CONDUIT AND FITTINGS

- A. Conduit:
 - 1. Metal Conduit and Tubing: Galvanized steel.
 - 2. Flexible Conduit: Steel or Aluminum.
 - 3. Liquidtight Flexible Conduit: Flexible conduit with PVC jacket.
 - 4. Plastic Conduit and Tubing: NEMA TC 2, PVC. Use Schedule 40 conduit.
 - 5. Non-Metallic Tubing: NEMA TC-13.
- B. Conduit Fittings:
 - 1. Metal Fittings and Conduit Bodies: NEMA FB 1.
 - 2. Plastic Fittings and Conduit Bodies: NEMA TC 3.

2.2 ELECTRICAL BOXES

- A. Boxes:
 - 1. Sheet Metal: NEMA OS 1, galvanized steel.
 - 2. Cast Metal: Aluminum or Cast ferrous alloy, deep type, gasketed cover, threaded hubs.
 - 3. Nonmetallic: NEMA OS 2.
- B. Floor Boxes for Installation in Poured Concrete Floors: Semi-adjustable, cast iron.
- C. Hinged Cover Enclosures: NEMA 250, Type 1, steel enclosure with manufacturer's standard enamel finish and continuous hinge cover, held closed by flush latch operable by screwdriver.
- D. Large Cast Metal Boxes:
 - 1. Surface-Mounted Type: NEMA 250, Type 4 and Type 6, flat-flanged, surface-mounted junction box; cast aluminum box and cover with ground flange, neoprene gasket, and stainless steel cover screws.
 - 2. Underground Type: NEMA 250, Type 4, Inside flanged, recessed cover box for flush mounting; galvanized cast iron box and plain cover with neoprene gasket and stainless steel cover screws.

2.3 BUILDING WIRE AND CABLE

- A. Feeders and Branch Circuits 8 AWG & Larger: Copper stranded conductor, 600 volt insulation, THW or THHN/THWN.
- B. Feeders and Branch Circuits smaller than 8 AWG: Copper conductor, 600 volt insulation, TW, THW, or THHN/THWN. solid conductor.
- C. Control Circuits: Copper, stranded conductor, 600 volt insulation, THW.

2.4 ARMORED CABLE

- A. Armored Cable, Size 14 Through 4 AWG: Copper conductor, 300 volt insulation, rated 60 degree C, Type AC.
- B. Armored Cable, Size 4 Through 1 AWG: Copper conductor, 300 volt insulation, rated 60 degree C, Type AC.

2.5 REMOTE CONTROL AND SIGNAL CABLE

- A. Control Cable for Class 1 Remote Control and Signal Circuits: Copper conductor, 600 volt insulation, rated 60 degree C, individual conductors twisted together & covered with PVC jacket.
- B. Control Cable for Class 2 or Class 3 Remote Control & Signal circuits: Copper conductor, 300 volt insulation, rated 60 degree C, individual conductors twisted together & covered with PVC jacket; UL listed.
- C. Plenum Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, rated 60 degree C, individual conductors twisted together [, shielded,] and covered with nonmetallic jacket; UL listed for use in air handling ducts, hollow spaces used as ducts, and plenums.

2.6 CORDS

- A. Description: Oil-resistant thermoset insulated multiconductor flexible cord with identified equipment grounding conductor, suitable for [extra] hard usage in damp locations.

2.7 WIRING DEVICES AND WALL PLATES

- A. Wall Switch: **IVORY TOGGLE**
 - 1. AC general use, quiet-operating snap switch rated 20 amperes and 120-277 volts AC, with plastic toggle handle, ivory color.

| | | | | |
|---------------------|-------------|-------------|-------------|-------------|
| Equal these | Single | Two | Three | Four |
| | <u>Pole</u> | <u>Pole</u> | <u>Pole</u> | <u>Pole</u> |
| 2. Manufacturers: | 1991-I | 1992-I | 1993-I | 1994-I |
| a. Arrow | 4901-I | 4902-I | 4903-I | 4904-I |
| b. Bryant | GE5951-2G | GE5952-2G | GE5953-2G | GE5954-2G |
| c. General Electric | 1221-I | 1222-I | 1223-I | 1224-I |
| d. Hubbell | 20AC1-I | 20AC2-I | 20AC3-I | 20AC4-I |
| e. Pass & Seymour | 720-AG-IV | 722-AG-IV | 723-AG-IV | 724-AG-IV |
| f. Slater | | | | |
 - 2. Manufacturers:

| | | |
|---------------------|--------------------|--------------------|
| | <u>Receptacles</u> | <u>Receptacles</u> |
| a. Arrow | 5362 or 5352-I | GF5342-I |
| b. Bryant | 5362 or 5352-I | GFR53FT-I |
| c. General Electric | GE5362 or 5352-2 | |
| d. Hubbell | 5362 or 5352-2 | GF5362-I |
| e. Pass & Seymour | 5362 or 5352-IV | 2091-FI |
| f. Slater | 5362 or 5352-AG-IV | SIR-20-F-IV |
 - B. Receptacle: **IVORY STANDARD**
 - 1. Provide straight-blade receptacles to NEMA WD 1.
 - a. Convenience Receptacle Configuration: Type 5- 20 R, plastic face, ivory color.

