PROJECT MANUAL

October 2025

NORTH KINGSTOWN
MUNICIPAL OFFICE BUILDING

100 FAIRWAY DRIVE
N. KINGSTOWN, RI 02852
Washington County

VOLUME II

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NORTH KINGSTOWN MUNICIPAL OFFICE BUILDING

North Kingstown, Rhode Island 02852 AA# 22133.1

SECTION 22 07 00
PLUMBING INSULATION

PART 1 GENERAL

1.01 WORK INCLUDED

A. Piping insulation.

B. Jackets and accessories.

1.02 RELATED WORK

A. Section 22 10 00 - Plumbing Piping.

1.03 QUALITY ASSURANCE

A. Applicator: Company specializing in piping insulation applications with three years' minimum experience.

B. Materials: Flame spread/fuel contributed/smoke developed rating in accordance with NFPA 255 and UL 723. Fiberglass insulation shall have a flame spread rating of 25/smoke developed rating of 50; calcium silicate insulation shall have a flame spread rating of 0/smoke developed rating of 0.

PART 2 PRODUCTS

2.01 INSULATION

A. Molded pipe insulation shall be manufactured to meet ASTM C 585 for sizes required in the system. It shall be of the type suitable for installation on piping systems. Molded fibrous glass pipe insulation shall comply with the requirements of ASTM C 547.

B. For indoor systems operating at temperatures from zero to +450F: Heavy density Fiberglas pipe insulation with factory applied all-service jacket (ASJ) and Doublesure two component adhesive closure system, rated for a maximum service temperature of 850F. For large pipe sizes where SSL-II is not available, the single adhesive SSL closure may be substituted. Circumferential joints shall be sealed by butt strips having a two-component sealing system. Stapling is not required to complete the closure. When self-sealing lap systems are used, sufficient thickness of insulation shall be used to maintain the outer surface temperature of the operating system below +150F. Manufacturer's data regarding thickness constraints in relation to operating temperature shall be followed. When multiple layers are required, all inner layers(s) shall be unjacketed. On cold systems, vapor barrier performance is extremely important. All penetrations of the ASJ and exposed ends of insulation must be sealed with vapor barrier mastic. If humidities more than 90% are expected, the ASJ shall be protected with either a mastic coating or a suitable vapor retarding outer jacket. Vapor seals at butt joints shall be applied at every fourth pipe section joint and at each fitting to provide isolation from water incursion.

C. Fittings and valves shall be insulated with pre-formed fiberglass fittings, fabricated sections of Fiberglas pipe insulation, Fiberglas pipe and tank insulation, Fiberglas blanket insulation, or insulating cement.

Thickness shall be equal to adjacent pipe insulation. Finish shall be with pre-formed PVC fitting covers or as otherwise specified on contract drawings. Flanges, couplings, and valve bonnets shall be covered with an oversized pipe insulation section sized to provide the same insulation thickness as on the main pipe section. An oversized insulation section shall be used to form a collar between the two insulation sections with low density blanket insulation being used to fill gaps. Jacketing shall match that used on straight pipe sections. Rough cut ends shall be coated with suitable weather or vapor resistant mastic as dictated by the system location and service. On hot systems where fittings are to be left exposed, insulation ends should be beveled away from bolts for easy access. On cold systems, particular care must be given to vapor sealing the fitting cover or finish to the pipe insulation vapor barrier. All valve stems must be sealed with caulking which allows free movement of the stem but provides a seal against moisture incursion.

D. All piping shall be supported in such a manner that neither the insulation or the vapor/weather barrier is compromised by the hanger or the effects of the hanger. In all cases, hanger spacing must be such that the circumferential joint may be made outside the hanger. On cold systems, vapor barrier must be continuous, including material covered by the hanger saddle.

E. Piping systems 3" in diameter or less, insulated with Fiberglas insulation, may be supported by placing saddles of the proper length and spacing under the insulation.

F. Thermal expansion and contraction of the piping and insulation system can generally be taken care of by utilizing double layers of insulation and staggering both longitudinal and circumferential joints. Where long runs are encountered, expansion joints may be required where single layers of insulation are being used and should be noted on the contract drawings.

G. On vertical runs, insulation support rings shall be used as indicated on contract drawings.

PART 3 EXECUTION

3.01 SITE INSPECTION

A. Before starting work under this section, carefully inspect the site and installed work of other trades and verify that such work is complete to the point where installation of materials and accessories under this section can begin.

B. Verify that all materials and accessories can be installed in accordance with project drawings and specifications and material manufacturers' recommendations.

C. Verify, by inspecting product labeling, submittal data, and/or certifications which may accompany the shipments, that all materials and accessories to be installed on the project comply with applicable specifications and standards and meet specified thermal and physical properties.

3.02 PREPARATION

A. Ensure that all pipe and equipment surface over which insulation is to be installed are clean and dry.

B. Ensure that insulation is clean, dry, and in good mechanical condition with all factory-applied vapor or weather barriers intact and undamaged. Wet, dirty, or damaged insulation shall not be acceptable for installation.

C. Ensure that pressure testing of piping or duct systems has been completed prior to installing insulation.

3.03 INSTALLATION

A. Install all insulation materials and accessories in accordance with manufacturers' published instructions and recognized industry practices to ensure that it will serve its intended purpose.

B. Install insulation on piping subsequent to installation of heat tracing, painting, testing, and acceptance tests.

C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. Butt insulation joints firmly to ensure complete, tight fit over all piping surfaces.

D. Maintain the integrity of factory-applied vapor barrier jacketing on all pipe insulation, protecting it against puncture, tears, or other damage.

E. Fittings: Cover valves, fittings, and similar items in each piping system using one of the following: Mitered sections of insulation equivalent in thickness and composition to that installed on straight pipe runs, or Insulation cement equal in thickness to the adjoining insulation, or PVC fitting covers insulated with material equal in thickness and composition to adjoining insulation.

F. Penetrations: Extend piping insulation without interruption through walls, floors, and similar piping penetrations, except where otherwise specified.

G. Joints: Butt pipe insulation against hanger inserts. For hot pipes, apply 3" wide vapor barrier tape or band over butt joints. For cold piping apply wet coat of vapor barrier lap cement on butt joints, and seal joints with 3" wide vapor barrier tape or band. All pipe insulation ends shall be tapered and sealed, regardless of service.

H. Vertical Piping: All insulated, exposed vertical piping within the building and all insulated piping exposed to the outdoors shall be additionally jacketed with 0.016" thick (minimum) aluminum. Vertical piping shall be protected to a height of 8'-0" above the floor.

3.04 FIELD QUALITY ASSURANCE

A. Upon completion of all insulation work covered by this specification, visually inspect the work and verify that it has been correctly installed. This may be done while work is in progress, to assure compliance with requirements herein to cover and protect insulation materials during installation.

3.05 PROTECTION

A. Replace damaged insulation which cannot be satisfactorily repaired, including insulation with vapor barrier damage and moisture-saturated insulation.

B. The insulation contractor shall advise the general and/or the mechanical contractor as to requirements for protection of the insulation work during the remainder of the construction period, to avoid damage and deterioration of the finished insulation work.

3.06 SAFETY PRECAUTIONS

A. Insulation contractor's employees shall be properly protected during installation of all insulation. Protection shall include proper attire when handling and applying insulation materials and shall include (but not be limited to) disposable dust respirators, gloves, hard hats, and eye protection.

B. The insulation contractor shall conduct all jobsite operations in compliance with applicable provisions of the Occupational Safety and Health Act, as well as with all state and/or local safety and health codes and regulations that may apply to the work.

3.07 SCHEDULE

A. Domestic Hot and Cold Water - use the following thicknesses of insulation:

Pipe Size	Insulation Thickness
Runouts (to 1")	1/2 inch
Up to 2"	1 inch
2 1/2" and over	1 1/2 inch

B. Condensate Waste Piping, Exposed Copper Waste Piping, Piping Concealed Within Concrete Block Walls or Buried Within Floor Slab - use 3/4-inch-thick insulation for all pipe sizes.

END OF SECTION 22 07 00

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SECTION 22 10 00
PLUMBING PIPING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Pipe and pipe fittings.

B. Valves.

C. Sanitary sewer piping system.

D. Domestic water piping system.

E. Fuel oil piping.

1.02 RELATED WORK

A. Section 22 07 00 - Piping Insulation.

B. Section 22 40 00 - Plumbing Fixtures.

1.03 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body. All valves shall be totally lead-free.

B. Fittings: All domestic water piping fittings shall be totally lead-free.

C. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.

D. Welders Certification: In accordance with ANSI/ASME Sec 9.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site.

B. Store and protect products.

C. Deliver and store valves in shipping containers with labelling in place.

PART 2 PRODUCTS

2.01 SANITARY WASTE AND VENT PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Cast Iron Pipe: ASTM A74 extra heavy weight. Fittings: Cast iron. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.

B. PVC Pipe: ASTM D2665, Schedule 40. Fittings: PVC. Joints: ASTM D2855, solvent weld. Use only if approved by local authority having jurisdiction.

2.02 SANITARY WASTE AND VENT PIPING, ABOVE GRADE

A. Cast Iron Pipe: ASTM A74, service weight. Fittings: Cast iron. Joints: Hub-and-spigot, CISPI HSN compression type with ASTMC-564 neoprene gaskets or lead and oakum.

B. Cast Iron Pipe: CISPI 301, hubless, service weight. Fittings: Cast iron. Joints: Pipe and fittings joined with clamp-and-shield couplings constructed of Type 304 stainless steel and incorporating a neoprene gasket meeting ASTM C564. Use only in accessible locations.

C. PVC Pipe: ASTM D2665, Schedule 40. Fittings: PVC. Joints: ASTM D2855, solvent weld. Use only if approved by local authority having jurisdiction.

D. Copper Pipe: ASTM B88, Type K, hard drawn; Fittings; ANSI/ASME B16.29, wrought copper. Joints: ANSI/ASTM B32, solder, Grade 95TA.

2.03 WATER PIPING AND CONDENSATE WASTE PIPING, ABOVE GRADE

A. Copper Tubing: ASTM B88, Type L, hard drawn. Fittings: ANSI/ASME B16.29, wrought copper. Joints: Use lead-free solder on all joints.

B. Copper Tubing: ASTM B88, Type K, hard drawn. Fittings; ANSI/ASME B16.29, wrought copper. Joints: Use lead-free solder on all joints. Use one-piece Type K copper for water piping installed within concrete block walls.

C. PVC Pipe: ASTM D2729, Schedule 40. Fittings: PVC. Joints: ASTM D2855, solvent weld. May be used only for condensate waste piping, if approved by local authority having jurisdiction.

D. CPVC Pipe and Fittings: Schedule 40 / Schedule 80 pipe and fittings shall be manufactured from a Type IV, Grade I Chlorinated Polyvinyl Chloride (CPVC) compound with a Cell Classification of 23447 per ASTM D1784. The pipe shall be manufactured in strict compliance to ASTM F441, consistently meeting the quality assurance test requirements of this standard regarding material, workmanship, burst pressure, flattening, and extrusion quality. The pipe shall be produced in the USA using domestic materials, by an ISO 9001 certified manufacturer, and shall be stored indoors after production, at the manufacturing site, until shipped from the factory. This pipe shall carry the National Sanitation Foundation (NSF) seal of approval for potable water applications.

2.04 FUEL OIL PIPING, BURIED

A. Copper tubing: ASTM B88, Type L, hard drawn. Fittings: ANSI/ASME B16.29, wrought copper. Joints: AWS A5.8, BCuP silver braze. Encase within Schedule 80 PVC conduit, 3-inch diameter (minimum).

B. Steel Pipe: ASTM A53 or A120, Schedule 40 black. Fittings: ASTM A234, forged steel welding type, with ANSI/AWWA C105 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape. Joints: ANSI/AWS D1.1, welded.

2.05 FUEL OIL PIPING, ABOVE GROUND

A. Copper Tubing: ASTM B88, Type L, hard drawn. Fittings: ANSI/ASME B16.23, cast brass, or ANSI/ASME B16.29, wrought copper. Joints: ANSI/ASTM B32, solder, Grade 95TA.

B. Steel Pipe: ASTM A53 or A120, Schedule 40 black. Fittings: ANSI/ASTM B16.3, malleable iron, or ASTM A234, forged steel welding type. Joints: Screwed for pipe two inches and under; ANSI/AWS D1.1, welded, for pipe over two inches.

2.06 FLANGES, UNIONS, AND COUPLINGS

A. Pipe Size 2 Inches and Under: 150 psig malleable iron unions for threaded ferrous piping; lead-free bronze unions for copper pipe, soldered joints.

B. Pipe Size Over 2 Inches: 150 psig forged steel slip-on flanges for ferrous piping; lead-free bronze flanges for copper piping; neoprene gaskets for gas service; 1/16-inch-thick preformed neoprene bonded to asbestos.

C. Grooved and Shouldered Pipe End Couplings: Malleable iron housing clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; "C" shape composition sealing gasket; steel bolts, nuts, and washers; galvanized couplings for galvanized pipe.

D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.07 GLOBE VALVES

A. Up to 2 Inches: Bronze body, bronze trim, rising stem and handwheel, inside screw, renewable composition disc, solder, or screwed ends, with backseating capacity.

B. Over 2 Inches: Iron body, bronze trim, rising stem, handwheel, OS&Y, plug-type disc, flanged ends, renewable seat, and disc.

2.08 BALL VALVES

A. Up to 2 Inches: Bronze one piece body, stainless steel ball, teflon seats and stuffing box ring, lever handle, and balancing stops where required or shown on drawings, solder, or threaded ends.

B. Over 2 Inches: Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, flanged.

2.09 SWING CHECK VALVES

A. Up to 2 Inches: Bronze 45-degree swing disc, solder, or screwed ends.

B. Over 2 Inches: Iron body, bronze trim, 45-degree swing disc, renewable disc and seat, flanged ends.

2.10 RELIEF VALVES

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

2.11 SUPPLY STOPS

A. Chrome plated rigid or flexible supply stops with angle valves with threaded inlet connections, wheel type handles, reducers, and escutcheons. Provide new rigid or flexible supply stops to all new fixtures, including kitchen equipment supplied by others.

2.12 AIR CHAMBERS AND SHOCK ARRESTORS

A. Provide air chambers at the far end of each hot and cold-water supply branch, to each single fixture and group of fixtures. Air chambers shall be full size of branch connection or 1 inch diameter minimum (whichever is the larger) and 18 inches long for single fixtures, with measured distance from tee connection at fixture supply to top of air chamber.

B. In place of air chambers, stainless steel metal bellows type shock arrestors with sealed-in air charge may be used, if approved by Engineer prior to installation. All parts which come in contact with water shall be stainless steel. Shock arrestors shall be sized in accordance with PDI WH-201. Note that the contractor shall be responsible for installing shock arrestors wherever quick-closing valves or devices are used in the plumbing system (i.e. such as and including washing machines), although these shock arrestors may not be explicitly identified and located on the Project Drawings.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale, oil, and dirt, inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

A. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

B. Route piping in orderly manner and maintain gradient.

C. Install piping to conserve building space and not interfere with use of space.

D. Group piping whenever practical at common elevations.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

F. Provide clearance for installation of insulation and access to valves and fittings.

G. Provide access where valves and fittings are not exposed.

H. Slope water piping and arrange to drain at low points.

I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

J. Prepare pipe, fittings, supports, and accessories not prefinished, ready for finish painting.

K. Establish invert elevations, with slopes for drainage at 1/4 inch per foot minimum for pipe sizes up to 2 1/2" and at 1/8 inch per foot minimum for pipe sizes above 2 1/2". Maintain gradients.

L. Install bell and spigot pipe with bell end upstream.

M. Install valves with stems upright or horizontal, not inverted.

N. Provide one plug cock wrench for every ten plug cocks sized 2 inches and smaller, minimum of one. Provide each plug cock sized 2-1/2 inches and larger with a wrench with set screw.

O. Use lead-free solder and flux for all domestic hot and cold water piping joint connections.

P. Use Type K, one-piece copper piping insulated with 1/2 inch thick flexible closed-cell polyethylene insulation for all water piping which is installed within concrete block walls or buried within the floor slab. Refer to Section 15260 for piping insulation.

Q. Install condensate waste piping from equipment waste connection to outdoors or nearest indirect waste connection, with P-trap at outlet connection on each piece of equipment. Condensate waste piping, with P-traps, shall be provided and installed for all air conditioning equipment with cooling coils, and wherever else required or indicated. Provide cleanouts in condensate waste piping system at all changes in direction greater than 45 degrees and not more than 50 feet apart on horizontal runs of condensate waste piping. The contractor shall be responsible for locating required cleanouts, although cleanouts have not been explicitly identified on the Drawings due to space limitations.

R. Horizontal waste piping branches shall connect to the base of a stack or horizontal stack offset a minimum of ten pipe diameters from the stack in the direction of flow.

S. Do not "bullhead" any piping systems.

T. Install all piping at elevations indicated on Project Drawings. Where no elevations are indicated, install piping as high as possible.