| | | |
|-------------|--------|------|
| Equal these | Duplex | GFCI |
|-------------|--------|------|
 - 2. Manufacturers:

| | | |
|---------------------|--------------------|--------------------|
| | <u>Receptacles</u> | <u>Receptacles</u> |
| a. Arrow | 5362 or 5352-I | GF5342-I |
| b. Bryant | 5362 or 5352-I | GFR53FT-I |
| c. General Electric | GE5362 or 5352-2 | |
| d. Hubbell | 5362 or 5352-2 | GF5362-I |
| e. Pass & Seymour | 5362 or 5352-IV | 2091-FI |
| f. Slater | 5362 or 5352-AG-IV | SIR-20-F-IV |
- C. Wall Dimmers:
 - 1. Rotary dial type, ivory color, 1500 Watts minimum, sized to accommodate circuit load shown on contract drawings, equal these manufacturers Slater DAF-1500 or DAF-2000, Challenger 3575 or 3576, and Leviton 61500 or 62000.
- D. Decorative Cover Plate: match switch plate color in smooth nylon or high impact thermo-plastic.

- E. All receptacles installed outdoors in a wet location shall have an enclosure that is weatherproof whether or not the attachment plug cap is inserted.

2.8 SERVICE FITTINGS

- A. Recessed 3-Service floor Boxes: Equal Hubbel 3SFB-C for concrete or 3SFB-SS for wood construction with 1 duplex receptacle & 1 telephone/data plate, cable exit door & steel reinforced thermoplastic access door (verify color with owner / architect).
- B. Recessed Duplex Receptacle: Equal Hubbell S-3925 duplex or S-2525 single brass cover plate on cast box set flush with finish floor surface.
- C. Receptacle Surface-type Service Fitting: One duplex configuration, satin aluminum housing, stainless steel device plate
- D. Communication Surface-type Outlet Service Fitting: one bushed 1" inside diameter opening configuration, satin aluminum housing, stainless steel device plate
- E. Surface-type Combination Fitting: One duplex convenience receptacle with one bushed 1" inside diameter opening configuration, satin aluminum housing, stainless steel device plate
- F. Poke-Through Service Fitting: Flush Type with integral flush box and cover., Fire Rating: 3 hours, One duplex and one communications outlet.
- G. Protective Ring: Brass or Aluminum finish.
- H. Split Nozzle: Brass or Aluminum finish.
- I. Carpet Ring: Brass or Thermo Plastic.

PART 3 EXECUTION

3.1 RACEWAY INSTALLATION

- A. Use only specified raceway in the following locations:
 - 1. Installations In or Under Concrete Slab, or Underground : Rigid steel conduit or Plastic conduit with steel ells. Provide concrete encasement where indicated or required.
 - 2. Exposed Outdoor Locations: Rigid steel conduit or intermediate metal conduit or Electrical metallic tubing. Use threaded or raintight fittings.
 - 3. Wet Interior Locations: Rigid steel conduit or intermediate metal conduit or Electrical metallic tubing. Plastic conduit on special conditions & where prior approved by Architect/Engineer. Use threaded or raintight fittings for metal conduit.
 - 4. Concealed Dry Interior Locations: Rigid steel conduit or intermediate metal conduit. Electrical metallic tubing.
 - 5. Exposed Dry Interior Locations: Rigid steel conduit or intermediate metal conduit. Electrical metallic tubing.
 - 6. Motor Connections: Flexible Conduit for vibrating equipment, length to be 36" or less.
- B. Size raceways for conductor type installed or for type THW conductors, whichever is larger.
 - 1. Minimum Size Conduit: 1/2-inch .
 - 2. Maximum Size Conduit in Slabs Above Grade: 3/4-inch, do not route conduits larger than 1/2-inch to cross each other.
- C. Use wire and cable in locations as follows:
 - 1. Concealed or Exposed Interior Locations & Above Accessible Ceilings: Building wire in raceway (conduit) or Armored cable.
 - 2. Wet or Damp Interior Locations: Building wire in raceway.
 - 3. Exterior Locations: Building wire in raceways.
 - 4. Underground Locations: Building wire in raceway.
- D. Use no wire smaller than 12 AWG for power and lighting circuits, and no smaller than 14 AWG for control wiring. Use 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 75 feet; and for 20 ampere, 277 volt branch circuit home runs longer than 200 feet.

3.2 EXAMINATION AND PREPARATION

- A. Verify that supporting surfaces are ready to receive work.
- B. Verify that interior of building is physically protected from weather.
- C. Verify that mechanical work that is likely to injure conductors has been completed.
- D. Completely and thoroughly swab raceway system before installing conductors.
- E. Electrical boxes are shown on Drawings in approximate locations unless dimensioned.

1. Obtain verification from Owner of floor box locations, and locations of outlets in offices and work areas, prior to rough-in.
2. Elevators: Determine location of outlets for lights, cab circuits, machines, and equipment installed in elevator pit, shaft, and machine rooms with elevator installer prior to rough-in.