3.03 APPLICATION

A. Use mechanical couplings and fasteners only in accessible locations. Provide adequate clearances for service.

B. Install unions downstream of valves and at equipment or apparatus connections.

C. Install lead-free bronze male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.

D. Install gate or ball valves for shutoff and to isolate equipment, part of systems, or vertical risers.

E. Install globe or ball valves for throttling, bypass, or manual flow control services.

F. Provide spring loaded check valves on discharge of water pumps.

G. Install shock arrestors complete with accessible isolation valve.

H. Do not use PVC piping as part of the building sanitary waste piping system whenever service water temperatures exceed 140 degrees F. If not certain whether PVC piping will be acceptable, consult Architect/Engineer prior to submission of bid.

3.04 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Prior to starting work, verify if the system is complete, flushed and clean.

B. Ensure PH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

C. The complete piping system, or parts thereof, shall be filled with a water/chlorine solution containing at least 50 mg/l (ppm) of chlorine, and then the piping system, or parts thereof, shall be valved off and allowed to stand for 24 hours.

D. Bleed water from outlets and flush system with clean potable water until chlorine does not remain in the water coming from the system.

E. Take samples no sooner than 24 hours after flushing, from 5 percent of outlets and from water entry, and analyze in accordance with methods prescribed by the health authority having jurisdiction. Repeat the entire procedure if it is shown by a bacteriological examination made by the testing authority that contamination is still present in the system.

3.05 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 reduced pressure backflow preventer and water meter with by-pass valves. Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Caulk the

enlarged sleeves and make watertight with pliable material. Anchor service main inside to concrete wall. Verify main system's water pressure from source to new water service, and, where new water service pressure exceeds 80 PSI, also provide line-size pressure reducing valve downstream of new water meter.

END OF SECTION 22 10 00

SECTION 22 30 00
PLUMBING EQUIPMENT

PART 1 GENERAL

1.01 WORK INCLUDED

A. Water heaters.

B. Pumps.

1.02 QUALITY ASSURANCE

A. Provide pumps with manufacturer's name, model number, and rating/capacity identified.

B. Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:

1. National Sanitation Foundation (NSF).
2. American Society of Mechanical Engineers (ASME).
3. National Board of Boiler and Pressure Vessel Inspectors (NBBPVI).
4. National Electrical Manufacturers' Association (NEMA).
5. Underwriters Laboratories (UL).

C. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.03 REGULATORY REQUIREMENTS

A. Conform to AGA and UL 174 requirements for water heaters.

B. Conform to ANSI/ASME Section 8D for manufacture of pressure vessels for heat exchangers.

C. Conform to ANSI/NFPA 30 for tanks.

1.04 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Division 1 Specifications.

B. Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division 1 Specifications.

B. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.06 WARRANTY

A. Provide one year manufacturer's warranty.

B. Warranty: Include coverage of domestic water heaters and in-line circulator.

PART 2 PRODUCTS

2.01 STORAGE WATER HEATERS (INDIRECT FIRED)

A. Furnish and install, where shown on the Project Drawings, indirect-fired storage water heaters. Each water heater shall be equal to Amtrol Boiler Mate Series Hot Water Maker, model, size, and capacity as noted on the Project Drawings. The complete unit shall be furnished with a built-in thermostat.

B. Lining: The storage section shall be lined with 100 percent corrosion-free polyethylene.

C. Connections: Boiler water shell connections shall be 3/4-inch NPT black iron; cold water inlet and hot water outlet shell connections shall be 3/4-inch brass NPT. Drain valve connection shall be 3/4-inch NPT at bottom of water heater, with drain valve furnished with water heater.

D. Heating Section: Water heater heating section shall be double wall construction, vertically mounted and removable type, protective-coated, double wound parallel flow heat exchanger.

E. Storage Tank Insulation: Water heater shall have rigid molded urethane foam insulation sandwiched between inner lining and outer tank shell.

F. Accessories: Water heaters shall be furnished complete with the following accessories:

1. 3/4" flow-check valve
2. 3/4" AGA/ASME rated temperature and pressure relief valve
3. 3/4" line-mounted vacuum breaker, installed in hot water discharge piping
4. Electrical relay to allow priority or non-priority control of water heater, complete with junction box

2.02 COMMERCIAL ELECTRIC WATER HEATERS

A. Automatic, vertical storage type, 150 psig maximum working pressure. Capacities and ratings shall be as indicated on the project drawings.

B. Glass lined welded steel tank, with tank inspection port, thermally insulated with minimum 2 inches glass fiber, encased in corrosion-resistant steel jacket; baked-on enamel finish; floor shield and legs.

C. Brass water connections, drain valve, high-density magnesium anode, and AGA temperature steam rated temperature and pressure relief valve.

D. Unit approved by UL as automatic storage water heater.

E. Automatic direct immersion thermostat with adjustable temperature range, minimum 175 degrees F differential, automatic reset high temperature limiting thermostat, factory set at 205 degrees F.

F. Accessories: Water heater shall be furnished complete with the following accessories:

1. 3/4" flow-check valve

2. 3/4" AGA/ASME rated temperature and pressure relief valve
3. 3/4" line-mounted vacuum breaker, installed in hot water discharge piping

PART 3 EXECUTION

3.01 WATER HEATER INSTALLATION

A. Install water heaters in accordance with manufacturer's instructions and to AGA and UL requirements.

B. Coordinate with plumbing piping and related fuel piping gas venting and electrical work to achieve operating system.

C. Install storage tanks in accordance with manufacturer's instructions.

D. Provide angle legs or skirt support for tanks independent of building structural framing members.

E. Clean and flush tank after installation. Seal until pipe connections are made.

F. Apply insulation as close as possible to storage tank by grooving, scoring, and beveling insulation, if necessary. Secure insulation to tank with studs, pins, clips, adhesive, wires, or bands. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. Cover insulation with metal mesh and finish with heavy coat of insulating cement. Do not insulate over nameplate or ASME stamps. Bevel and seal insulation around such.

G. Contractor shall provide all control devices and wiring, as required, to put the water heater in proper operational mode.

3.02 PUMP INSTALLATION

A. Install it in accordance with the manufacturer’s instructions.

B. Provide air cock and drain connection on horizontal pump casings.

C. Provide line sized ball valve and strainer on suction and line sized soft seated check valve and globe valve on discharge.

D. Decrease from line size, with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings.

E. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

F. This contractor shall provide all control wiring for proper operation of recirculating pump. Pumps shall cycle on and off as required to maintain water temperature as determined by aquastat setting.

END OF SECTION 23 30 00

SECTION 22 40 00
PLUMBING FIXTURES

PART 1 GENERAL

1.01 WORK INCLUDED

A. Water closets.

B. Lavatories.

C. Sinks.

D. Service sinks.

E. Showers.

1.02 RELATED WORK

A. Section 22 10 00 - Plumbing Piping.

B. Related Division 1 Specifications.

1.03 QUALITY ASSURANCE

A. Fixtures and trim: By same manufacturer for each product specified throughout.

B. All fixtures and trims shall comply with Federal and State regulations regarding maximum permissible content of lead in these products. More stringent of these requirements shall apply in all cases. It shall be the Contractor's responsibility to verify that lead content for all products used on this Project to comply with applicable regulations.

1.04 SUBMITTALS

A. Include fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

B. Fixtures submitted for use on the Project, substituted for those fixtures as herein specified, shall be verified by the contractor to have equal or lesser requirements regarding pressures required for proper fixture operation. Particular attention shall be paid to fixtures with flush valve trim. The contractor shall accept all responsibility for any resulting inadequate operating pressures which result from the substitution of fixtures as specified herein.

1.05 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Division 1 Specifications.

B. Include fixture trim exploded view and replacement parts lists.

1.06 WARRANTY

A. Provide a one-year warranty.

PART 2 PRODUCTS

2.01 PLUMBING FIXTURES

A. Refer to Project Drawings for all plumbing fixture model numbers and specifications.

PART 3 EXECUTION

3.01 INSPECTION

A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

B. Verify adjacent construction is ready to receive rough-in work of this Section.

3.02 INSTALLATION

A. Install each fixture with trap, easily removable for servicing and cleaning.

B. Provide chrome plated rigid or flexible supplies to all fixtures, with angle valves with wheel handles or loose key lock shield handles, reducers, and escutcheons.

C. Install components level and plumb.

D. Install and secure fixtures in place with wall supports, wall carriers and bolts.

E. Seal fixtures to wall and floor surfaces with sealant.

F. Cover all exposed waste and water piping beneath handicapped use lavatories and sinks with form-fitted vinyl plastisol insulation, equal to Brocar Products "Trap Wrap".

3.03 ADJUSTING AND CLEANING

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

B. At completion clean plumbing fixtures and equipment.

C. Solidly attach water closets to floor with lag screws. Lead flashing is not intended to hold fixture in place.

END OF SECTION 22 40 00

NORTH KINGSTOWN
MUNICIPAL OFFICE BUILDING
North Kingstown, Rhode Island 02852 AA# 22133.1

SECTION 23 03 00
BASIC MECHANICAL REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Basic Mechanical Requirements specifically applicable to Division 23 Sections, in addition to Division 1 - General Requirements.

1.02 WORK SEQUENCE

A. Install work in phases to accommodate Owner's occupancy requirements during the construction period. Coordinate mechanical schedule and operations with Architect/Engineer.

1.03 ALTERNATES

A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at the Owner's option. Accepted Alternates will be identified in Owner-Contractor Agreement.

B. Coordinate related work and modify surrounding work as required.

C. Schedule of Alternates - see Division 1 Specifications.

1.04 SUBMITTALS

A. Submit under provisions of Division 1 Specifications. Provide submittals, including specifications, design data, and calculations (as required) for all equipment and materials relating to Division 23 Specifications which are proposed for use on the project. No work will be allowed to proceed until the Architect/Engineer's submittal review is completed.

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.

D. Products which are submitted for use on the Project must be equal in quality, performance and serviceability to the products as shown on the Project Drawings and Specifications, including any accessories as noted or specified. It shall be the mechanical contractor's responsibility to verify product equality to the Architect/Engineer's satisfaction before substitution of products will be allowed. If requested, the contractor shall furnish samples of any submitted equipment and materials for general inspection to check for conformity with the requirements of the Specifications.

E. Where the contractor proposes to use items and equipment other than those specified and/or detailed on the Project Drawings, which may require any redesign of the structure, partitions, foundation, piping, wiring, or any other parts of the mechanical, electrical, and/or architectural layouts, all such required redesign, including new drawings and detailing necessary, shall be prepared by the contractor at the contractor's expense, and shall be approved by the Architect/Engineer.

F. The mechanical contractor shall prepare and submit As-Built drawings of all systems and equipment at the completion of all the systems' installation. These drawings shall be provided to the Architect/Engineer for review and approval. Any deviations from the original Project Drawings shall be noted.

G. If requested, the mechanical contractor shall submit a schedule of values, reflecting reasonable and true line item costs, to the Architect/Engineer as part of the Project records. This schedule of values will be submitted prior to the start of construction.

1.05 REGULATORY REQUIREMENTS

A. Obtain permits, and request inspections from authorities having jurisdiction. All permits, inclusive of their associated costs, are the responsibility of the contractor who performs the related work. The contractor shall verify availability of utility services, including water and natural gas pressures required, invert elevations for connection to sanitary waste systems, etc., and obtain authorization and approval from the respective utility for connections as required for this Project. Any fees required by the respective utilities for installation and connection to these services shall be the responsibility of the contractor. Satisfactory proof of final inspection and approval by all authorities having jurisdiction shall be presented to the Architect/Engineer before work is accepted.

B. All materials and equipment shall be designed, constructed, installed, and tested in strict accordance with these specifications and the latest editions of all the following applicable standards:

Rhode Island State Building Code	RISBC
National Environmental System Contractors Assoc.	NESCA
American Society of Mechanical Engineers	ASME
American Society of Testing Materials	ASTM
National Electric Code	NEC
National Fire Code	NFC
National Fire Protection Association	NFPA
Underwriters Laboratories, Inc.	UL
National Electrical Manufacturers Association	NEMA
Occupational Health and Safety Act	OSHA
Air Conditioning and Refrigeration Inst.	ARI
Air Moving and Conditioning Association	AMCA
American Society of Heating, Refrigeration and Air Conditioning Engineers	ASHRAE
Environmental Protection Agency	EPA
Building Officials Conference of America	BOCA
Federal Construction Safety Standards	FCSS
American Gas Association	AGA
Sheet Metal and Air Conditioning Contractors National Association	SMACNA
All applicable local ordinances and codes	

C. The above-listed codes and standards shall be followed as minimum requirements and shall not relieve the mechanical contractor of any additional requirements as indicated on the Project Drawings or as herein specified. Where provisions of pertinent codes and standards conflict with Division 23 Specifications, the more stringent provisions shall govern and shall be conformed to.

D. Any materials or workmanship called for in the above referenced requirements not specified or shown on the Drawings shall be furnished and installed by the contractor as though same had been specifically indicated or mentioned. Any work installed in conflict with these requirements shall become the sole responsibility of the contractor, who shall assume the expense to rectify the installation to the Architect/Engineer's satisfaction.

E. The contractor shall notify the Architect/Engineer of any deviations from the above referenced requirements pertaining to work indicated or specified before the installation of this work is affected.

F. The contractor is strongly urged to visit the jobsite and review existing conditions which may affect the contractor's work, prior to submission of bid. The contractor shall be advised that no extra compensation will be provided for any additional work required to be done to provide complete functional systems if a site review has identified the necessity for the additional work. This condition will be strictly conformed to, even if all required work is not explicitly indicated on the Project Drawings.

1.06 PROJECT/SITE CONDITIONS

A. Install Work in locations shown on Drawings, unless prevented by Project conditions. As the drawings are diagrammatic and approximate, unless fixed by dimensions, actual field conditions shall govern the exact location of ductwork and piping installation locations. Do not scale Drawings for exact locations. Maintain all required clearances from and around all new and existing mechanical and electrical equipment and apparatus, as noted in equipment or apparatus manufacturer's installation requirements or applicable standards and codes.

B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of Architect/Engineer before proceeding. No additional compensation will be allowed for these changes as required by Project conditions.

C. It shall be the contractor's responsibility to review all Project Drawings which may affect the location of any equipment and apparatus installation locations and/or permit full coordination of work with other trades. The right to make any reasonable change in location of apparatus and equipment up to the time of rough-in is reserved by the Architect/Engineer. Such changes shall be made without additional expense to the Owner.

1.07 SEQUENCING AND SCHEDULING

A. Construct Work in sequence under provisions of Division 1 Specifications.

1.08 TESTING, ADJUSTING AND BALANCING

A. The general contractor shall be responsible for providing the services of an AABC or NEBB certified testing, adjusting and balancing firm. This balancing firm shall be responsible for testing, adjusting, and balancing all systems and equipment to the satisfaction of the Architect/Engineer. This work shall be performed by a firm that is not directly or indirectly employed by the mechanical contractor.

B. All required tests shall be done in the presence of the Architect/Engineer, or their representatives.

1.09 SPECIFIC REQUIREMENTS

A. Only the latest editions and revisions of standards and codes referenced in Division 23 Specifications shall apply to the work.

B. The Specifications and Project Drawings are complementary, one to the other. Any items mentioned or called for by one shall be considered as being indicated in both the Specifications and the Project Drawings.

C. The contractor shall provide all labor, materials, tools and equipment required for complete and satisfactory installation.

D. All materials and equipment shall be delivered to the job site wrapped in protective covering, and shall be stored in a clean, dry location free from dust and water, in such a manner to permit easy access for inspection and handling. Damaged items shall be replaced at no additional cost to the Owner. Any items subject to moisture or condensation shall be completely replaced at no additional cost to the Owner.

E. The mechanical contractor shall be responsible for providing starters and disconnects for all equipment specified under Division 15 Specifications, unless explicitly stated otherwise. Starters shall be Cutler Hammer or equal with push buttons, HAND-OFF-AUTO switches, overload and low voltage protection, and auxiliary contacts as required by operational sequences. Starters for three-phase motors shall be magnetic type, unless stated otherwise. When automatic or interlocking control of single-phase motors is required, provide magnetic starters. Starters for two-speed motors shall be two-speed consequent pole type, with decelerating time delay relay for 30 second delay when switching from high to low speed. Manually controlled single-phase motors shall be provided with a two-pole manual thermal switch. Starters and disconnects for outdoor use shall be of weatherproof type (NEMA Type 3R).

1.10 DEFINITIONS

A. "Contractor" specifically means sub-contractor working under his respective section of specifications.

B. "Furnish" and/or "Provide" means to supply, erect, install and connect completely in readiness for regular operation, particular work referred to, unless otherwise specified.

C. "Piping" includes in addition to the pipe, all fittings, valves, hangers, and other accessories relating to such piping.

D. "Ductwork" includes in addition to pipe, all fittings, valves, hangers, and other accessories relating to such piping.