3.3 INSTALLATION

- A. Perform Work according to NECA Standard of Installation.
- B. Arrange conduit to maintain headroom and to present neat appearance.
 1. Route exposed raceway parallel and perpendicular to walls and adjacent piping.
 2. Maintain minimum 6-inch clearance to piping and 12-inch clearance to heat surfaces such as flues, steam pipes, and heating appliances.
 3. Maintain required fire, acoustic, and vapor barrier rating when penetrating walls, floors, and ceilings.
 4. Route conduit through roof openings for piping and ductwork where possible; otherwise, route through roof jack with pitch pocket.
 5. Group in parallel runs where practical. Use rack constructed of steel channel. Maintain spacing between raceways or derate circuit ampacities to NFPA 70 requirements.
 6. Use conduit hangers and clamps; do not fasten with wire or perforated pipe straps.
 7. Use conduit bodies to make sharp changes in direction.
 8. Terminate conduit stubs with insulated bushings.
 9. Use suitable caps to protect installed raceway against entrance of dirt and moisture.
 10. Provide No. 12 AWG insulated conductor or suitable pull string in empty raceways, except sleeves and nipples.
 11. Install expansion-deflection joints where raceway crosses building expansion or seismic joints.
 12. Install plastic conduit and tubing according to manufacturer's instructions.
- C. Install surface metal raceway and multioutlet assemblies according to manufacturer's instructions.
 1. Use flat-head screws or clips and straps suitable for the purpose, to fasten channel to surfaces. Mount plumb and level.
 2. Use suitable insulated bushings and inserts at connections to outlets and corner fittings in metal raceway.
 3. Use fittings and accessories designed for use with raceway system.
- D. Install auxiliary gutter and wireway according to manufacturer's instructions.
- E. Install electrical boxes as shown on the drawings, and as required for splices, taps, wire pulling, equipment connections and regulatory requirements.
 1. Use cast outlet box in exterior locations and wet locations.
 2. Use hinged cover enclosure for interior pull and junction box larger than 12" in any dimension.
 3. Locate and install electrical boxes to allow access. Provide access panels if required.
 4. Locate and install electrical boxes to maintain headroom and to present neat mechanical appearance.
 5. Install pull boxes and junction boxes above accessible ceilings or in unfinished areas.
 6. Provide knockout closures for unused openings.
 7. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.
 8. Coordinate mounting heights & locations of outlets above counters, benches, backsplashes, & at electric water coolers.
 9. Install lighting outlets to locate luminaires as shown on reflected ceiling plan.
- F. Use recessed outlet boxes in finished areas and where indicated.
 1. Secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness.
 2. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.
 3. Locate boxes in masonry walls to require cutting corner only. Coordinate masonry cutting to achieve neat openings for boxes.
 4. Do not install boxes back-to-back in walls; provide 6 inches separation, minimum; except provide minimum 24 inches separation in acoustic-rated walls.
 5. Do not damage insulation.
- G. Install floor boxes according to manufacturer's instructions.
 1. Set boxes level and flush with finish flooring material.
 2. Use cast floor boxes for installations in slab on grade.
- H. Install cable and wire according to manufacturer's instructions.

1. Neatly train and secure wiring inside boxes, equipment, and panelboards.
 2. Use wire pulling lubricant for pulling 4 AWG and larger wires.
 3. Support cables above accessible ceilings to keep them from resting on ceiling tiles.
 4. Make splices, taps, and terminations to carry full ampacity of conductors without perceptible temperature rise.
 5. Terminate spare conductors with electrical tape.
 6. Terminate aluminum wire according to manufacturer's instructions. Use tin-plated, aluminum-bodied compression connectors. Fill with anti-oxidant compound prior to installation of conductor. Use suitable reducing connectors or mechanical connector adapters for connecting aluminum conductors to copper conductors.
- I. Install wiring devices according to manufacturer's instructions.
1. Install wall switches 42" above floor, OFF position down.
 2. Install wall dimmers 42" above floor. Derate ganged dimmers as instructed by manufacturer. Do not use common neutral.
 3. Install convenience receptacles 18 " above floor, 6 " above counters, grounding pole on bottom.
 4. Install specific purpose receptacles at heights shown on Drawings.
 5. Install cord and attachment plug caps on equipment under the provisions of Section 16050. Size cord for connected load and rating of branch circuit overcurrent protection.
- J. Install wall plates flush and level.
1. Install decorative plates on switch, receptacle, and blank outlets in finished areas,[using jumbo size plates for outlets installed in masonry walls].
 2. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface-mounted outlets.
- K. Install service fittings according to manufacturer's instructions.
- L. Drill floor opening and install poke-through fittings according to manufacturer's instructions.
- M. Interface outlet box, service fitting &/or floorbox installation with furniture furnished by owner.
- N. Provide & install wiring, in conduit for equipment & controls provided under other sections of these specifications including, but not limited to Plumbing & HVAC systems. Wiring systems in conduit include rough-in & connection for HVAC controls & thermostats as specified in Section 15600.
- O. Caulk around conduits that pass through smoke partitions, fire-rated assemblies, & corridor walls, using a non-combustible, permanently plastic, waterproof, non-staining compound which leaves a smooth finished appearance, or pack with non-combustible material to within 1/2" of both r faces, & provide the waterproof compound described above. See Division 07000 - Firestopping, for requirements & materials.

3.04 FIELD QUALITY CONTROL

- A. Perform field inspection and testing of Electrical system.
1. Inspect wire and cables for physical damage and proper connection.
 2. Torque test conductor connections and terminations to manufacturer's recommended values.
 3. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.

END OF SECTION

SECTION 16400

SERVICE AND DISTRIBUTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Section 16050 - Electrical Materials & Methods
- B. Service entrance and metering.
- C. Enclosed switches.
- D. Grounding & Lighting Arresters.
- E. Transformers.
- F. Panelboards.
- G. Enclosed circuit breakers.
- H. Fuses.
- I. Motor starters.
- J. Contactors.

1.2 SYSTEM DESCRIPTION

- A. Electric Service System: See drawings for amperages, voltages, phases, & number of wires at 60 Hz.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate relevant information on panelboards.
- B. Product Data: Provide data on enclosed switches and circuit breakers, fuses, circuit breakers, busway plug-in devices, transformers, motor starters, and contactors.
- C. Test Reports: Submit for field inspection and testing. Include description of procedures, duration, instruments used, and test values obtained. Present information in table comparing acceptable values to actual values.
- D. Operating and Maintenance Instructions: Panelboard NEMA PB 2.1.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of Utility Company.

1.5 MAINTENANCE

- A. Submit extra materials required for maintenance:
 - 1. Provide two of each size and type fuse.

PART 2 PRODUCTS

2.1 METERING EQUIPMENT (see drawings for size & location)

- A. Meter & CT's: By the Power Company.
- B. Meter Base, Conduits, & Weatherheads: By Electrical Contractor.

2.2 ENCLOSED SWITCHES

- A. Enclosed Switch Assemblies: NEMA KS 1; Type GD.
 - 1. Fuse clips: Designed to accommodate Class R fuses.
- B. Enclosures: NEMA KS 1; Type 1 or 3R as required.

2.3 FUSES

- A. Fuses 600 Amperes and Less: current limiting, one-time fuse, 250 or 600 volt, UL Class RK 1 or RK 5.

- B. Fuses Larger Than 600 Amperes: Current limiting, fast-acting one time fuse, 600 volt, UL Class L.
- C. Fuse Interrupting Rating: 200,000 rms amperes.

2.4 GROUNDING MATERIALS

- A. Ground Rods: Copper-encased steel, 3/4" diameter, minimum length 10'-0".
- B. Clamps: Bronze.

2.5 PANELBOARDS

- A. Equal these Manufacturers:
 - 1. Cutler-Hammer
 - 2. Federal Pacific Electric
 - 3. G.E.
 - 4. ITE
 - 5. Square "D"
 - 6. Westinghouse
- B. Main and Distribution Panelboards: NEMA PB 1; circuit breaker type.
 - 1. Enclosure: Type 1 or Type 3R.
 - 2. Provide surface cabinet front with screw cover & lockable hinged door.
 - 3. Bus: Copper or Copper Clad Aluminum.
 - 4. Ground Bus: Copper.
 - 5. Voltage: as noted on drawings.
 - 6. Minimum Integrated Equipment Rating: 10,000 amperes rms symmetrical for 240 volt panelboards; 20,000 amperes rms symmetrical for 480 volt panelboards.
- C. Lighting and Appliance Branch Circuit Panelboards: NEMA PB 1; circuit breaker type.
 - 1. Enclosure: NEMA PB 1; Type 1 or Type 3R as required.
 - 2. Provide flush cabinet front with lockable door, keyed alike. Surface mounted cabinet allowed in electrical or mechanical rooms
 - 3. Bus: Copper or Copper Clad Aluminum bus.
 - 4. Ground Bus: Copper.
 - 5. Voltage: as noted on drawings.
 - 6. Minimum Integrated Equipment Rating: 10,000 amperes rms symmetrical for 240 volt panelboards.
- D. Accessories: Provide circuit breaker accessories as indicated on Drawings.

2.6 ENCLOSED CIRCUIT BREAKERS

- A. Circuit Breaker: NEMA AB 1.
 - 1. Voltage: as shown on drawings to match equipment.
 - 2. Interrupting Rating: 10,000 amperes minimum.
 - 3. Enclosure: NEMA AB 1; Type 1 or 3R as required; steel.
 - 4. Accessories: As indicated on Drawings.

2.7 MOTOR STARTERS

- A. Manual Motor Starter:
 - 1. NEMA ICS 2; AC general-purpose Class A manually operated, full-voltage controller with overload relay, & push button operator.
 - 2. Fractional Horsepower Manual Starter: NEMA ICS 2; AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, & toggle operator.
 - 3. Enclosure: NEMA ICS 6; Type 1.
- B. Magnetic Motor Starter: NEMA ICS 2.
 - 1. Full Voltage Motor Starters: AC general-purpose Class A magnetic controller for induction motors rated in horsepower
 - 2. Two-Speed Starters: Include integral time delay transition between FAST and SLOW speeds.
 - 3. Coil Operating Voltage: as required for equipment.
 - 4. Extra Auxiliary Contacts: 2 normally open & field convertible.
 - 5. Control Power Transformers: 120 volt secondary.
 - 6. Enclosure: Type 1.