E. "Concealed" means hidden from view, in chases, walls or underground.

F. "Exposed" means not installed underground or concealed as defined above.

G. "Supply" means purchase and delivery of material to the site.

H. "Install" means to erect in place the supplied item.

1.11 GUARANTEE

A. The mechanical contractor shall guarantee, in writing, the quality of all materials, equipment and workmanship furnished and installed by the mechanical contractor for a period of one year from the date of final acceptance of this installation by the Owner, and shall replace any defective apparatus, material and equipment at the mechanical contractor's expense. This guarantee shall be endorsed and shall be submitted to the Owner by the General Contractor.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 23 03 00

SECTION 23 05 29
SUPPORTS AND ANCHORS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Pipe, duct, and equipment hangers and supports.

B. Equipment bases and supports.

C. Sleeves and seals.

D. Flashing and sealing equipment and pipe stacks.

PART 2 PRODUCTS

2.01 PIPE HANGERS AND SUPPORTS

A. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron, adjustable swivel, split ring.

B. Hangers for Pipe Sizes 2 to 4 Inches and Cold Pipe Sizes 6 Inches and Over: Carbon steel, adjustable, clevis.

C. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.

D. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp; adjustable steel yoke and cast-iron roll for hot pipe sizes 6 inches and over.

E. Vertical Support: Steel riser clamp.

F. Floor Support for Pipe Sizes to 4 Inches and All Cold Pipe Sizes: Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support.

G. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

H. Shield for Insulated Piping 2 Inches and Smaller: 18 gage galvanized steel shield over insulation in 180-degree segments, minimum 12 inches long at pipe support.

I. Shield for Insulated Piping 2-1/2 Inches and Larger (Except Cold Water Piping): Pipe covering protective saddles.

J. Shields for Insulated Cold Water Piping 2-1/2 Inches and Larger: Hard block non-conducting saddles in 90-degree segments, 12-inch minimum length, block thickness same as insulation thickness.

K. Shields for Vertical Copper Pipe Risers: Sheet lead.

2.02 HANGER RODS

A. Steel Hanger Rods: Threaded both ends, threaded one end, or continuous threaded.

2.03 INSERTS

A. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.04 FLASHING

A. Metal Flashing: 26 gage galvanized steel.

B. Lead Flashing: 5 lb/sq ft sheet lead for waterproofing; one lb/sq ft sheet lead for soundproofing.

C. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.

D. Caps: Steel, 22 gage minimum; 16-gage at fire resistant elements.

2.05 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Floors: Form with 18 gage galvanized steel.

B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Form with steel pipe or 18 gage galvanized steel.

C. Sleeves for Domestic Hot and Cold-Water Piping, Cast Iron, PVC, and Copper DWV Piping, Electrical and Communications Conduit Through Fire Rated and Fire Resistive Floors and Walls: Prefabricated fire rated sleeves. All openings shall have been tested and approved by UL. Utilize proper rated penetrations equal to or greater than the barrier assembly at which the penetration occurs.

D. Sleeves for Round Ductwork: Form with galvanized steel.

E. Sleeves for Rectangular Ductwork: Form with galvanized steel.

2.06 FABRICATION

A. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

B. Design hangers without disengagement of supported pipe.

C. Provide copper plated hangers and supports for copper piping.

2.07 FINISH

A. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

PART 3 EXECUTION

3.01 INSERTS

A. Provide inserts for placement in concrete formwork.

B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

D. Where concrete slabs form the finished ceiling, provide inserts to be flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide thru-bolt with recessed square steel plate and nut flush with top of slab.

3.02 PIPE AND DUCTWORK HANGERS AND SUPPORTS

A. Support horizontal piping as follows:

PIPE SIZE	MAX. HANGER SPACING	HANGER DIAMETER
1/2 to 1-1/4 inch	6'-0"	3/8"
1-1/2 to 2 inch	10'-0"	3/8"
2-1/2 to 3 inch	10'-0"	1/2"
4 inch	10'-0"	5/8"
PVC (All Sizes)	4'-0"	3/8"
C.I. Bell and Spigot (or No-Hub)	5'-0" and at joints	1/2"

B. Install hangers to provide a minimum of 1/2 inch space between finished covering and adjacent work.

C. Place a hanger within 12 inches of each horizontal elbow.

D. Use hangers with 1-1/2-inch minimum vertical adjustment.

E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.

F. Support vertical piping on every floor. Support vertical cast iron pipe at each floor at hub.

G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

H. Support riser piping independently of connected horizontal piping.

I. Support all ductwork in accordance with SMACNA standards, latest edition(s).

J. All piping and ductwork shall be supported independently from the building structure. In no circumstance will supports and/or hangers be allowed to be attached from adjacent piping and/or ductwork.

3.03 EQUIPMENT BASES AND SUPPORTS

A. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

B. Construct support of steel members. Brace and fasten with flanges bolted to structure.

C. Provide rigid anchors for pipes after vibration isolation components are installed.

D. Provide six-inch-high concrete pad for each pump, boiler and/or air handling unit set on floor. Overall pad dimensions shall be equal to equipment dimensions plus six inches all around.

3.04 FLASHING

A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.

B. Flash vent and soil pipes projecting 3 inches minimum above finished roof surface with lead worked one inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counterflash and seal.

C. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36-inch sheet size. Fasten flashing to drain clamp device.

D. Seal all drains, cleanouts, and all other floor and/or roof penetrations watertight to adjacent materials.

E. Provide curbs for mechanical roof installations 14 inches minimum high above roofing surface. Flexible sheet flash and counterflash with sheet metal; seal watertight.

3.05 SLEEVES

A. Set sleeves in position in formwork. Provide reinforcing around sleeves.

B. Extend sleeves through floors one inch above finished floor level. Caulk sleeves full depth and provide floor plate.

C. Where piping, conduit or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with firestopping insulation and caulk seal airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration. Refer to Specification Section 15100 for approved firestopping materials and methods.

D. Install chrome plated steel escutcheons on finished surfaces.

E. All firestopping and waterproofing devices installed at penetrations and openings through fire resistive walls and floors shall be in strict accordance with the manufacturer's instructions.

END OF SECTION 23 05 29

SECTION 23 07 13
DUCTWORK INSULATION

PART 1 GENERAL

1.01 WORK INCLUDED

A. Ductwork insulation.

B. Insulation jackets.

1.02 RELATED WORK

A. Section 23 31 00 - Ductwork.

1.03 QUALITY ASSURANCE

A. Applicator: Company specializing in ductwork insulation application with three years minimum experience.

B. Materials: Flame spread/fuel contributed/smoke developed rating in accordance with NFPA 255 and UL 723. Fiberglass insulation shall have a flame spread rating of 25/smoke developed rating of 50; calcium silicate insulation shall have a flame spread rating of 0/smoke developed rating of 0.

1.04 SUBMITTALS

A. Submit product data under provisions of Division 1 Specifications.

B. Include product description, list of materials and thickness for each service, and locations.

C. Submit manufacturer's installation instructions with product data.

PART 2 PRODUCTS

2.01 DUCT, PLENUM, AND HOUSING INSULATION

A. Duct work operating at temperatures up to +450F shall be insulated with Fiberglas insulation in blanket, batt, or board form. The insulation shall be selected to conform readily to the surface to which it will be applied. For temperatures over +400F, insulation shall be applied in double layers, staggering the joints of both the insulation and the lagging (if used) wherever practical. Observe manufacturer's recommendations on maximum temperature and thickness combinations. Before installing insulation, inspect to make sure that all seams and joints in the ductwork have been sealed by the responsible contractor. Insulation may be one of the following types, depending on project requirements:

Type A: For indoor service at operating temperatures to 250F, round or rectangular duct work: Fiberglas all service duct wrap, light density glass fiber insulation in roll form, faced with a reinforced foil/kraft laminate, meeting the requirements of ASTM C 553.

a. Insulation shall be applied to sheet metal ductwork or plenums using manufacturer's recommended stretch-out tables (see Owens-Corning Pub. No. 3-MS-9266) to prevent excessive compression. Insulation shall be secured as indicated on drawings. As a minimum, where ducts are 24" in width or greater, mechanical fasteners spaced at 18" (approx.) centers are required on the bottom of the duct to prevent the insulation from sagging.

b. All joints and seams shall be stapled with outward clinching staples at 6" (approx.) centers. Where a vapor barrier is required, all joints, seams, tears, punctures, and other penetrations shall be closed with 3" pressure-sensitive tape matching the facing or with a vapor barrier mastic reinforced with 3" glass scrim tape.

2.02 ACCESSORY MATERIALS

A. Accessory materials installed as part of insulation work under his section shall include (but not be limited to):
1. Closure Materials - Butt strips, bands, wires, staples, mastics, adhesives; pressure-sensitive tapes
2. Field-applied jacketing materials - Sheet metal, plastic, canvas, fiber glass cloth, insulating cement, PVC fitting covers
3. Support Materials - Hanger straps, hanger rods, saddles
4. Fasteners, weld pins/studs, speed clips, insulation washers
5. Metal mesh or expanded metal lagging

B. All accessory materials shall be installed in accordance with project drawings and specifications, manufacturer's instructions, and/or in conformance with the current edition of the Midwest Insulation Contractors Association (MICA) "Commercial & Industrial Insulation Standards."

PART 3 EXECUTION

3.01 SITE INSPECTION

A. Before starting work under this section, carefully inspect the site and installed work of other trades and verify that such work is complete to the point where installation of materials and accessories under this section can begin.

B. Verify that all materials and accessories can be installed in accordance with project drawings and specifications and material manufacturers' recommendations.

C. Verify, by inspecting product labeling, submittal data, and/or certifications which may accompany the shipments, that all materials and accessories to be installed on the project comply with applicable specifications and standards and meet specified thermal and physical properties.

3.02 PREPARATION

A. Ensure that all surfaces on which insulation is to be installed are clean and dry.

B. Ensure that insulation is clean, dry, and in good mechanical condition with all factory-applied vapor or weather barriers intact and undamaged. Wet, dirty, or damaged insulation shall not be acceptable for installation.

C. Ensure that pressure testing of piping or duct systems has been completed prior to installing insulation.

3.03 INSTALLATION

A. Ductwork Insulation
1. General:
   a. Before installing insulation, ensure that all seams and joints in ductwork have been sealed by the contractor responsible for the duct system.
   b. Install insulation in accordance with manufacturer's published instructions and recognized industry practice to ensure that it will serve its intended purpose.

c. Install insulation materials with smooth and even surfaces. Butt joints firmly together to ensure complete and tight fit over surfaces to be covered.
d. Maintain the integrity of factory-applied vapor barrier jacketing on all insulation, protecting it against puncture, tears, or other damage. All staples used on cooling or dual temperature ductwork insulation shall be coated with suitable sealant to maintain vapor barrier integrity.

2. Penetrations:
   a. Extend ductwork insulation without interruption through walls, floors, and similar ductwork penetrations, except where otherwise specified.
3. Ductwork Exposed to Weather:
   a. Protect outdoor insulation from weather by installing outdoor protective finish or jacketing as recommended by the insulation manufacturer.
4. Rigid Insulation:
   a. Rigid duct insulation may be impaled over welded pins and secured with insulation caps and washers matching the color of the vapor barrier facing. All seams shall be firmly butted and sealed with pressure-sensitive vapor barrier tape matching the facing.
   b. Corner angles shall be installed on all external corners of rigid duct insulation in exposed finished areas before jacketing, except oven and hood exhaust duct insulation which shall have no corner angles.
5. Duct Wrap Insulation:
   a. Duct wrap insulation shall be applied with all joints butted firmly together. All joints in the insulation covering shall be sealed with adhesive. Duct wrap insulation shall be secured to bottom of rectangular or oval ducts over 24" wide with mechanical fasteners on 16" (approx.) centers to prevent sagging.
6. Duct lining insulation:
   a. Duct liner insulation shall be applied with all joints tightly butted using 90% coverage of adhesive meeting the requirements of ASTM C 916 plus mechanical fasteners spaced according to the liner manufacturer's schedule for the interior width of the plenum, housing, or air shaft. (Also refer to Section 15890, Ductwork.)

3.04 FIELD QUALITY ASSURANCE

A. Upon completion of all insulation work covered by this specification, visually inspect the work and verify that it has been correctly installed. This may be done while work is in progress, to assure compliance with requirements herein to cover and protect insulation materials during installation.

3.05 PROTECTION

A. Replace damaged insulation which cannot be satisfactorily repaired, including insulation with vapor barrier damage and moisture-saturated insulation.

B. The insulation contractor shall advise the general and/or the mechanical contractor as to requirements for protection of the insulation work during the remainder of the construction period, to avoid damage and deterioration of the finished insulation work.

3.06 SAFETY PRECAUTIONS

A. Insulation contractor's employees shall be properly protected during installation of all insulation. Protection shall include proper attire when handling and applying insulation materials and shall include (but not be limited to) disposable dust respirators, gloves, hard hats, and eye protection.

B. The insulation contractor shall conduct all jobsite operations in compliance with applicable provisions of the Occupational Safety and Health Act, as well as with all state and/or local safety and health codes and regulations that may apply to the work.

3.07 SCHEDULE

DUCTWORK	INSULATION TYPE	THICKNESS
Concealed Exhaust Ducts Exposed to Outdoor Air, Concealed Outdoor Air Intake Ducts	A	3"

DUCTWORK	INSULATION TYPE	THICKNESS
Concealed Supply and Return Ducts	A	3"

END OF SECTION 23 07 13

SECTION 23 07 19
PIPING INSULATION

PART 1 GENERAL

1.01 WORK INCLUDED

A. Piping insulation.

B. Jackets and accessories.

1.02 RELATED WORK

A. Section 23 21 13 - Hydronic Piping.

1.03 QUALITY ASSURANCE

A. Applicator: Company specializing in piping insulation applications with three years minimum experience.

B. Materials: Flame spread/fuel contributed/smoke developed rating in accordance with NFPA 255 and UL 723. Fiberglass insulation shall have a flame spread rating of 25/smoke developed rating of 50; calcium silicate insulation shall have a flame spread rating of 0/smoke developed rating of 0.

PART 2 PRODUCTS

2.01 INSULATION

A. Molded pipe insulation shall be manufactured to meet ASTM C 585 for sizes required in the system. It shall be of the type suitable for installation on piping systems. Molded fibrous glass pipe insulation shall comply with the requirements of ASTM C 547.

B. For indoor systems operating at temperatures from zero to +450F: Heavy density Fiberglas pipe insulation with factory applied all-service jacket (ASJ) and Doublesure two component adhesive closure system, rated for a maximum service temperature of 850F. For large pipe sizes where SSL-II is not available, the single adhesive SSL closure may be substituted. Circumferential joints shall be sealed by butt strips having a two-component sealing system. Stapling is not required to complete the closure. When self-sealing lap systems are used, sufficient thickness of insulation shall be used to maintain the outer surface temperature of the operating system below +150F. Manufacturer's data regarding thickness constraints in relation to operating temperature shall be followed. When multiple layers are required, all inner layers shall be unjacketed. On cold systems, vapor barrier performance is extremely important. All penetrations of the ASJ and exposed ends of insulation must be sealed with vapor barrier mastic. If humidities more than 90% are expected, the ASJ shall be protected with either a mastic coating or a suitable vapor retarding outer jacket. Vapor seals at butt joints shall be applied at every fourth pipe section joint and at each fitting to provide isolation from water incursion.

C. Fittings and valves shall be insulated with pre-formed fiberglass fittings, fabricated sections of Fiberglas pipe insulation, Fiberglas pipe and tank insulation, Fiberglas blanket insulation, or insulating cement. Thickness shall be equal to adjacent pipe insulation. Finish shall be with pre-formed PVC fitting covers or as otherwise specified on contract drawings. Flanges, couplings, and valve bonnets shall be covered with an oversized pipe insulation section sized to provide the same insulation thickness as on the main pipe section. An oversized insulation section shall be used to form a collar between the two insulation sections with low density blanket insulation being used to fill gaps. Jacketing shall match that used on straight pipe sections. Rough cut ends shall be coated with suitable weather or vapor resistant mastic as dictated by the system location and service. On hot systems where fittings are to be left exposed, insulation ends should be beveled away from bolts for easy access. On cold systems, particular care must be given to vapor sealing the fitting cover or finish to the pipe insulation vapor barrier. All valve stems must be sealed with caulking which allows free movement of the stem but provides a seal against moisture incursion.

D. Piping located outdoors and exposed to the weather shall be insulated as indicated above except the thickness shall be determined according to the worst weather extremes expected. The insulation shall then be protected with one of the following weatherproof finishes as indicated on contract drawings:
1. Metal jacketing shall be 0.016" (0.6 mm) minimum aluminum or stainless steel with moisture barrier, secured in accordance with the jacket manufacturer's recommendations. Longitudinal joints shall be applied so they will shed water and shall be sealed completely. Circumferential joints shall be closed using preformed butt strips following manufacturer's recommendations for securement.
2. UV resistant PVC jacketing may be applied in lieu of metal jacketing provided jacketing manufacturer's limitations regarding pipe size, surface temperature and thermal expansion and contraction are followed.
3. Fittings shall be insulated as prescribed above, jacketed with preformed fitting covers matching outer jacketing used on straight pipe sections, with all joints weather sealed.
4. On outdoor chilled water and refrigerant lines, the insulation system shall be completely vapor sealed before the weather-resistant jacket is applied. The outer jacket shall not compromise the vapor barrier by penetration of fasteners, etc. Vapor stops at butt joints shall be applied at every fourth pipe section joint and at each fitting to provide isolation of water incursion.

E. All piping shall be supported in such a manner that neither the insulation or the vapor/weather barrier is compromised by the hanger or the effects of the hanger. In all cases, hanger spacing must be such that the circumferential joint may be made outside the hanger. On cold systems, vapor barrier must be continuous, including material covered by the hanger saddle.

F. Piping systems 3" in diameter or less, insulated with Fiberglas insulation, may be supported by placing saddles of the proper length and spacing under the insulation.

G. Thermal expansion and contraction of the piping and insulation system can generally be taken care of by utilizing double layers of insulation and staggering both longitudinal and circumferential joints. Where long runs are encountered, expansion joints may be required where single layers of insulation are being used and should be noted on the contract drawings.

H. On vertical runs, insulation support rings shall be used as indicated on contract drawings.

PART 3 EXECUTION

3.01 SITE INSPECTION

A. Before starting work under this section, carefully inspect the site and installed work of other trades and verify that such work is complete to the point where installation of materials and accessories under this section can begin.

B. Verify that all materials and accessories can be installed in accordance with project drawings and specifications and material manufacturers' recommendations.

C. Verify, by inspecting product labeling, submittal data, and/or certifications which may accompany the shipments, that all materials and accessories to be installed on the project comply with applicable specifications and standards and meet specified thermal and physical properties.

3.02 PREPARATION

A. Ensure that all pipe and equipment surface over which insulation is to be installed are clean and dry.

B. Ensure that insulation is clean, dry, and in good mechanical condition with all factory-applied vapor or weather barriers intact and undamaged. Wet, dirty, or damaged insulation shall not be acceptable for installation.

C. Ensure that pressure testing of piping or duct systems has been completed prior to installing insulation.

3.03 INSTALLATION

A. Install all insulation materials and accessories in accordance with manufacturer's published instructions and recognized industry practices to ensure that it will serve its intended purpose.

B. Install insulation on piping after installation of heat tracing, painting, testing, and acceptance tests.

C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. Butt insulation joints firmly to ensure complete, tight fit over all piping surfaces.

D. Maintain the integrity of factory-applied vapor barrier jacketing on all pipe insulation, protecting it against puncture, tears, or other damage.

E. Fittings: Cover valves, fittings, and similar items in each piping system using one of the following: Mitered sections of insulation equivalent in thickness and composition to that installed on straight pipe runs, or Insulation cement equal in thickness to the adjoining insulation, or PVC fitting covers insulated with material equal in thickness and composition to adjoining insulation.

F. Penetrations: Extend piping insulation without interruption through walls, floors, and similar piping penetrations, except where otherwise specified.

G. Joints: Butt pipe insulation against hanger inserts. For hot pipes, apply 3" wide vapor barrier tape or band over butt joints. For cold piping apply wet coat of vapor barrier lap cement on butt joints, and seal joints with 3" wide vapor barrier tape or band. All pipe insulation ends shall be tapered and sealed, regardless of service.

H. Vertical Piping: All insulated, exposed vertical piping within the building and all insulated piping exposed to the outdoors shall be additionally jacketed with 0.016" thick (minimum) aluminum. Vertical piping shall be protected to a height of 8'-0" above the floor.

3.04 FIELD QUALITY ASSURANCE

A. Upon completion of all insulation work covered by this specification, visually inspect the work and verify that it has been correctly installed. This may be done while work is in progress, to assure compliance with requirements herein to cover and protect insulation materials during installation.

3.05 PROTECTION

A. Replace damaged insulation which cannot be satisfactorily repaired, including insulation with vapor barrier damage and moisture-saturated insulation.

B. The insulation contractor shall advise the general and/or the mechanical contractor as to requirements for protection of the insulation work during the remainder of the construction period, to avoid damage and deterioration of the finished insulation work.

3.06 SAFETY PRECAUTIONS

A. Insulation contractor's employees shall be properly protected during installation of all insulation. Protection shall include proper attire when handling and applying insulation materials and shall include (but not be limited to) disposable dust respirators, gloves, hard hats, and eye protection.

B. The insulation contractor shall conduct all jobsite operations in compliance with applicable provisions of the Occupational Safety and Health Act, as well as with all state and/or local safety and health codes and regulations that may apply to the work.

3.07 SCHEDULE

A. Heating Hot Water Piping - use the following thicknesses of insulation:

Pipe Size	Insulation Thickness
Runouts (to 1")	1 inch
1" and less	1 inch
1 1/4" to 4"	1 1/2 inch

B. Condensate Waste Piping, Refrigerant Suction and Hot Gas Piping, Piping Concealed Within Concrete Block Walls or Buried Within Floor Slab - use 3/4-inch-thick insulation for all pipe sizes.

END OF SECTION 23 07 19

SECTION 23 08 00
MECHANICAL SYSTEM COMMISSIONING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of contract, including General and Supplementary Conditions and other related sections of these Specifications, apply to work in this Section.

1.02 DEFINITIONS

A. Building commissioning is a joint team effort to ensure that all mechanical equipment and systems have been completely and properly installed and put into service. The commissioning work will begin only after all systems are 100 percent complete and functional. The factory startup of all equipment shall have been carried out, as well as control system completion, startup, and systems balancing. The commissioning team shall be made up of representatives of the Owner, the Architect/Engineer, and the Contractor's organizations.

B. The Commissioning Authority will schedule the commissioning of mechanical systems through the General Contractor. The trades represented during the commissioning shall include sheet metal, piping and fitting, refrigeration, plumbing, controls, and balancing. The lead tradesman for each trade who has performed the work shall be present. The balancing and controls contractors may be released when their portion of work is completed. The Commissioning Authority shall submit a schedule of activities for commissioning at least thirty (30) days prior to the start of systems commissioning.

1.03 DOCUMENTS

A. The following documents shall be assembled and bound into the operating and maintenance manuals and delivered in accordance with the related Division 1 Specifications:

1. Plumbing systems sanitization certification
2. Certificates of completion from the following contractors:
   a) Sheet Metal
   b) Plumbing and Piping
   c) Automatic Temperature Controls
   d) Fire Protection (where provided)
3. Balancing report, including duct pressure test
4. Boiler startup, including stack gas test
5. Hydronic systems water analysis report
6. Boiler and piping systems water analysis report
7. All operation and maintenance data

B. Record Drawings, showing As-Built changes to all systems, shall be submitted in accordance with Division 1 Specifications.

1.04 SCOPE OF WORK

A. The work included under this Section shall include complete and thorough investigation of all mechanical systems to ensure proper installation and operation of all components and systems. The following systems will be evaluated:

1. Automatic Temperature Controls
2. Instrumentation
3. Air Distribution and Exhaust Air Systems
4. Pumping Systems - All Types
5. Hydronic Heating Distribution Systems
6. Plumbing Systems, including Fixtures
7. Electrical Systems for Mechanical Equipment

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SYSTEM COMMISSIONING

A. The following procedures shall be verified during the commissioning process. All procedures are to be checked and carried out by the contractor prior to commissioning.

3.02 PRELIMINARY WALK-THROUGH

A. A preliminary walk-through shall be made to provide a visual check of the various systems, to insure that all components are properly installed. The following items shall be observed:

Air Distribution

1. Mounting and support of equipment
2. Noise, vibration, air, and water leaks
3. Air filtration, presence and operation of dampers, diffusers, registers and grilles, fire dampers and access doors
4. Presence of thermostats and other adjustable temperature control devices
5. Presence of smoke sensors and other safety devices
6. Instrumentation, gauges, thermometers, flow measuring devices

Plumbing and Piping Systems

1. Mounting and support of equipment
2. Noise, vibration, and leaks
3. Strainers, valves, fixtures, instrumentation, and flow measuring or control devices

Heating and Cooling Equipment

1. General installation and service access
2. Proper cycling
3. Excessive noise, vibration, and leaks
4. Presence of safety devices and controls
5. All electrical for mechanical lugs are tight and comply with specified requirements, starters, disconnects, and controls

B. Any discrepancies or deficiencies shall be noted for further investigation during detailed evaluation of systems.

C. Verify that all cleaning and touch-up painting has been completed.

3.03 DETAILED EVALUATION

A. Air Distribution Systems

1. Spot checks of approximately ten (10) percent of air outlets shall be made. Architect/Engineer shall select outlets and air balancing contractor shall demonstrate a reading of each outlet. Where appropriate, thermostats shall be adjusted to simulate full cooling, full heating, hood operation, etc.
2. Air balancing contractor shall demonstrate total air flow at each air handling system at simulated full cooling/heating and/or maximum outdoor air.
3. Air balancing contractor shall demonstrate proper airflow at each fume hood, exhaust air system, range, dishwasher, and process hood.
4. Air balancing contractor shall demonstrate proper room static pressure with respect to adjacent space(s).
5. Air balancing contractor shall demonstrate motor horsepower draw at selected fan motors.
6. Air balancing contractor shall demonstrate mixed outdoor/return air temperatures upstream of heating/cooling coils to verify proper minimum outdoor air damper settings.
7. Discrepancies between balancing report and spot check shall be dealt with by contractor to correct all deficiencies. Where significant deficiencies are detected, the entire balancing procedure shall be repeated.
8. Any noted drafts or noisy air distribution devices shall be evaluated, and corrective action shall be taken.
9. Selected filtration devices shall be checked to ensure that they are clean and of proper type for applicable function.
10. Any related balancing problems noted during the preliminary walk-through shall be addressed and corrected.

B. Heat Transfer and Hydronic Systems

1. Contractor shall demonstrate that systems have been thoroughly flushed and strainers have been cleaned, by team observation of sufficient number of strainers as selected by Architect/Engineer. Where significant debris is found, all strainers shall be verified for cleanliness, and systems shall be reflushed if so, directed by Architect/Engineer.
2. Hydronics balancing contractor shall demonstrate fluid flows at approximately ten (10) percent of fluid flow control devices.
3. Selected pumps shall be observed for proper amperage and motor horsepower draw.
4. Fluid temperatures and pressures shall be observed for each system and compared with design values.
5. Glycol concentration shall be measured for compliance with design specifications.
6. Any noted deficiencies between the sample evaluations and the balancing report shall be dealt with to correct any deficiencies. If significant deficiencies are detected, the entire balancing procedure shall be repeated.
7. Any balancing related problems identified during the preliminary walk-through shall be addressed and corrected.

C. HVAC Control Systems

1. The controls contractor shall demonstrate the proper functioning of each control system, including compliance with specified sequences of operation, and instruct Owner’s operating personnel in the proper operation of the systems. The balancing contractor shall be present to correct flows and assist in fine-tuning the systems.
2. Controls contractor shall demonstrate the proper functioning of the following devices:
   a) Each thermostat to adequately control heating and cooling
   b) Each automatic damper and valve
   c) Outdoor and return air dampers
   d) Economizer operation
   e) Boiler and pump starting and stopping from program control
   f) Exhaust fan and air handling fan start and stop
3. Controls contractor shall point out proper labelling of each control device.
4. Controls contractor and balancing contractor shall coordinate efforts as required until all functions of air distribution and hydronic/steam systems have been fully demonstrated and have been accepted by Contracting Officer and Architect/Engineer.

D. Sheet Metal

1. Sheet metal contractor shall demonstrate the following:
    a) Proper voltage, overload heater size, and proper rotation of each motor-driven fan or air handling device
    b) Proper belt tension and drive alignment
    c) Proper clearance and compression of spring isolation of fans and drives
    d) Proper installation of flexible connections
    e) Sealing of all ductworks as per specifications
    f) Proper operation of smoke purge
    g) Complete insulation of ductwork, including sound attenuation as required
    h) Completion of deficiencies identified during balancing and controls commissioning
    i) Marking and labelling of each air handling device
    j) Proper shutdown of air handling systems in the event of presence of smoke or combustion products
    k) Monitor bearings for excessive heat or noise
    l) Heating and cooling coil fins are straight
2. Sheet metal contractor shall correct any deficiencies identified during preliminary walk-through and detailed evaluation.

E. Plumbing and Piping

1. Plumbing and piping contractor shall demonstrate the following:
    a) Explain cleaning, degreasing and flushing procedure of piping systems
    b) Proper filling of all hydronic systems
    c) Proper glycol concentration and pH of hydronic systems
    d) Piping and valve marking
    e) Equipment operation, including fixtures
2. The Plumbing and piping contractor shall correct any deficiencies identified during the preliminary walk-through and detailed evaluation.

F. Electrical

1. Electrical contractor shall demonstrate the following:
    a) Properly sized starters, overload heaters and disconnects for mechanical equipment
    b) Proper voltage as specified
    c) Wiring as per specifications
    d) Outdoor disconnects are rated for outdoor use
    e) All electrical for mechanical equipment and systems
2. Electrical contractor shall correct any deficiencies identified during preliminary walk-through and detailed evaluation.

G. Each contractor shall explain any special features or intricacies of systems operation to the building operations personnel. Items covered should include safety features, hazards to be aware of, precautions to be observed to avoid damage to equipment, and any seasonal adjustments which are required. Generally, discuss service frequency of devices such as bearings, belt drives, filters, strainers, etc. Show maintenance and operating personnel where additional information can be found in the Operation and Maintenance Manuals.

3.04 CERTIFICATION

A. A Completion Certification shall be signed by all trades involved, indicating that all commissioning and final Punch List work has been completed and that systems are installed according to the Contract Documents and manufacturer's installation instructions. The contractors shall further certify that all adjustment, lubrication, alignment and start-up procedures have been carried out.

B. The Contracting Officer shall certify the commissioning procedure was observed and shall acknowledge that it was carried out to his satisfaction. The contracting Officer shall acknowledge receipt of Operation and Maintenance Manuals, As-Built Drawings, Warranties, and all certificates required.

3.05 WARRANTIES FOR SYSTEMS

A. The warranties as specified, which shall begin with the beneficial use of the systems by the Owner, are the responsibility of the mechanical contractor. It shall be the mechanical contractor's responsibility to repair, adjust or replace any defective material and equipment during the warranty period. It shall be the Owner's responsibility to notify the mechanical contractor of any deficiencies immediately.

B. During the warranty period, the Owner and building operating personnel should not make any adjustments, alterations, or repairs without first contacting the mechanical contractor. Adjustments of room thermostats may be made at the building occupant's discretion without contacting the mechanical contractor. The mechanical contractor should be contacted as soon as possible so that a permanent repair can be carried out.

C. Emergency repairs and adjustments may be made without first contacting the mechanical contractor. Emergency repairs would include such items as repairing leaks, adjusting controls to prevent building freeze-up, or other similar adjustments to prevent the building from becoming uninhabitable or unsafe.

D. Maintenance procedures which are the responsibility of the Owner during the warranty period include the following:

1. Replacement of air filters
2. Replacement of fuel filters
3. Replacement or repair of any items which are damaged or broken by building users or as a result of "Acts of God"
4. Replacement of water softener salt
5. Filling of fuel storage tank(s)
6. Cleaning of grease traps and oil interceptors
7. Replacement of acid neutralization marble (if required)

END OF SECTION 23 08 00

SECTION 23 31 00
DUCTWORK

PART 1 GENERAL

1.01 WORK INCLUDED

A. Low pressure ducts.

1.02 1.02 RELATED WORK

A. Section 23 07 13 - Duct Insulation.

B. Section 23 33 00 - Ductwork Accessories.

1.03 QUALITY ASSURANCE

A. Welding Materials and Procedures: Conform to ANSI/ASME SEC 9 and applicable state labor regulations. Welders must be state-certified.

1.04 DEFINITIONS

A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain sizes inside lining.

B. Low Pressure: Three pressure classifications: 1/2-inch WG positive or negative static pressure and velocities less than 2,000 fpm; 1-inch WG positive or negative static pressure and velocities less than 2,500 fpm and 2-inch WG positive or negative static pressure and velocities less than 2,500 fpm.

1.05 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA 90A and NFPA 90B standards.

1.06 SUBMITTALS

A. Submit shop drawings under provisions of Division 1 Specifications.

B. Indicate all duct mains and fittings, duct runouts, particulars such as gages, sizes, welds, and configuration prior to start of fabrication and installation of low pressure, medium and high pressure, and glass fiber duct systems. Any conflicts with work of other trades that necessitate changes in duct sizes or intended routing shall be indicated on shop drawings, so that Architect/Engineer can review proposed changes. Required changes not indicated on shop drawings shall become the sole responsibility of the installing contractor.

C. Submit manufacturer's installation instructions for glass fiber ducts.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site.

B. Store and protect products.

PART 2 PRODUCTS

2.01 MATERIALS

A. General: Non-combustible or conforming to requirements for Class 1 air duct materials, or UL 181.

B. Steel Ducts: ASTM A525 or ASTM A527 galvanized steel sheet, lock-forming quality, having zinc coating of 1.25 oz per sq ft for each side in conformance with ASTM A90.