- C. Combination Motor Starters: Combine motor starters with molded case circuit breaker or fusible switch in single enclosure.

2.8 CONTACTORS

- A. General Purpose Contactors: NEMA ICS 2; mechanically or electrically held. Enclosure: NEMA ICS 6; Type 1.
- B. Lighting Contactors: NEMA ICS 2; mechanically or electrically held.
 - 1. Enclosure: NEMA ICS 6; Type 1.
 - 2. Provide bus terminals suitable for mounting in panelboard.

2.9 LIGHTING ARRESTERS

- A. Furnish & install lighting arrester(s) of proper voltage & phase in the main distribution equipment as required to protect the system.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

- A. Make arrangements with Utility Company to obtain permanent electric service to the Project.

3.2 INSTALLATION

- A. Install Utility services in accordance with Utility Company instructions. See riser diagram on drawing for service entrance type, size, location etc.
- B. Install equipment in accordance with manufacturer's instructions.
- C. Install proper fuses in each fused switch.
- D. Provide grounding and bonding to NFPA 70.
 - 1. Supplementary Grounding Electrode: Use driven ground rod on exterior of building. Provide for effectively grounding of metal frame of the building.
 - 2. Provide separate, insulated equipment grounding conductor in feeder and branch circuits. Terminate each end on a grounding lug, bus, or bushing.
 - 3. Provide grounding and bonding at Utility Company's metering equipment and pad-mounted transformer.
 - 4. Use 6 AWG minimum size, copper conductor to bond communications system grounding conductor to nearest effectively grounded metallic water pipe.
- E. Install panelboards and load centers to NEMA PB 1.1.
- F. Panelboards shall be field marked, per NEC 110.16, to warn qualified persons of potential electric arc flash hazards. The marking shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment. Warning to be per NFPA 70E-2000, Electrical Safety Requirements for Employee Workplaces & ANSI Z535.4-1998, Product Safety Signs and Labels.

3.2 FIELD QUALITY CONTROL

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
- B. Measure ground resistance from system neutral connection at service entrance to convenient ground reference point by passing minimum current of 10 amperes DC and measuring voltage drop. Maximum resistance: 10 ohms.

3.3 CLEANING

- A. Clean equipment finishes to remove paint and concrete splatters.

END OF SECTION

SECTION 16500

LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Section 16050 - Electrical Basic Materials & Methods
- B. Luminaires and lampholders.
- C. Lamps.
- D. Ballasts.
- E. Exit Signs.
- F. Emergency lighting units.

1.2 SUBMITTALS

- A. Shop Drawings: Indicate construction details for Products which are not manufacturer's standard.
- B. Product Data: Provide product data for each luminaire and lighting unit.
- C. Operating and Maintenance Instructions: Provide maintenance and operating instructions for battery powered lighting units.

1.3 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Conform to requirements of NFPA 101.
- C. Furnish products listed by Underwriters Laboratories, Inc. or other testing firm acceptable to authority having jurisdiction.

1.4 MAINTENANCE

- A. Provide two extra of each lamp installed.
- B. For future service & repair leave all opened remaining cartons / packages of lamps at project site to give to Owner.

PART 2 PRODUCTS

2.1 LUMINAIRES AND LAMP HOLDERS

- A. Luminaire Schedule: Product requirements for each luminaire and lampholder are specified in luminaire schedule on Drawings.
- B. Accessories: Provide required accessories for mounting and operation of each luminaire as indicated.
 - 1. Recessed Luminaires: Provide trim type suitable for ceiling system in which luminaire is installed.
 - 2. Thermal Protection: Provide thermal protection devices to meet NFPA 70 requirements.
 - 3. Surface Luminaires: Provide spacers and brackets required for mounting.
 - 4. Pendant Luminaires: Provide swivel hangers, pendant rods, tubes, and chains as indicated to install luminaire at appropriate height.

2.2 EMERGENCY LIGHTING UNITS

- A. Description: Self-contained emergency lighting unit 120 volt units or connected to emergency power circuit.
 - 1. If self-contained unit to have nickel-cadmium battery & Dual-rate battery charger with AC ON, RECHARGING; TEST switch indicators and controls.

2.3 EXIT SIGNS

- A. Construction:

1. Housing: Extruded aluminum or thermal plastic as noted on schedule.
 2. Face: Aluminum stencil face with red or green letters as required by code.
 3. Directional Arrows: Universal type for field adjustment.
 4. Mounting: Universal, for field selection.
- B. Emergency Power Supply: Either emergency generator or an integral, listed for emergency lighting use nickel-cadmium battery with dual-rate battery charger having AC ON; TEST switch indicators and controls.