C. Flexible Ducts: Interlocking spiral of galvanized steel or aluminum construction or fabric supported by helically wound spring steel wire or flat steel bands; rated to 2 inches WG positive and 1.5 inches WG negative for low pressure ducts and 15 inches WG positive or negative for medium high-pressure ducts.

D. Insulated Flexible Ducts: Flexible duct wrapped with flexible glass fiber insulation, enclosed by seamless aluminum pigmented plastic vapor barrier jacket; maximum 0.23 K value at 75 degrees F.

E. Fasteners: Rivets, bolts, or sheet metal screws.

F. Sealant: Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.

G. Hanger Rod: Steel galvanized; threaded both ends, threaded one end, or continuously threaded.

2.02 LOW PRESSURE DUCTWORK

A. Fabricate and support in accordance with SMACNA Low Pressure Duct Construction Standards and ASHRAE handbooks, except as indicated. Provide duct material, gages, reinforcing, and sealing. Seal all joints, seams, and openings with duct sealant.

B. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by written permission. All exposed round ductwork 8-inch diameter and larger shall be spiral lockseam type.

C. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.

D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.

E. Provide easements where low pressure ductwork conflicts with piping and structure. Where easements exceed 10 percent duct area, split into two ducts maintaining original duct area.

F. Connect flexible ducts to metal ducts with liquid adhesive plus tape.

G. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of air flow. Use heavy beads on joint connections for duct sizes greater than 8-inch.

H. Use double nuts and lock washers on threaded rod supports.

PART 3 EXECUTION

3.01 INSTALLATION

A. Provide openings in ductwork where required to accommodate thermometers and 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. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

B. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

C. Connect terminal units to medium or high-pressure ducts with one-foot maximum length of flexible duct. Do not use flexible duct to change direction.

D. Connect diffusers, registers, grilles, or troffer boots to low pressure ducts with 5 feet maximum length of flexible duct. Hold in place with strap or clamp.

E. Provide residue traps and access doors (12 inch by 12 inch) in clothes dryer exhaust ducts at base of vertical risers, all changes in direction, and at twenty-foot maximum intervals, with provisions for cleanout. Install dryer exhaust ductwork with pitch down toward dryer.

F. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

G. Obtain manufacturer's inspection and acceptance of fabrication and installation of glass fiber ductwork at beginning of installation.

H. Install all ductwork at elevations indicated on Project Drawings. Where no elevations are indicated, install ductwork as high as possible.

I. Seal all ductwork, including all longitudinal and transverse joints and seams, and duct connections. Tape used as duct sealant shall not be acceptable.

3.02 DUCTWORK APPLICATION SCHEDULE

AIR SYSTEM	MATERIAL
Low Pressure Supply	Steel, Aluminum
Return and Relief	Steel, Aluminum
General Exhaust	Steel, Aluminum

3.03 ADJUSTING AND CLEANING

A. Clean duct systems with high power vacuum machines. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access to ductwork for cleaning purposes.

END OF SECTION 23 31 00

SECTION 23 33 00
DUCTWORK ACCESSORIES

PART 1 GENERAL

1.01 WORK INCLUDED

A. Volume control dampers.

B. Fire dampers.

C. Backdraft dampers.

D. Air turning devices.

E. Flexible duct connections.

F. Duct access doors.

1.02 RELATED WORK

A. Section 23 31 00 - Ductwork.

PART 2 PRODUCTS

2.01 VOLUME CONTROL DAMPERS

A. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards, and as indicated.

B. Fabricate splitter dampers of material same gage as duct to 24 inches size in either direction, and two gages heavier for sizes over 24 inches.

C. Fabricate splitter dampers of single thickness sheet metal to streamline shape. Secure blade with continuous hinge or rod. Operate with minimum 1/4-inch diameter rod in self-aligning, universal joint action flanged bushing with set screw.

D. Fabricate single blade dampers for duct sizes to 9-1/2 x 30 inch.

E. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 12 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

F. Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.

G. Provide locking, indicating quadrant regulators on single and multi-blade dampers. Where rod lengths exceed 30 inches provide regulator at both ends. Quadrant regulators shall be equal to Duro-Dyne Model KS-385L.

H. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

2.02 FIRE DAMPERS

A. Fabricate in accordance with NFPA 90A and UL 555, and as indicated. All fire dampers shall be dynamic type (with air flow).

B. Fabricate curtain type dampers of galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream except for low pressure ducts up to 12 inches in height.

C. Fusible links, UL 33, shall separate at 160 degrees F. Provide adjustable link straps for combination fire/balancing dampers.

2.03 BACKDRAFT DAMPERS

A. Gravity backdraft dampers, size 18x18 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 16 gage galvanized steel, or extruded aluminum, with center pivoted blades of maximum 6-inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degrees stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.04 AIR TURNING DEVICES

A. Multi-blade device with blades aligned in short dimension; steel or aluminum construction; with individually adjustable blades, mounting straps.

2.05 FLEXIBLE DUCT CONNECTIONS

A. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards, and as indicated.

B. UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 20 oz per sq yd, approximately 2 inches wide, crimped into metal edging strip.

2.06 DUCT ACCESS DOORS

A. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards and as indicated. All access doors shall be UL listed 1 1/2 hour "B" label fire-rated for fire-rated wall systems.

B. Review locations prior to fabrication.

C. Fabricate rigid and close-fitting doors of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum one-inch-thick insulation with sheet metal cover.

D. Provide two hinges and two sash locks for sizes up to 18 inches square, three hinges and two compression latches with outside and inside handles for sizes up to 24 x 48 inches. Provide an additional hinge for larger sizes.

E. Access doors with sheet metal screw fasteners are not acceptable.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install accessories in accordance with the manufacturer’s instructions.

B. Provide balancing dampers at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts, and on duct runouts to all individual diffusers, registers, and grilles, as required for air balancing. Use splitter dampers only where indicated.

C. Provide fire dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings, and hinges.

D. Demonstrate re-setting of fire dampers to authorities having jurisdiction and Owner's representative.

E. Provide backdraft dampers on exhaust fans or exhaust ducts near to outside and where indicated.

F. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment.

G. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, and elsewhere as indicated. Provide minimum 12 x 12-inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated.

END OF SECTION 23 33 00

SECTION 23 37 00
AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Diffusers.

B. Registers/grilles.

C. Louvers.

D. Goosenecks.

1.02 QUALITY ASSURANCE

A. Test and rate performance of air outlets and inlets in accordance with ADC Equipment Test Code 1062 and ASHRAE 70.

B. Test and rate performance of louvers in accordance with AMCA 500.

1.03 REGULATORY REQUIREMENTS

A. Conform to ANSI/NFPA 90A.

PART 2 PRODUCTS

2.01 RECTANGULAR OR SQUARE CEILING DIFFUSERS

A. Rectangular or square, stamped, multicore type diffuser to discharge air in pattern as indicated on Project Drawings or by model number, with sectorizing baffles where indicated.

B. Provide surface mount snap-in inverted T-bar or spline type frame, as indicated by model number. In plaster ceilings, provide plaster frame and ceiling frame.

C. Fabricate of steel with baked enamel off-white finish.

D. Provide opposed blade damper and multi-louvered equalizing grid and direction changer, with damper adjustable from diffuser face.

2.02 CEILING SUPPLY REGISTERS/GRILLES

A. Streamlined and individually adjustable curved blades to discharge air along face of grille, two-way deflection.

B. Fabricate one inch margin frame with concealed mounting and gasket.

C. Fabricate of aluminum extrusions with factory prime coat finish.

D. Provide integral, gang-operated opposed blade dampers with removable key operator, operable from face, and provide steel air volume extractors for installation at duct to register/grille connections.

2.03 CEILING EXHAUST AND RETURN REGISTERS/GRILLES

A. Streamlined blades, depth of which exceeds 3/4 inch spacing, with spring or other device to set blades, vertical or horizontal face.

B. Fabricate one inch margin frame with concealed mounting.

C. Fabricate of steel with 20 gage minimum frames and 22 gage minimum blades, steel and aluminum with 20 gage minimum frame, or aluminum extrusions, with factory baked enamel finish.

D. Where not individually connected to exhaust fans, provide integral, gang-operated opposed blade dampers with removable key operator, operable from face.

E. In gymnasiums, blades shall be front pivoted, welded in place or securely fastened to be immobile.

2.04 WALL SUPPLY REGISTERS/GRILLES

A. Streamlined and individually adjustable curved blades to discharge air along face of grille, two-way deflection.

B. Fabricate one inch margin frame with concealed mounting and gasket.

C. Fabricate of aluminum extrusions with factory baked enamel finish.

D. Provide integral, gang-operated opposed blade dampers with removable key operator, operable from face, and provide steel air volume extractors for installation at duct to register/grille connections.

2.05 WALL EXHAUST AND RETURN REGISTERS/GRILLES

A. Streamlined blades, depth of which exceeds 3/4 inch spacing, with spring or other device to set blades, vertical face.

B. Fabricate one inch margin frame with mounting.

C. Fabricate of steel with 20 gage minimum frames and 22 gage minimum blades, steel and aluminum with 20 gage minimum frame, or aluminum extrusions, with factory baked enamel.

D. Where not individually connected to exhaust fans, provide integral, gang-operated opposed blade dampers with removable key operator, operable from face.

2.06 LOUVERS

A. Provide 4-inch-deep louvers with blades on 45-degree slope with center baffle and return bend, heavy channel frame, bird screen with 1/2-inch square mesh for exhaust and 3/4 inch for intake.

B. Fabricate of 16 gage galvanized steel or 12 gage extruded aluminum, welded assembly, with factory baked enamel or color anodized finish.

C. Furnish with exterior flat flange or angle flange for installation.

D. Fabricate louver penthouses with mitered corners and reinforce with structural angles.

2.07 GOOSENECKS

A. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards of minimum 18 gage galvanized steel.

B. Mount on minimum 12-inch-high curb base.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install items in accordance with manufacturers' instructions.

B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.

C. Install diffusers to ductwork with airtight connection.

D. Provide balancing dampers on duct takeoff to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, or grille and register assembly.

E. Install all air volume extractors and equalizing grids at diffusers, grilles, and registers, in accordance with manufacturer's instructions.

F. Paint ductwork visible behind air outlets and inlets matte black.

G. See schedule on drawings for all sizes and types of air inlets and outlets required.

END OF SECTION 23 37 00

NORTH KINGSTOWN
MUNICIPAL OFFICE BUILDING
North Kingstown, Rhode Island 02852 AA# 22133.1

SECTION 23 72 00
ENERGY RECOVERY VENTILATORS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Energy Recovery Ventilator (ERV) shall be a package unit as manufactured by RenewAire, or approved equal, and shall transfer both heat and humidity using static plate core technology.

1.02 RELATED WORK

A. Section 23 07 13 - Ductwork Insulation.

B. Section 23 31 00 - Ductwork.

C. Section 23 33 00 - Ductwork Accessories: Flexible duct connections.

1.03 SUBMITTALS

A. Provide submittal data for the following:
1. Energy wheel performance data for both summer and winter operation.
2. Motor ratings, electrical characteristics and motor and fan accessories.
3. Combined efficiency data per ARI Guideline V-2003 for each model. Data shall include RER, COP, Unitary Net Cooling, Unitary EER and CEF.
4. Material types and gauges of all component pieces and assemblies.
5. Dimensioned drawings for each type of installation, showing isometric and plan views, to include location of attached ductwork and service clearance requirements.
6. Estimated gross weight of each installed unit.
7. Installation, Operating and Maintenance manual (IOM) for each model.
8. [Remote Control Panel description to include all functions.]

1.04 QUALITY ASSURANCE

A. Fan Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.

B. Sound Ratings: AMCA 301; tested to AMCA 300 and bear AMCA Certified Sound Rating Seal.

C. Fabrication: Conform to AMCA 99 and ARI 430.

D. Filter Media: ANSI/UL 900 listed, Class I or Class II, approved by local authorities.

E. Air Coils: Certify capacities, pressure drops, and selection procedures in accordance with ARI 410.

F. Packaged Energy Recovery Air Handling Units: Product manufacturer regularly engaged in production of components who issues complete catalog data on total product.

G. Certifications:

1. Entire unit shall be AMCA Certified for air flow. AMCA certification of individual components is not acceptable.
2. The entire unit shall be ETL Certified per U.L. 1995 and bear an ETL sticker.
3. The energy recovery section shall be AHRI Certified, per Standard 1060.

1.05 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data.

B. Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in containers, with factory-installed shipping skids and lifting lugs.

B. Store and protect products.

C. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been testing run under observation.

1.08 EXTRA STOCK

A. Provide one extra set of disposable panel filters.

PART 2 PRODUCTS

2.01 CONSTRUCTION

A. The energy recovery component shall be of fixed-plate crossflow construction, with no moving parts.

B. No condensate drain pans or drains shall be allowed and the unit shall be capable of operating in both winter and summer conditions without generating condensate.

C. The unit case shall be constructed of G90 galvanized, 20-gauge steel, with lapped corners and zinc plated screw fasteners.

D. Access doors shall provide easy access to blowers, ERV cores, and filters. Doors shall have an airtight compression seal using closed cell foam gaskets. Pressure taps, with captive plugs, shall be provided allowing cross-core pressure measurement allowing for accurate airflow measurement.

E. Case walls and doors shall be insulated with 1 inch, 4-pound density, foil/scrim faced, high-density fiberglass board insulation, providing a cleanable surface and eliminating the possibility of exposing the fresh air to glass fibers, and with minimum R-value of 4.3 (hr·ft2·°F/BTU). EV450IN case walls and doors shall be insulated with 7/8 inch, expanded polystyrene foam insulation faced with a cleanable foil face on all exposed surfaces.

F. The ERV cores shall be protected by a MERV-13 rated, 2" nominal, pleated, disposable filter in both airstreams.

G. The unit shall have single-point power connection and a single-point 24 VAC contactor control connection.

H. Blower motors shall be Premium Efficiency, EISA compliant for energy efficiency. The blower motors shall be totally enclosed (TEFC) and shall be supplied with factory installed motor starters (HE6X and

HE8X 208-230/460V models are open drip-proof). Direct drive models (EV450 and HE1X models) shall be EISA-compliant for energy efficiency with open drip proof design and integral thermal protection.

I. Blowers shall be quiet running, forward curve type and be either direct drive (EV450 and HE1X only) or belt drive. HE1.5X shall be backward incline, motorized impeller type packages. HE6X and HE8X units use backward incline, belt drive blower packages. Belt drive motors shall be provided with adjustable pulleys and motor mounts allowing for blower speed adjustment, proper motor shaft orientation and proper belt tensioning.

J. The unit electrical box shall include a factory installed, non-fused disconnect switch and a 24 VAC, Class II transformer/relay package.

K. The ERV shall be provided "inverter-ready" allowing for applications of inverters supplied and installed by others.

2.02 INCLUDED OPTIONS

A. Provide unit and duct connection orientation per project schedule.

B. Provide double wall construction with 24-gauge galvanized steel liner.

C. Units are available single or three phase at a full range of operating voltages. See Project Drawings.

D. Provide motor horsepower as specified.

E. Provide factory installed disconnect fuses.

F. Provide factory installed filter monitors for each airstream.

G. Provide MERV-13 filters for final installation after construction phase.

H. Provide factory installed Variable Frequency Drives or solid-state speed controllers (based on motor type and voltage) allowing either preset or variable speed operation with appropriate 0–10-volt DC or DDC control signal.

I. Provide ECM controlled motors allowing either two preset speeds or variable speed operation with a 0–10-volt DC control signal.

J. Provide factory installed isolation dampers for either or both air streams. The insulated dampers shall be of a low leakage design and shall not restrict the airstream, reducing airflow, in any way. The dampers shall be opened with a motor actuator powered by the standard unit transformer package and have a spring return for low off- position power consumption.

2.03 UNIT CONTROLS

A. The unit shall be constructed so that it can function as a stand-alone heating and cooling system controlled by factory-supplied controllers, thermostats and sensors or it can be operated as a heating and cooling system controlled by a Building Management System (BMS). This unit shall be controlled by a factory-installed microprocessor programmable controller (DDC) that is connected to various optional sensors.

B. Unit shall incorporate a DDC controller with integral LCD screen that provides text readouts of status, operating settings, and alarm conditions. DDC controller shall have a built-in keypad to permit operator to access read-out screens and change settings without the use of ancillary equipment, devices, or software. DDC controllers that require the use of equipment or software that is not factory-installed in the unit are not acceptable. Alarm readouts consisting of flashing light codes are not acceptable]. Owner-specified ventilating conditions can be input by means of pushbuttons.

1. Operating protocol: The DDC shall be factory-programmed for BACnet IP for monitoring of the unit's status.
2. Operating protocol: The DDC shall be factory-programmed for BACnet IP for monitoring of the unit's status and control of the unit's functions.

C. Remote Interface: Contractor shall provide and install a Remote Interface that functions as a remote indicator of owner-selected operating parameters and also permits remote inputting of new operating parameters. Each remote panel shall have a large LCD user interface screen similar in form and function to the screen on the DDC. Installed location of room display shall be as indicated on the plans or at the direction of Owner and/or Owner's representative.

D. Sensors
1. Room / Space Temperature Sensors
2. Dirty Filter Sensor
3. CO2 Sensor
4. Temperature Sensors- OAI, EAW, RAI, OAD
5. Current Sensor- OAF-A, EF-A

2.04 ELECTRIC COILS

A. Assembly: ANSI/UL 1096 listed and labelled, with NEMA 1 terminal control box and hinged cover, splice box, coil, casing, and controls.

B. Coil: Open coil of nickel-chrome Type A resistance wire with refractory ceramic support bushings.

C. Casing: Die formed channel frame of 16 gage galvanized steel with 3/8 inch mounting holes on 3 inch centers. Provide tube supports for coils longer than 36 inches.

D. Controls: Automatic reset thermal cut-out, built-in magnetic contactors, modulating single-stage Silicon Controlled Rectifier (SCR) capable of accepting 0-10Vdc or 4-20mA as control signal, control circuit transformer and fuse, manual reset thermal cut-out, air flow proving switch, fused disconnect.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions and in conformance with ARI 435.

B. Isolate fan section with flexible duct connections.

C. Install unit on vibration isolators.

D. Wire electric duct coils in accordance with ANSI/NFPA 70.

END OF SECTION 23 72 00

SECTION 23 80 00
DECENTRALIZED HVAC EQUIPMENT

PART 1 GENERAL

1.01 SYSTEM DESCRIPTION

A. The variable capacity, heat pump heat recovery air conditioning system shall be a Mitsubishi Electric VRFZ (Variable Refrigerant Flow Zoning). The VRFZ systems shall be simultaneous cooling and heating split system heat pump.

The system shall consist of an outdoor unit, BC (Branch Circuit) Controller, multiple indoor units (E models), and M-NET DDC (Direct Digital Controls). Each indoor unit or group of indoor units shall be capable of operating in any mode independently of other indoor units or groups. The system shall be capable of changing mode (cooling to heating, heating to cooling) with no interruption to system operation. Each indoor unit or group of indoor units shall be independently controlled. The sum of connected capacity of all indoor air handlers shall range from 50% to 150% of outdoor rated capacity.

1.02 QUALITY ASSURANCE

A. The units shall be listed by Electrical Laboratories (ETL) and bear the ETL label.

B. All wiring shall be in accordance with the National Electrical Code (NEC).

C. The units shall be manufactured in a facility registered to ISO 9001 and ISO14001 which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).

D. A full charge of refrigerant for the condensing unit only shall be provided in the condensing unit.

1.03 DELIVERY, STORAGE AND HANDLING

A. Unit shall be stored and handled according to the manufacturer’s recommendation.

PART 2 – WARRANTY

2.01 The units shall be covered by the manufacturer’s limited warranty for a period of one (1) year from date of installation. If the systems are:

1. Designed by a certified CITY MULTI Diamond Designer
2. Installed by a contractor that has successfully completed the Mitsubishi Electric three-day service course;
3. Verified with a completed commissioning report submitted to and approved by the Mitsubishi Electric Service Department, then the units shall be covered by an extended manufacturer’s limited warranty for a period of five (5) years from date of installation.

In addition, the compressor shall have a manufacturer's limited warranty for a period of seven (7) years from date of installation.

If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer.

This warranty shall not include labor.

2.02 Manufacturer shall have a minimum of twenty years of HVAC experience in the U.S. market.

2.03 All manufacturer technical and service manuals must be readily available for download by any local contractor should emergency service be required. Registering and sign-in requirements which may delay emergency service reference are not allowed.

2.04 The VRFZ system shall be installed by a contractor with extensive install and service training. The mandatory contractor service and install training should be performed by the manufacturer.

PART 3 – PRODUCTS

3.01 OUTDOOR UNIT

A. General: The outdoor unit shall be used specifically with VRFZ components. The outdoor units shall be equipped with multiple circuit boards that interface to the M-NET controls system and shall perform all functions necessary for operation. Each outdoor unit module shall be completely factory assembled, piped and wired and run tested at the factory.

1. The model nomenclature and unit requirements are shown below. All units requiring a factory supplied twinning kits shall be piped together in the field, without the need for equalizing line(s). If an alternate manufacturer is selected, any additional material, cost, and labor to install additional lines shall be incurred by the contractor.
2. Outdoor unit shall have a sound rating no higher than 60 dB(A) individually or 63 dB(A) twinned. Units shall have a sound rating no higher than 50 dB(A) individually or 53 dB(A) twinned while in night mode operation. If an alternate manufacturer is selected, any additional material, cost, and labor to meet published sound levels shall be incurred by the contractor.
3. Both refrigerant lines from the outdoor unit to the BC (Branch Circuit) Controller (Single or Main) shall be insulated.
4. There shall be no more than 3 branch circuit controllers connected to any one outdoor unit.
5. Outdoor unit shall be able to connect to up to 50 indoor units depending upon model.
6. The outdoor unit shall have an accumulator with refrigerant level sensors and controls.
7. The outdoor unit shall have a high pressure safety switch, over-current protection, crankcase heater and DC bus protection.
8. The outdoor unit shall be capable of operating in heating mode down to -4°F ambient temperature or cooling mode down to 23°F ambient temperature, without additional low ambient controls. If an alternate manufacturer is selected, any additional material, cost, and labor to meet low ambient operating condition and performance shall be incurred by the contractor.
9. The outdoor unit shall not cease operation in any mode based solely on outdoor ambient temperature.
10. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained.
11. Unit must defrost all circuits simultaneously in order to resume full heating more quickly. Partial defrost which may extend "no or reduced heating" periods shall not be allowed.

B. Unit Cabinet:

1. The casing(s) shall be fabricated of galvanized steel, bonderized and finished. Units cabinets shall be able to withstand 960 hours per ASTM B117 criteria for seacoast protected models (–BS models)

C. Fan:

1. Each outdoor unit module shall be furnished with one direct drive, variable speed propeller type fan. The fan shall be factory set for operation under 0 in. WG external static pressure, but capable of normal operation under a maximum of 0.24 in. WG external static pressure via dipswitch.
2. All fan motors shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.
3. All fan motors shall be mounted for quiet operation.
4. All fans shall be provided with a raised guard to prevent contact with moving parts.
5. The outdoor unit shall have vertical discharge airflow.

D. Refrigerant:

1. R454B refrigerant shall be required for outdoor unit systems.

E. Coil:

1. The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
2. The coil fins shall have a factory applied corrosion resistant blue-fin finish.
3. The coil shall be protected with an integral metal guard.
4. Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.
5. The outdoor coil shall include 4 circuits with two position valves for each circuit, except for the last stage.

F. Compressor:

1. Each outdoor unit module shall be equipped with one inverter driven scroll hermetic compressor. Non inverter-driven compressors shall not be allowed.
2. A crankcase heater(s) shall be factory mounted on the compressor(s).
3. The outdoor unit compressor shall have an inverter to modulate capacity. The capacity shall be completely variable with a turndown of 19%-8% of rated capacity, depending upon unit size.
4. The compressor will be equipped with an internal thermal overload.
5. The compressor shall be mounted to avoid the transmission of vibration.
6. Field-installed oil equalization lines between modules are not allowed. Prior to bidding, manufacturers requiring equalization must submit oil line sizing calculations specific to each system and module placement for this project.

G. Electrical:

1. The outdoor unit electrical power shall be 208/230 or 460 volts, 3-phase, 60 hertz.
2. The outdoor unit shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz), 207-253V (230V/60Hz) or 414-506V (460V/60Hz).
3. The outdoor unit shall be controlled by integral microprocessors.
4. The control circuit between the indoor units, BC Controller and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

3.02 BRANCH CIRCUIT (BC) CONTROLLERS

A. General: The BC (Branch Circuit) Controllers shall be specifically used with R454B systems. These units shall be equipped with a circuit board that interfaces to the M-NET controls system and shall perform all functions necessary for operation. The unit shall have a galvanized steel finish. The BC Controller shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory. This unit shall be mounted indoors, with access and service clearance provided for each controller. The sum of connected capacity of all indoor air handlers shall range from 50% to 150% of rated capacity.

B. BC Unit Cabinet:

1. The casing shall be fabricated of galvanized steel.
2. Each cabinet shall house a liquid-gas separator and multiple refrigeration control valves.
3. The unit shall house two tube-in-tube heat exchangers.

C. Refrigerant:

1. R454B refrigerant shall be required.

D. Refrigerant valves:

1. Each branch shall have multiple two-position valves to control refrigerant flow.
2. Service shut-off valves shall be field-provided/installed for each branch to allow service to any indoor unit without field interruption to overall system operation.
3. Linear electronic expansion valves shall be used to control the variable refrigerant flow.

E. Integral Drain Pan:

1. An integral condensate pan and drain shall be provided.

F. Electrical:

1. The unit electrical power shall be 208/230 volts, 1 phase, 60 hertz.
2. The unit shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253V (230V/60Hz).
3. The BC Controller shall be controlled by integral microprocessors.
4. The control circuit between the indoor units and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

3.03 WALL-MOUNTED INDOOR UNITS

A. General: Shall be a wall-mounted indoor unit section and shall have a modulating linear expansion device and a flat front. The PKFY shall be used with the R2-Series outdoor unit and BC Controller, Y-Series outdoor unit, or S-Series outdoor unit. The PKFY shall support individual control using M-NET DDC controllers.

B. Indoor Unit: The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

C. Unit Cabinet:

1. All casings, regardless of model size, shall have the same white finish.
2. Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining shall be standard.

3. There shall be a separate back plate which secures the unit firmly to the wall.

D. Fan:

1. The indoor fan shall be an assembly with one or two line-flow fan(s) direct driven by a single motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. A manual adjustable guide vane shall be provided with the ability to change the airflow from side to side (left to right).
4. A motorized air sweep louver shall provide an automatic change in airflow by directing the air up and down to provide uniform air distribution.

E. Filter:

1. Return air shall be filtered by means of an easily removable, washable filter.

F. Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. All tube joints shall be brazed with phos-copper or silver alloy.
4. The coils shall be pressure tested at the factory.
5. A condensate pan and drain shall be provided under the coil.
6. Both refrigerant lines to the PKFY indoor units shall be insulated.

G. Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz)

H. Controls:

1. This unit shall use controls provided by Mitsubishi Electric to perform functions necessary to operate the system.
2. The unit shall be able to control external backup heat.
3. The unit shall have a factory built in receiver for wireless remote control.
4. Each indoor unit shall be provided with hard-wired wall-mounted thermostat.

3.04 4-WAY CEILING-RECESSED CASSETTE WITH GRILLE INDOOR UNITS

A. General: Shall be a four-way cassette style indoor unit that recesses into the ceiling with a ceiling grille. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation function, a test run switch, and the ability to adjust airflow patterns for different ceiling heights. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

B. Unit Cabinet:

1. The cabinet shall be space-saving ceiling-recessed cassette.
2. The cabinet panel shall have provisions for a field installed filtered outside air intake.

3. Branch ducting shall be allowed from cabinet.
4. Four-way grille shall be fixed to bottom of cabinet allowing two, three or four-way blow.
5. The grille vane angles shall be individually adjustable from the wired remote controller to customize the airflow pattern for the conditioned space

C. Fan:

1. The indoor fan shall be an assembly with a turbo fan direct driven by a single motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. The indoor fan shall consist of five (5) speed settings, Low, Mid1, Mid2, High and Auto.
4. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and space temperature.
5. The indoor unit shall have an adjustable air outlet system offering 4-way airflow, 3-way airflow, or 2-way airflow.
6. The indoor unit shall have switches that can be set to provide optimum airflow based on ceiling height and number of outlets used.
7. The indoor unit vanes shall have 5 fixed positions and a swing feature that shall be capable of automatically swinging the vanes up and down for uniform air distribution.
8. The vanes shall have an Auto-Wave selectable option in the heating mode that shall randomly cycle the vanes up and down to evenly heat the space.
9. If specified, the grille shall have an optional i-see sensor that will measure room temperature variations and adjust the airflow accordingly to evenly condition the space.

D. Filter:

1. Return air shall be filtered by means of a long-life washable filter

E. Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. All tube joints shall be brazed with phos-copper or silver alloy.
4. The coils shall be pressure tested at the factory.
5. A condensate pan and drain shall be provided under the coil.
6. The unit shall be provided with an integral condensate lift mechanism that will be able to raise drain water 33 inches above the condensate pan.
7. Both refrigerant lines to the PLFY indoor units shall be insulated.

F. Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).

G. Controls:

1. This unit shall use controls provided by Mitsubishi Electric to perform functions necessary to operate the system.

2. The unit shall be able to control external backup heat.
3. The unit shall have a factory built in receiver for wireless remote control.
4. Each indoor unit shall be provided with hard-wired wall-mounted thermostat.

3.05 DUCTED AIR HANDLER

A. General: The PVFY shall be a ducted indoor fan coil design with a fixed bottom return, a fixed vertical discharge supply, and a modulating linear expansion device. The unit shall have the capability to be mounted in either the vertical or horizontal (left position only) and have the capability to integrate into systems with various types of indoor units connected. The PVFY shall be used with the R2-Series outdoor unit and BC Controller, P-Series outdoor unit, or S-Series outdoor unit. The PVFY shall support individual control using M-NET DDC controllers. Units shall have the ability to control supplemental heat via connector Cn24 and a 12 VDC output.

B. Indoor Unit: The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

C. Unit Cabinet:

1. The cabinet shall be pre-painted, pre-insulated, 22-gauge galvanized steel.

D. Fan:

1. The indoor unit fan shall be an assembly with a single direct drive fan with a high efficiency DC motor.
2. The indoor fan shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings.
3. The indoor unit shall have a ducted air outlet system and ducted return air system.
4. The fan shall have 3-speeds with the capability to operate between 0.3”-0.5” wc (selectable).

E. Filter:

1. The contractor shall provide a field fabricated filter rack.

F. Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. All tube joints shall be brazed with phos-copper or silver alloy.
4. The coils shall be pressure tested at the factory.
5. A condensate pan and drain shall be provided under the coil.
6. The condensate shall be gravity drained from the fan coil.
7. Both refrigerant lines to the PVFY indoor units shall be insulated.

G. Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).

H. Controls:

1. This unit shall use controls provided by Mitsubishi Electric to perform functions necessary to operate the system. Please refer to Part 4 for details on controllers and other control options.

PART 4 – CONTROLS

4.01 OVERVIEW

A. General: The Controls Network (CMCN) shall be capable of supporting remote controllers, schedule timers, system controllers, centralized controllers, an integrated web based interface, graphical user workstation, and system integration to Building Management Systems via BACnet® and LonWorks®.

4.02 ELECTRICAL CHARACTERISTICS

A. General: The CMCN shall operate at 24VDC. Controller power and communications shall be via a common non-polar communications bus.

B. Wiring: Control wiring shall be installed in a system daisy chain configuration from indoor unit to ME remote controller to indoor unit, to the BC controller (main and subs, if applicable) and to the outdoor unit. Control wiring to remote controllers shall be run from the indoor unit terminal block to the controller associated with that unit.

Control wiring for schedule timers, system controllers, and centralized controllers shall be installed in a daisy chain configuration from outdoor unit to outdoor unit, to system controllers, to the power supply.

Control wiring for the Deluxe MA, Simple MA, and Wireless MA remote controllers shall be from the remote controller to the first associated indoor unit (TB-15) then to the remaining associated indoor units (TB-15) in a daisy chain configuration...

C. Wiring type: Wiring shall be 2-conductor (16 AWG), twisted shielded pair, stranded wire, as defined by the Design Tool AutoCAD output. Network wiring shall be CAT-5e with RJ-45 connection.

4.03 CONTROLS NETWORK

A. The Controls Network (CMCN) consists of remote controllers, schedule timers, system controllers, centralized controllers, and/or integrated web based interface communicating over a high-speed communication bus. The Controls Network shall support operation monitoring, scheduling, error email distribution, personal browsers, tenant billing, online maintenance support, and integration with Building Management Systems (BMS) using either LonWorks® or BACnet® interfaces. The below figure illustrates a sample CMCN System Configuration.

4.04 CMCN: REMOTE CONTROLLERS

A. Simple MA Remote Controller (PAC-YT51CRB)
The Simple MA Remote Controller (PAC-YT51CRB) shall be capable of controlling up to 16 indoor units (defined as 1 group). The Simple MA Remote Controller shall be compact in size, approximately 3” x 5” and have limited user functionality. The Simple MA supports temperature display selection of Fahrenheit or Celsius. The Simple MA Remote Controller shall allow the user to change on/off, mode (cool, heat, auto (R2-Series only), dry, and fan), temperature setting, and fan speed setting. The Simple MA Remote Controller shall be able to limit the set temperature range from the Simple MA The room temperature shall be sensed at either the Simple MA Remote Controller or the Indoor Unit dependent on the indoor unit dipswitch setting. The Simple MA Remote Controller shall display a four-digit error code in the event of system abnormality/error.

The Simple MA Remote Controller shall only be used in same group with PAR-21MAA (Deluxe MA Remote Controllers), Wireless MA (PAR-FL32MA-E / PAR-FA32MA-E), or with other PAC-YT51CRB (Simple MA Remote Controllers), with up to two remote controllers per group.