2.4 LAMPS

- A. Description:
1. Incandescent Lamps: 125 volts, shape as scheduled.
 2. Fluorescent Lamps: Type and color as scheduled.
 3. Mercury Vapor HID Lamps: Deluxe white or Color improved.
 4. Metal Halide HID Lamps: Phosphor coated.
 5. High Pressure Sodium HID Lamps: Clear, suitable for ballast furnished in luminaire and for all burning positions.
 6. Reflector Lamp Beam Patterns: Conform to ANSI C78.379.

2.5 FLUORESCENT BALLASTS

- A. Provide fluorescent ballast suitable for use under installation conditions listed for each luminaire and lampholder.
1. Voltage: As scheduled.
 2. Ballasts for nominal 430 mA lamps: Premium, Superpremium, or Electronic type as scheduled.

2.6 ACCESSORIES

- A. Provide Wall Brackets, Photocontrols, Bolt Covers, Anchor Bolts, Hardware, etc. as required for a complete installation.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

- A. Examine adjacent surfaces to determine that surfaces are ready to receive work.

3.2 INSTALLATION

- A. Install luminaires and accessories in accordance with manufacturers instructions.
1. Provide pendant accessory to mount suspended luminaires at height indicated.
 2. Support surface-mounted luminaires from ceiling grid tee structure; provide auxiliary support laid across top of ceiling tees. Fasten to prohibit movement.
 3. Install recessed luminaires to permit removal from below. Use plaster frames. Install grid clips in gymnasium & multipurpose spaces.
 4. Install lamps in luminaires and lampholders.

3.3 ADJUSTING AND CLEANING

- A. Align luminaires and clean lenses and diffusers at completion of work.
- B. Aim adjustable luminaires and lampholders as indicated or as directed.
- C. Adjust directional arrows on exit signs to meet approval of authority having jurisdiction.
- D. Clean paint splatters, dirt and debris from installed luminaires.
- E. Touch up luminaire finish at completion of work.
- F. Relamp luminaires which have failed lamps at completion of work.

END OF SECTION

SECTION 16720

FIRE ALARM SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES:

- A. Section 16050: Basic Materials and Methods
- B. Fire alarm and smoke detection system
- C. Related Sections: 16100-400 - Electrical

1.2 SUBMITTALS

- A. Shop Drawings: Indicate fire alarm and smoke detection system wiring diagrams.
- B. Product Data: Provide data on each fire alarm and smoke detection component.
- C. Operation and Maintenance Instructions: Include instructions on fire alarm and smoke detection system.
- D. Submit under provisions of Division 01000.

1.3 REGULATORY REQUIREMENTS

- A. Conform to NFPA 72 code for fire alarm and smoke detection systems. Certify inspection and approval from authority having jurisdiction.
- B. Conform to NFPA 101.

1.4 MAINTENANCE

- A. Submit extra materials required for maintenance: Two spare fire alarm station glass fronts

1.5 QUALITY ASSURANCE

- A. Each and all items of the Fire Alarm System shall be listed as a product of a SINGLE fire alarm system manufacturer under the appropriate category by Underwriters' Laboratories, Inc. (UL), and shall bear the "U.L." label. All control equipment shall be listed under UL category UOJZ as a single control unit. Partial listing shall not be acceptable.
- B. In addition to the UL-UOJZ requirement mentioned above, the system controls shall be UL listed for Power Limited Applications per NEC 760. All circuits must be marked in accordance with NEC article 760-23.

1.6 GENERAL

- A. New Fire Alarm System with required control modules, wiring and equipment as required. The new system shall use closed loop initiating device circuits with individual zone and individual indicating appliance circuit supervision.
- B. Include manual pull stations, automatic fire detectors, horns, flashing lights, all wiring, connections to devices, outlet boxes, junction boxes, and all other necessary material for a complete operating system.
- C. All panels and peripheral devices shall be the standard product of a single manufacturer and shall display the manufacturer's name on each component. The catalog numbers specified under this section are those of Simplex Time Recorder Co. and constitute the type, product quality, material and desired operating features.
- D. Equipment submissions must include a minimum of the following:
- E. Complete descriptive data indicating UL listing for all system components.
- F. Complete sequence of operations of the system.
- G. Complete system wiring diagrams for components capable of being connected to the system and interfaces to associated equipment.
- H. A copy of any state or local Fire Alarm System equipment approvals (if required by local jurisdiction).

1.7 OPERATION

- A. The system alarm operation subsequent to the alarm activation of any manual station or automatic detection device shall be as follows:
 - 1. All audible alarm indicating appliances shall sound a pattern until silenced by the alarm silence switch at the control panel or the remove annunciator.
 - 2. All visual alarm indicating appliances shall display a pattern until extinguished by the Alarm Silence Switch.
 - 3. A supervised signal to notify the local fire department or an approved central station shall be activated. To accommodate and facilitate job site changes, the type of "city connection circuit" shall be on site configure-able to provide a "reverse polarity" connection.
 - 4. The associated initiating device circuit red LED shall flash on the existing control panel until the alarm has been silenced at the control panel. Once silenced, this same LED shall latch on. A subsequent alarm received from another zone after silencing shall flash the subsequent zone alarm LED on the control panel. A pulsing alarm tone shall occur within the control panel and the remote annunciator until silenced.
- B. The alarm indicating appliances may be silenced after one (1) minute by authorized personnel upon entering the existing locked control cabinet and operating the alarm silence switch and the remove annunciator. A subsequent zone alarm shall reactivate the signals.
- C. The activation of any system smoke detector shall initiate an Alarm Verification operation whereby the panel will reset the activated detector and wait for a second alarm activation. If, within one (1) minute after resetting, a second alarm is reported from the same or any other smoke detector, the system shall process the alarm as described previously. If no second alarm occurs within one minute the system shall resume normal operation. The Alarm Verification shall operate only on smoke detector alarms. Other activated initiating devices shall be processed immediately. The alarm verification operation shall be selectable by zone.
- D. Alarm and trouble conditions shall be immediately displayed on the control panel front without manual inquiry.