The Simple MA Remote Controller shall require no addressing. The Simple MA Remote Controller shall connect using two-wire, stranded, non-polar control wire to TB15 connection terminal on the indoor unit. The PAC-YT51CRB shall require cross-over wiring for grouping across indoor units.

B. Wireless MA Remote Controller
The Wireless MA Remote Controller (PAR-FL32MA) used in conjunction with the Wireless MA Remote Controller Receiver (PAR-FA32MA) shall be capable of controlling up to 16 indoor units (defined as 1 group). The Wireless MA Remote Controller is approximately 6" x 2-1/4" and the Wireless MA Remote Controller Receiver is approximately 4-3/4" x 2-3/4". The Wireless MA Remote Controller shall have a range of 22 feet. A single Wireless MA Remote Controller shall be capable of signaling multiple Wireless MA Remote Controller Receivers for control of multiple indoor units. The Wireless MA Remote Controller and Remote Receiver shall support temperature display selection of Fahrenheit or Celsius. The Wireless MA Remote Controller shall control the following grouped operations: On/Off, Operation Mode (cool, heat, auto (R2-Series only), dry, and fan), temperature set point, fan speed setting, and airflow direction setting. The Wireless MA Remote Controller shall support 1 on/off timer setting per day. The room temperature shall be sensed at either the Wireless MA Remote Controller Receiver or the Indoor Unit dependent on the indoor unit dipswitch setting. The Wireless MA Remote Controller shall display a four-digit error code in the event of system abnormality/error.

The Wireless MA Remote Controller and Receiver shall only be used in the same group with other Wireless MA (PAR-FL32MA / PAR-FA32MA), Deluxe MA Remote Controllers (PAR-21MAA) or Simple MA Remote Controllers (PAC-YT51CRB), with up to two remote controllers per group.

The Wireless MA Remote Controller and Receiver shall require no addressing. The Wireless MA Remote Controller Receiver shall connect using two-wire, stranded, non-polar control wire to TB15 connection terminal on the indoor unit. The Wireless MA Remote Controller Receiver shall require cross-over wiring for grouping across indoor units.

4.05 CMCN: SYSTEM CONTROLLERS

A. PAC-YT40ANRA: ON/OFF Controller
The PAC-YT40NARA ON/OFF Controller shall be capable of turning ON/OFF up to sixteen groups of indoor units, for a maximum of 50 indoor units. All of the units, up to 50, shall be turned ON/OFF using the main switch. A LED for each group of indoor units, up to 16 groups, shall indicate if there is a failure within each group by flashing. A main LED shall flash if there is an error on any one of the 16 groups for a maximum of 50 indoor units. A LED shall indicate the ON/OFF status for each group of indoor units. The PACY-YT40ANRA shall be approximately 5" x 5" in size and shall be powered using either the PAC-SC50KUA Power Supply on TB 7 of the outdoor unit or via the indoor transmission line on TB 3 on the outdoor unit. The ON/FF Controller can output via level signal operation state and error state.

B. PAC-YT34STA: SCHEDULE TIMER
The Schedule Timer (PAC-YT34STA) shall schedule operation for a maximum of 50 indoor units. The maximum number of indoor units supported per one group shall be 16. The maximum number of groups supported shall be 50. The Schedule Timer shall be used in conjunction with PAR-21MAA (Deluxe MA Remote Controllers), Wireless MA (PAR-FL32MA-E / PAR-FA32MA-E), and/or PAR-F27MEA (ME Remote Controllers).

The Schedule Timer shall support up 9 scheduling patterns with up to 16 operations per pattern. Operations shall include on/off, mode selection (cool, heat), set temperature, and prohibition of remote controller functions (on/off, operation mode change, and set temperature adjustment). Patterns shall be applied to each group of indoor units on a per-day basis. The minimum time interval shall be 5-minutes. The Schedule Timer shall display a four-digit error code in the event of system abnormality/error.

The Schedule Timer shall be manually addressed using rotary dial switch to the M-NET communication bus. The Schedule Timer shall be powered using either the PAC-SC50KUA Power Supply or via the indoor transmission line.

The Schedule Timer can be used in conjunction with G-50A Centralized Controller which has higher priority but requires change in dipswitch setting. The Schedule Timer shall accept level or pulse input signals and shall output level signals for specific functions, as defined in below table.

C. System Group Controller (PAC-SF44SRA)
The System Centralized Controller (PAC-SF44SRA) shall be capable of controlling a maximum of 50 groups or a maximum of 50 indoor units across multiple CITY MULTI outdoor units. The System Group Controller shall be approximately 5”x 5” in size and shall be powered using either the PAC-SC50KUA or PAC-SC51KUA Power Supply on TB 7 of the outdoor unit or via the indoor transmission line on TB 3 on the outdoor unit. The System Group Controller shall have operation controls which can be applied to an individual indoor unit, a group of indoor units (up to 50 indoor units), or all indoor units (collective batch operation). This control set of operation controls for the System Group Controller shall include on/off, operation mode selection (cool, heat, auto (R2-Series only), dry, and fan), and temperature setting. The System Group Controller shall be able to enable or disable operation of local remote controllers.

4.06 INPUT/OUTPUT (IO) BOARDS

A. Digital Input Digital Output (DIDO) Board
The DIDO IO board shall be capable of providing On/Off control for non-Mitsubishi equipment via the AG-150A/G-50A/GB-50A Centralized Controller’s licensed web browser functions and the TG-2000A software. Each DIDO board shall have two digital inputs and two digital outputs and shall be capable of expanding to a total of six digital inputs and six digital outputs. Each digital output shall be capable of supporting an independent schedule via the AG-150A/G-50A/GB-50A Centralized Controller’s licensed web browser functions and the TG-2000A software. Status indication of the On/Off state of the non-Mitsubishi equipment shall be either via the On/Off status of the digital output or by receipt of a digital input to the DIDO board.

The DIDO IO board shall be capable of receiving a digital input for interlock settings with the indoor units or digital outputs on the DIDO board. Based on the digital input status the DIDO board shall be capable of setting the following parameter on the indoor unit On/Off, Mode, and Set Temperature to predefined settings. The DIDO board shall also be capable of interlocking the On/Off state of a digital output on the DIDO board based on a digital input status.

B. Analog Input (AI) Board
The AI IO board shall be capable of monitoring temperature or humidity via the AG-150A/G-50A/GB-50A Centralized Controller’s licensed web browser functions and the TG-2000A software. Each AI board shall have two analog inputs. Each input shall be capable of receiving a 4/20mA, 0/10 VDC, or 1/5 VDC signal for monitoring temperature or humidity. The AI board shall be capable of monitoring the temperature or humidity input and shall be capable of displaying graphical trending of the temperature or humidity values via the AG-150A/G-50A/GB-50A Centralized Controller’s licensed web browser functions and the TG-2000A software. Notification of user adjustable high and low level alarms shall be capable of being emailed to distribution list or outputted via a digital output.

The AI IO board shall be capable of setting the following parameters on the indoor unit On/Off, Mode, and Set Temperature to predefined settings based on the input value of the temperature or humidity. The AI board shall also be capable of interlocking the On/Off state of a digital output on the input value of the temperature or humidity.

4.07 POWER SUPPLY (PAC-SC51KUA)

A. The power supply shall supply 24VDC (TB 3) for the AG-150 centralized controller and 24VDC (TB 2) voltage for the central control transmission.

4.08 M-SERIES CONTROL

A. The CMCN shall have the capability of controlling and monitoring the Mitsubishi Electric units through the use of an adaptor to allow the units to communicate on the M-Net communication bus.

END OF SECTION 23 80 00

SECTION 23 84 19
DEHUMIDIFICATION UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Dehumidification system.

B. Controls and control panels.

1.02 REFERENCES

A. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

B. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

C. ASHRAE 52 - Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.

D. FS TT-C-490 - Cleaning Method and Pretreatment of Ferrous Surfaces for Organic Coatings.

E. UL - Underwriters Laboratories.

1.03 REGULATORY REQUIREMENTS

A. Conform to ANSI/NFPA 90A for the installation of dehumidification systems.

B. Units shall be completely factory assembled, wired, piped, and tested. All controls shall be factory adjusted and preset to the design conditions. Test report shall be available on request. Engineers reserve the right to witness factory performance testing.

C. Manufacturer of the packaged system for natatorium environment control shall have a minimum of five years experience in the production of these systems.

D. The system shall have a limited warranty for one full year from start-up or 15 months from shipment, whichever comes first.

E. The entire cabinet shall be painted internally and externally.

1.04 SUBMITTALS

A. Submit overall dimension drawings, field wiring diagram, and product data including air flow, static pressures, total power consumption, moisture removal capacity, moisture removal efficiency, air leaving conditions under all operating modes, and total refrigerant charge.

B. Basis of unit selection and performance with supporting documentation to be furnished with bid. Guaranteed maximum annual operating cost to be supplied with bid.

1.06 OPERATION AND MAINTENANCE DATA

A. Electrical wiring diagrams, installation and maintenance instructions and the owner's manual shall be supplied with each unit.

PART 2 PRODUCTS

2.01 GENERAL

A. Furnish and install Storage Vault environment control system. Performance and specifications shall meet or exceed that shown on the equipment schedule. The manufacturer shall supply a written guarantee of space humidity and temperature conditions.

B. The dehumidifier unit shall include compressor(s), evaporator (dehumidifying coil), condenser (air reheat coil), supply and return/exhaust air blowers, blower motors, motor starters and controls in one complete enclosure. All controls shall be factory adjusted and preset to the design conditions.

C. The unit shall be designed for indoor or outdoor rooftop installation.

D. The unit shall include an economizer mixing section.

E. The unit shall be designed for field assembly to allow for retrofit installation where access to the installation site is restricted. Unit shall be fully factory tested prior to disassembly for shipment.

F. The unit shall be designed as a split system and shall consist of a separate air handling section and compressor section. Evaporator and condenser coils, blower(s) and blower motor(s), and any applicable dampers shall be located in the remote air handling section. Compressor(s) shall be located on an open skid section.

2.02 CABINET

A. The units shall be constructed of 14-gauge satin coated sheet metal, reinforced for maximum rigidity with a 12-gauge base. The cabinet shall have one section for the blower, compressor(s) and water heater(s) and a second section for the coils and drain pan.

B. Hinged, removable service panels shall be furnished to provide access to all internal parts from both sides and in both sections.

C. Each unit shall have a built-in electrical control panel in a separate compartment in order not to disturb the air flow within the dehumidifier during electrical servicing.

D. The unit shall have a built-in air filter rack with separate access door.

E. The unit shall be equipped with an opening suitable for connection of a duct to admit outdoor air to comply with ASHRAE Ventilation Standard 62-1989. Air must be filtered prior to entering the unit. Pre-heating or pre-cooling outdoor air shall not be necessary in summer and winter design conditions. Air shall be admitted between the evaporator and condenser coils.

F. Rooftop cabinet shall be painted with two coats of Sicopoxy primer and two coats of Acrythane finish, color grey. Unit shall be weatherproof, and all seams shall be bolted with stainless steel hardware and sealed to prevent leakage. Unit shall have a built-in electrical control panel with separate double-door compartment (single door shall not be acceptable). Roof curb model shall have all connections from the bottom. The freestanding model shall have duct connections for horizontal ducts, bottom drain connection and pool water connections from the side. Opening for outdoor air to comply with ASHRAE Ventilation Standard 62-1989 shall be equipped with filter, dampers, and weatherproof hood.

2.03 INSULATION

A. Entire coil section shall be insulated to prevent condensation with 1/2-inch-thick fiberglass duct liner insulation, approved for 250 EF operating temperature and up to 5,000 fpm air velocity. Surface to be protected against perforation with a reinforcing mesh. Fire resistance rating to conform with NFPA Standard 90A. Sound attenuation coefficient shall be not less than 0.64 at a frequency of 1000 Hz as per ASTM Standard C423. Thermal conductivity shall be not more than 0.232 Btu/in≅h≅sq ft≅F at 75 F. Insulation shall be securely fastened with approved adhesive and mechanical fasteners.

B. Rooftop units shall be insulated with 1-inch-thick fiberglass duct liner insulation, approved for 250 EF operating temperature and up to 5,000 fpm air velocity. surface to be protected against perforation with a reinforcing mesh. Fire resistance rating to conform with NFPA Standard 90A. Sound attenuation coefficient shall be not less than 0.86 at a frequency of 1000 Hz as per ASTM Standard C423. Thermal conductivity shall be not more than 0.232 Btu/in≅h≅sq ft≅F at 75 F. Insulation shall be securely fastened with approved adhesive and mechanical fasteners.

2.04 EVAPORATOR (DEHUMIDIFIER COIL)

A. Shall not be less than eight rows deep for maximum moisture removal capacity with air velocity not to exceed 500 fpm, with 1/2-inch OD seamless copper tubing mechanically expanded to assure high heat transfer with maximum twelve flat aluminum fins per inch.

B. Corrugated, facetized or copper fins shall not be acceptable. System performance reduction from coated coils must be fully disclosed.

C. Coil shall have a 16-gauge galvanized casing and end plates coated with 660 clear coat.

D. Coil shall be factory tested at air pressures not less than 400 psig in a water bath.

E. An adjustable damper shall be installed above the evaporator coil for apparatus dew point control during cold water start-up. Capacity reduction methods shall absolutely not be used for dew point control.

F. Coil shall have an optional 5-year extended warranty.

2.05 CONDENSER (AIR REHEAT COIL)

A. Shall not be less than three rows deep for variable heat transfer into the air with 1/2-inch OD seamless copper tubing mechanically expanded to assure high heat transfer with maximum twelve facetized aluminum fins per inch.

B. Copper fins shall not be acceptable. System performance reduction from coated coils must be fully disclosed.

C. Coil shall have a 16-gauge galvanized casing and end plates coated with 660 clear coat.

D. Coil shall be factory tested at air pressures not less than 400 psig in a water bath.

E. Coil shall have an optional 5-year extended warranty.

2.06 DRAIN PAN

A. Each unit shall be equipped with a sloped non-trapping drain pan under the entire evaporator coil to prevent condensate carryover. Flat drain pans susceptible to water pooling and subsequent bacteria growth shall not be acceptable.

B. The drain pan shall be made of 12-gauge grey Noryl plastic with hair cell finish, temperature resistant to 200 EF complete with recessed bottom drain, sanitary round corners, and flush mounted stainless-steel strainer for minimum condensate collection in pan. Drain connection shall be suitable for 1 1/2-inch P-trap connection using compression ring fitting for easy disassembling and cleaning.

2.07 BLOWERS

A. Shall be double width, double inlet, multi-blade forward curved centrifugal type blower wheel, dynamically and statically balanced and tested, mounted on a solid steel shaft coated with silicon.

B. Shall have a galvanized steel wheel and galvanized steel casing painted with a baked enamel finish.

C. Bearings shall be grease-lubricated, self-aligning for 200,000 hours average life.

2.08 BLOWER MOTORS

A. Shall be open drip-proof, class B insulation, induction type, 40 EC rise, pre-lubricated ball bearings mounted on an adjustable base.

B. Shall have a service factor rating of 1.15 or higher and must be stamped or marked high efficiency.

2.09 BLOWER BELT DRIVE ASSEMBLY

A. Shall be single V-belt with a safety factor of not less than 1.2 based on nominal motor horsepower, dynamically balanced cast iron fixed pitch blower sheave and dynamically balanced cast iron variable pitch motor sheave.

2.10 COMPRESSORS

A. Shall be semi-hermetic compressor(s), reciprocating type, suction gas cooled, suitable for refrigerant R-410A, equipped with internal solid state thermal protection sensor, service valves, easily removable crankcase heater for liquid migration protection, spring mounted, muffler plate on the discharge valve, oil pump for forced lubrication, oil level sight glass, suitable for reduced voltage starting (not applicable for 460 V), pump down cycle protection and oil failure protection.

B. Compressor manufacturers must have a wholesale outlet for replacement parts in the nearest major city.

C. Compressor(s) shall have an optional 5-year extended warranty.

2.11 REFRIGERATION CIRCUIT

A. Shall have a replaceable core type liquid line filter drier, liquid and moisture indicator visible from outside the unit without removal of the access panel, thermostatic expansion valve, pump down solenoid valve, two manual valves to isolate filter drier for fast drier core replacement.

C. Tamper proof hermetically sealed non-adjustable high- and low-pressure controls and refrigeration service valves shall be installed using Schraeder type valves.

C. Refrigeration service valves shall be located outside of the airstream.

D. Suction line shall be fully insulated with not less than 1/2-inch closed cell insulation.

2.12 CONTROL PANEL

A. Shall be built-in within a separate compartment in order not to disturb the air flow during servicing.

B. Blower motors and compressors shall be controlled by contactors.

C. Blower motors and compressor(s) shall be protected with push-button operated, adjustable thermal trip and fixed magnetic trip overloads.

D. Voltage monitor shall be provided to shut down electrical system to prevent damage in the event of temporary voltage fluctuation or phase loss. Voltage monitor shall be auto reset.