1.8 SUPERVISION

- A. All auxiliary manual controls shall be supervised so that all switches must be returned to the normal automatic position to clear system trouble.
- B. Each independently supervised circuit shall include a discrete amber "Trouble" LED to indicate disarrangement conditions per circuit.
- C. The System Expansion Modules connected by ribbon cables shall be supervised for module placement. Should a module become disconnected from the C.P.U. the system trouble indicator must illuminate and audible trouble signal must sound.
- D. Should a serial annunciator fail to communicate to the control panel for any reason, the system annunciator trouble indicator (LED) shall pulse a specific number of times at the control panel to indicate which annunciator has failed to communicate.

1.9 POWER REQUIREMENTS

- A. The existing control panel has 120 VAC power (with battery backup) via a dedicated fused disconnect circuit.
- B. All circuits requiring system operating power shall be 24 VDC and shall be individually fused at the control panel. Battery standby shall be 24 hours with 5 min of alarm, provide calculations to verify this requirements.

PART 2 PRODUCTS

2.1 FIRE ALARM CONTROL PANEL

- A. Where shown on the plans, provide and install to equal a Simplex 4005-Series Fire Alarm Control Panel. Construction shall be modular with solid state, microprocessor based electronics. All visual indicators shall be high contrast, LCD or LED type.
- B. The control panel shall contain the following features:
 - 2 Initiation Device Circuits (Addressable Points) (4005 = 8 zones)
 - 2 Alarm indicating Appliance Circuits (Hard-Wired Input/Output (I/O) Points)
 - 1 Digital Alarm Communicating Transmitter.
 - 1 Earth Ground Supervision Circuit

- 1 Basic minimum 5 Amp power supply
- 1 Automatic Battery Charger
- 1 set Standby Batteries
- 1 lot Resident non-volatile programmable operating system memory for all operating requirements
- 1 Supervised Manual Evacuation Switch

2.2 MANUAL STATIONS

- A. Equal: Simplex type 4099 series double action and shall be constructed of high impact, red Lexan with raised white lettering and a smooth high gloss finish. To minimize nuisance alarms, activation shall require two separate and distinct actions. The first action shall require a glass front to be broken exposing the pull lever. The second action requires the operating lever to be pulled down. Once pulled down, the lever shall remain at a 90 degree angle from the front of the station to provide a visual indication of the station in alarm. Reset shall require a key common to the control panel and replacement of the glass window. Pull station shall be by the same manufacturer to insure compatibility.

2.3 SMOKE DETECTORS

- A. System Smoke Detectors: Furnish and install where indicated on the plans, to equal a Simplex 4098 series smoke detectors with 4098-series base.
- B. Detectors shall be listed to U.L. standard 268 and shall be documented compatible with the control equipment to which it is connected. Detector shall be listed for this purpose by Underwriters Laboratories, Inc. The detectors shall obtain their operating power from the fire alarm panel supervised detection loop. The operating voltage shall be 24 VDC (nominal). Removal of the detector head shall interrupt the supervisory circuit of the fire alarm detection loop and cause a trouble signal to be generated at the control panel.
- C. Each detector shall have a flashing status indicating LED for visual supervision. When the detector is actuated, the flashing LED will latch on steady and at full brilliance. The detector may be reset by actuating the control panel reset switch.
- D. To minimize nuisance alarms, voltage and RF transient suppression techniques shall be employed as well as a smoke verification circuit and an insect screen. The detector design shall provide full solid state construction and compatibility with other normally open fire alarm detection loop devices (heat detectors, pull stations, etc.). The detector head shall be easily disassembled to facilitate cleaning.

2.4 AUTOMATIC HEAT DETECTORS

- A. Automatic heat detectors shall be rate-of-rise & fixed-temperature type. When activated, the units shall be non-restorable and give visual evidence of such operation. Heat detectors equal Simplex type 4098 series (135 degrees F).

2.5 HORNS/STROBES

- A. Horns/Strobe to equal Simplex type 4903 series. The units shall be polarized and shall be operated by 24 VDC. Each assembly shall include separate wire leads for in/out wiring for each leg of the associated signal circuit. T-tapping of signal device conductors to signal circuit conductors shall NOT be accepted. The visible unit to be 110 Candela-Second Xenon flash & horn to be 87dB @ 10 feet. The white lexan lens shall have the work "FIRE" in red lettering.

2.6 VISUAL LAMPS

- A. Visual indicating appliances equal Simplex type 4904 series. The lamp assembly shall incorporate a built-in reflector for more efficient light propagation and a special shock-mounting arrangement to resist bulb failure due to vibration. Lamp shall provide 4 wire connection to insure properly supervised in/out system connection. These units shall be U.L. listed and capable of either ceiling or wall mounting. The unit shall be complete with a temper resistant, pyramidal shaped lexan lens with "Fire" lettering visible on front. Visual units shall be 110 Candela-Second Xenon flash output to meet ADA requirements.

2.7 DOOR HOLDERS

- A. Door Holders: Magnetic door holders shall be Simplex type 2088-series and shall have an approximate holding force of 35 lbs. The door portion shall have a stainless steel pivotal mounted armature with shock absorbing nylon bearing. Unit shall be capable of being recessed mounted as required. Door holders shall be UL listed for their intended purpose. Locate as follows:

2.8 DUCT SMOKE DETECTORS

- A. Duct Smoke Detectors: Duct smoke detectors shall be Simplex type 4098 series and shall be of the solid state photoelectric type and shall operate on the light scattering photodiode principle. The detectors shall be designed to ignore invisible airborne particles or smoke densities that are below the factory set alarm point. No radioactive materials shall be used. Each duct detector to have associated model 2098-9806 remote alarm indicator & test switch located near by in mechanical room.
- B. Detector construction shall be of the split type, that is, mounting base with twist-lock detecting head. Contacts between the base and head shall be of the bifurcated type using spring-type, self-wiping contacts. Removal of the detector head shall interrupt the supervisory circuit of the fire alarm detection loops and cause a trouble signal a the control panel. Detector design shall provide full solid state construction and compatibility with other normally open fire alarm detection loop devices (heat detectors, pull stations, etc.). Duct housing couplings shall be slotted to insure proper alignment of the sampling and exhaust tubes. detector shall have an alarm LED visible through a transparent front cover. Detectors shall obtain their operating power from the supervised current in the fire alarm loop. Installation must comply with NFPA-09A.

2.9 WIRE/CABLE

- A. Non-power limited fire-protective signaling cable, copper conductor, 150 volt insulation rating 60°C.
- B. Power limited fire-protective signaling cable, copper conductor, 300 volt insulation rating 105°C.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Provide and install the system in accordance with the plans and specifications all applicable codes and the manufacturer's recommendations. All wiring shall be installed in strict compliance with all the provisions of NEC Article 760 A and C, Power Limited Fire Protective Signaling Circuits or if required, may be reclassified as no-power limited and wired in accordance with NEC Article 760 A and B. Upon completion, the contractor shall so certify in writing to the owner and general contractor. All junction boxes shall be sprayed red and labeled "Fire Alarm". Wiring color code shall be maintained throughout the installation.
- B. Installation of equipment and devices that pertain to other work in the contract shall be closely coordinated with the appropriate sub-contractors.
- C. The contractor shall clean all dirt and debris from the inside and the outside of the fire alarm equipment after completion of the installation.
- D. The manufacturer's authorized representative shall provide on-site supervision of installation.
- E. Install fire and smoke detection alarm system in accordance with manufacturer's instructions.
 - 1. Install manual station with operating handle 42" above floor & audible and visual signal devices 7'-3" above floor.
 - 2. Install fire alarm system wiring in conduit in concealed locations.
 - 3. Mount end-of-line device in box with last device or separate box adjacent to last device in circuit.
 - 4. Make conduit and wiring connections to duct smoke detectors.
 - 5. The system shall use closed loop initiating device circuits and be wired as such.
- F. All conduit, conduit fittings, pull boxes, junction boxes, 120V AC circuits and system ground cable shall be provided and installed by electrical contractor under Section 16110 - Raceway Systems.
- G. Racks, back boxes, etc. which are not standard rough-in items shall be provided by fire alarm contractor and installed by electrical contractor as part of rough-in.
- H. Provide for & coordinate with other contractors for the connection of their systems to fire alarm system. This may include, but not limited to sprinkler system flow & tamper switches, elevator capture, HVAC equipment shut-down & damper controls, telephone city tie, & fire pump controls.

Provide required relays & contacts to accomplish operation & connection.

3.2 TESTING

- A. The completed fire alarm system shall be fully tested in accordance with NFPA-72 by the contractor in the presence of the owner's representative and the Local Fire Marshall. Upon completion of a successful test, the contractor shall so certify in writing upon their letterhead to the Architect that all fire alarm pull stations, smoke and heat detectors, magnetically held open doors, lights, and horns have been checked and are in proper operation. One hundred percent (100%) of all devices shall be tested.

3.3 WARRANTY

- A. The contractor shall warrant the completed fire alarm system wiring and equipment to be free from inherent mechanical and electrical defects for a period of one (1) year from the date of the completed and certified tests or from the date of first beneficial use.
- B. The equipment manufacturer shall make available to the Owner, a maintenance contract proposal to provide a minimum of two (2) inspections and test per year in compliance with NFPA-72 guidelines.

END OF SECTION 16720