E. Power block terminal shall be provided for proper wire size.
F. Dry contacts shall be provided for alarm and blower interlock.

G. Color coding and wire numbering shall be provided for easy troubleshooting. All wires shall be in a wire duct.

H. Compressor(s) shall have a time delay start to prevent short cycling.

I. A 24 VAC/120 VA power supply shall be provided to operate a ventilation system during the economizer cooling mode.

J. All wiring shall be installed in accordance with UL or CSA safety electrical code regulations and shall be in accordance with NFPA. All components used shall be UL or CSA listed.

K. A 24 VAC/220 VA power supply shall be provided to operate a ventilation system during the economizer cooling mode.

L. A separate power block terminal shall be provided for 115V, single phase power for service.

2.13 MICROPROCESSOR CONTROL

A. Unit shall be monitored and controlled with a solid-state microprocessor system complete with control panel equipped with 2 lines by 16-character LCD display.

B. The operator panel shall be of metal casing, splashproof (NEMA 3R, front side) for use in hostile environments and equipped with 22 large snap-action keys. The operator panel shall be capable of being panel mounted, handheld, desktop or wall mounted and include a serial TTY 9600 baud communications interface to the controller.

C. The operator panel shall be field replaceable, and connector shall be equipped with slide lock. The panel shall have a built-in self-test mode for keyboard and display.

D. The operator panel shall be CSA and UL approved.

E. The operator panel shall be remote mounted up to a maximum of 3280 feet away from the controller using a 110/120VAC power adapter and 4-wire shielded cable.

F. There shall be an optional personal computer man-machine interface (MMI) to be used in place of the operator panel. Up to 30 units shall be controllable in a network configuration from a single personal computer (minimum computer requirements are IBM PC/AT or compatible, VGA monitor, 1MB RAM, 40 MB hard drive, 5 1/4 or 3 1/2-inch floppy diskette drive, MicroSoft Windows, mouse). The MMI will monitor and control the units as per the operator panel with the addition of:
Graphical color displays of operation (if using color VGA monitor)
Mouse compatible
Alarm display and logging.
Sensor monitoring
Sensor real-time trend analysis
Setpoint visualization and adjustment
Full on-line help
Automatic installation
Fully Windows compatible
Printed reports

G. The following status and alarm functions shall be displayed on the operator panel and monitored by the controller when required:
Compressor #1 on
Compressor #2 on
Compressor #1 auto/off
Compressor #2 auto/off
Compressor #1 overload
Compressor #2 overload
Compressor #1 high pressure
Compressor #2 high pressure

Compressor #1 low pressure
Compressor #2 low pressure
Compressor #1 overheat.
Compressor #2 overheat.
Compressor #1 oil failure
Compressor #2 oil failure
Compressor #1 pumpdown
Compressor #2 pumpdown
Unit remote off.
Manual reset required.
Evaporator damper closed.
Low water flow, circuit #1
Low water flow, circuit #2
Blower #1 (supply) off
Blower #2 (return) off
Blower #1 overload
Blower #2 overload
Anti-short cycle timer compressor #1
Anti-short cycle timer compressor #2
Replace backup battery.
Voltage monitor/Power failure
Call for dehumidification.
Call for cooling.
Call for pool water heating.
Call for ventilation.
Dehumidification on
Air conditioning on
Water heater #1 on
Water heater #2 on
Ventilation on
Firestat on
Freezestat on
Active/non-active period
Air zero reheat mode.
Service mode.
Auxiliary air heat 1st stage on
Auxiliary air heat 2nd stage on
Compressor #1 run time
Compressor #2 run time

H. The following sensors shall be factory mounted in the unit and the sensor data shall be displayed on the operator panel and monitored by the controller as required:
Return air temperature.
Supply air temperature.
Air off evaporator #1 temperature
Air off evaporator #2 temperature
Entering pool water temperature
Leaving pool water temperature
Return air relative humidity.
Compressor #1 hot gas temperature
Compressor #2 hot gas temperature

I. An outdoor air temperature sensor shall be field mounted and used for "smart" ventilation control when outdoor air conditions warrant cooling using outdoor air when a demand for cooling exists.

J. Optional temperature, pressure and humidity sensors shall be available for additional pools and other custom design usage up to a maximum of 16 sensors.

K. All sensors shall be unit mounted, factory tested and calibrated. Easy-to-use field calibration capability shall be provided through either trim potentiometers or the operator panel. Humidity sensors shall be corrosion resistant, especially suited for harsh exposure such as indoor pools and spas with chlorine containing environments.

L. The control program shall be factory developed to user specification, factory tested and loaded into the controller. Through the operator panel, the user shall be able to set/perform the following functions:
Compressor #1 auto/off mode
Compressor #2 auto/off mode
Blower auto/off mode
Manual reset
Service mode for demand forcing (password protected)
Change all humidity and temperature setpoints, heating/cooling deadband and differential (password protected)
Sensor calibration (password protected)

M. The programmable controller shall consist of:
22 digital inputs
16 digital outputs (250VAC, 10A relay contacts)
8 analog inputs (0-10VDC sensor inputs, 11-bit resolution, 40 microsecond conversion time)
1 analog output (0-10VDC or 0-20mA selectable)
Short-circuit protection on all digital and analog outputs.
Expansion capability to maximum 256 digital inputs/outputs, 16 analog inputs/outputs
Power supply 20-30VDC, 160 mA
Class 1 electronic short-circuit protection
16 Kbytes program and data memory
2 microsecond instruction execution time
Watchdog timer for auto-shutdown in case of catastrophic failure.
128 timers (0.01 to 9990 second resolution), 128 counters built-in
Battery backed-up program/data storage, Lithium 3.4V 850 mAh battery, service life of 5 years.
Built-in EPROM and RAM self-test.
Built-in EPROM programmer for program backup.
CSA and UL approved.
Standard rail mounting for easy field service.
Worldwide service network

N. Factory service via modem shall be available using 9600 baud modem and standard telephone line. Full monitoring and control functions shall be available from the factory.

O. EPROM cartridge for program backup and easy field program upgrades.

2.14 AIR FILTERS

A. Shall be 2-inch disposable type suitable for commercial application, to handle average dust loading. Initial resistance at 100% R.A.F. of 0.12-inch W.G. and average arrestance efficiency of 85% based on 500 fpm air velocity.

B. Unit shall have an extended filter rack with hinged door for even air distribution across the dehumidifier coil. Filters must not be less than 8 inches from the evaporator coil face.

2.15 AIR-COOLED AIR CONDITIONING

A. Unit shall be equipped with air conditioning feature to reject heat to an outdoor air-cooled condenser. The outdoor condenser shall be equipped with a transformer and 24VAC control including contactor for fan motor.

B. Unit shall be provided with a dry contact rated for 24VAC/8A to operate the remote outdoor condenser control.

C. Refrigeration circuit shall include three-way refrigerant valve, receiver with pressure relief valve set at 400 psig sized to hold the outdoor condenser charge, pressure control valve and pressure differential valve, and two shutoff valves to isolate the outdoor condenser.

PART 3 EXECUTION

3.01 UNIT SELECTION

A. Specified manufacturer to be Dectron. Alternate manufacturers must be bid as such with full submittals in writing to the engineer one week prior to bid.

3.02 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Handle unit carefully to prevent damage, breaking, denting, and scoring. Damaged units or damaged components shall not be installed. Replace all damaged parts with new parts from the manufacturer.

B. If the unit is to be stored prior to installation store it in a clean, dry place. Protect from weather, dirt, fumes, water, construction, and physical damage.

C. Comply with manufacturer's rigging and installation instructions for unloading the unit and moving it to the final location.

3.03 INSTALLATION

A. Execute the work in accordance with the specifications and in accordance with the manufacturer's instructions and only by workmen experienced in this type of work.

B. Provide adequate drainage connections for condensate system.

END OF SECTION 23 84 19

SECTION 26 10 00
GENERAL ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 GENERAL PROVISION

A. The Conditions of the Contract and applicable requirements of Division 1 govern the work of this Section.

1.02 DESCRIPTION OF WORK

A. Furnish all labor and materials necessary for the complete installation of electrical work as indicated on the Drawings and includes, but is not necessarily limited to:

1. Electrical service modifications.
2. Complete feeder system, in conduit, to power panels, branch circuit panels, and HVAC equipment.
3. Branch circuit panels for power and lighting.
4. Complete branch circuit wiring system for lighting, motors, receptacles, junction boxes, and similar uses.
5. Lighting fixtures, wall switches, receptacles, and similar items.
6. Communications conduit.
7. Fire alarm system modifications.
8. Electrical demolition.

1.03 QUALITY ASSURANCE:

A. All materials and apparatus used in the work which is included in Underwriters Label Service shall be new and bear the Underwriters Laboratories, Inc. "UL" label. Materials not included in Underwriters Label Services shall be new and conform to NEMA or other applicable industry standards.

B. All manufactured articles, materials, apparatus, and equipment shall be applied, connected, erected, cleaned, and conditioned as recommended by the manufacturer.

C. Equipment and fixtures shown in schedules represent the basis for design. Substitutions of equal or superior fixtures will be allowed, but only with a Contractor/Supplier warranty of equal function and equal or superior quality.

D. Shop Drawings: Submit catalog data or drawings of the following equipment for final approval:

1. Power and lighting panels
2. Lighting fixtures, dimming equipment

3. Fire Alarm Equipment
4. Emergency Generator
5. Automatic Transfer switch

E. Codes and Standards:

1. All work and material shall conform to the current edition of the National Electrical Code.
2. All work shall be in accordance with the current edition of the National Electrical Safety Code.

1.04 PREPARATION

A. The electrical drawings are diagrammatic design drawings. The equipment, conduit and device locations are approximate. Any changes necessary to clear up obstructions or conflicts shall be made as approved by the Engineer and at no additional cost to the Owner.

B. The Subcontractor shall familiarize himself with the Architectural and Mechanical drawings and specifications and shall coordinate and adapt his work to the building as required by these drawings and specifications.

C. The Subcontractor shall make necessary field measurements to ascertain space requirements, including those for connection, and all equipment and apparatus shall be made easily accessible.

1.05 RELATED WORK SPECIFIED UNDER OTHER SECTIONS

1. Temporary wiring for building construction - see Div. 1
2. Cutting and patching - see Div. 1
3. Painting of all backboards (on all sides and edges before mounting); painting of panels (trims and doors - 2 coats before mounting); painting of exposed electrical raceways, boxes, and fittings - see DIVISION 9.
4. Section 07 84 00 Fire Stopping

1.06 TEMPORARY ELECTRICAL WIRING

A. Provide temporary electrical wiring of power and lighting for construction. Coordinate temporary electrical service with the local electric utility company. Pay all costs related to this service including utility company charges. Coordinate with the general contractor and other trades, so that conflicts are avoided.

B. Size the service adequate for normal construction needs for a project of this type including the load required for construction trailers. However, the service to and wiring of construction trailers is the responsibility of each trade contractor and not part of the work of this section.

C. The general contractor is to pay for the cost of energy consumed.

D. Service is to be 120/208 volts, 3 phase, 4 wire.

E. Provide all required connections, panels, circuit breakers, metering provision, feeders, branch circuit wiring, transformers, lighting fixtures, lamps, receptacles, switches, etc. for a complete and operating temporary electrical system.

F. Provide a minimum of 5-foot candles of temporary general illumination throughout the floor area of the building, including all corridors and stairways.

G. Provide feeders of sufficient capacity for the requirements of the work, enough outlets, 120/240 volt, or equivalent, conveniently located so that extension cords not exceeding 100 feet will reach all work requiring artificial light or power.

H. At the end of the day's work, disconnect all lights and power, other than the minimum required security illumination.

I. Provide replacement light bulbs as required throughout the period of construction.

J. Conform to all codes and regulations.

PART 2 PRODUCTS

2.01 SERVICE

A. Provide complete electrical service conforming to all requirements of the local electric utility company, municipality, and state.

B. Service to be as indicated on the drawings. Stub-ups to be rigid galvanized steel.

C. All back charges for the power company and telephone company as required will be by contractor.

2.02 CONDUIT

A. Conduits laid below grade or in floor shall be Schedule 40, heavy wall rigid PVC conduit or rigid galvanized steel, unless noted or so specified. Concrete encased ducts shall be typing DB. Provide a minimum of 30" of cover for direct buried conduit. All duct banks shall be encased in concrete. Provide a visible separation from primary conduits and other conduits.

B. No conduit shall be smaller than 1/2" (interior) and 3/4" (exterior below grade).

C. Conduit sizes indicated may be increased if desired to facilitate the pulling of cables.

D. In the floor slab and underground provide rigid galvanized threaded conduit with threaded fittings or use PVC conduit with equipment grounding conductor and rigid galvanized stub-ups.

E. Provide concrete encasement on PVC under roads and parking.

F. Interior conduits shall be rigid galvanized steel, intermediate conduit, or electrical metallic tubing (EMT).

G. Electrical contractors shall carefully and completely seal all exterior conduits to prevent the entry of water into the building. Install conduit in accordance with NECA "Standard of Installation". Join PVC conduit using cement as recommended by the manufacturer. Wipe conduit dry and clean before joining. Apply a full even coat of cement to the entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.

H. Provide a nylon pull string in all empty conduits.

2.03 CONDUCTORS

A. Specified gauge sizes refer to American Wire Gauge, 98.5% conductivity, annealed copper conductors. Wire sizes No.8 and smaller shall be THWN, XHHW, rated 75 degrees C minimum and suitable for wet and dry locations. Wire sizes No. 6 and larger shall be THWN, XHHW, suitable for wet or dry locations. No wire shall be smaller than no. 12, unless noted or so specified. All wire shall be copper.

B. Wires #12 and #10 shall be solid. Sizes #8 and larger shall be Class B strand.

C. Unless indicated or specified otherwise, all wiring shall have 600 volt rated insulation.

D. Branch circuit wiring carried through fluorescent fixture channels for connection to adjacent fixtures shall be Type "RHH" or "THHW" 90 C rated.

E. Conductors installed in conduits or directly buried outside the building shall be type USE/THHN.

F. Wire shall be Anaconda, Collyer, General Cable, or Southwire.

G. Wire Joints in circuit work at outlets shall be Buchanan "B-Cap", Ideal "Wire-Nut" Nos. 452 or 453, "Scotchlock Type R", or T & B "Sta-Kon".

H. MC cables may be used in concealed spaces.

2.04 OUTLET BOXES

A. Provide size and type boxes as required. Coordinate with other sections. Provide outlets flush unless otherwise indicated.

B. For schools, use stainless steel plates throughout.

C. Face plates shall be smooth (un ribbed) ivory, specification grade nylon plates. Provide stainless steel, brushed finish in all utility type spaces.

2.05 RECEPTACLES

A. Receptacle devices shall be selected for an ampacity equal to the branch circuit ampacity show on Drawings.

B. Receptacles exposed to the weather shall be weatherproof and protected by ground-fault devices. Receptacles located within 6' of sinks shall be GFI type.

2.06 WIRING DEVICES

A. MANUFACTURE; Harvey Hubbell or Arrow-Hart. All devices shall be of the same manufacturer.

B. WALL TOGGLE SWITCHES: Shall be quiet AC type, ivory, specification grade, with provisions for back wiring and side wiring with captively held clamping screws. Body covers shall be color coded for current rating. Devices shall be UL listed and labeled and meet or exceed requirements of NEMA Standard WD-1-1976.

C. GENERAL PURPOSE SWITCHES: Shall be 120–277-volt AC rated and shall be flush type and totally enclosed.

D. D. WALL RECEPTACLES: Shall be 125-volt AC, grounding type, specification grade, with provision for back wiring and side wiring with captive held clamping screws. Devices shall be UL listed and labeled and meet or exceed NEMA Standard Publication WD-1, 1974, par. 3.02.

2.07 SAFETY SWITCHES

A. Safety switches shall be general duty type, UL listed and labeled, conforming to NEMA Standard KSI-1975, and of rating shown on drawings. Operation shall be through quick-make, quick-break mechanism, with interlocking cover to prevent opening until switch is put in the "open" position. Switches shall be fusible, except where noted on drawings.

B. Enclosures shall be NEMA 1, except that switches mounted where they are exposed to weather shall have NEMA 3R, "weatherproof" enclosures.

C. Switches shall be of Square-D, Westinghouse, GE or ITE Manufacture, and shall have a factory applied gray enamel finish over rust inhibitor primer.

2.08 DISTRIBUTION PANELS

A. All branch circuits shall derive their power from distribution panels as shown in drawings.

B. Multi-pole breakers shall have an integral common trip. Breakers shall have continuous current and interrupting ratings and number of poles indicted on the drawings. When not specifically indicated, branch breakers shall have 10,000 amperes minimum symmetrical interrupting rating. Breakers shall be quick-make, quick-break type, through action of a combination thermal-magnetic trip element which shall trip-free of the handle and operate in response to an overload or a short circuit. The mechanism shall be sealed in bakelite enclosure.

C. Provide circuit breakers rated for "Switched Duty" for all circuit breakers used for switching lights or other loads. All circuit breakers shall be bolt on type.

2.09 GROUNDING

A. Unless otherwise indicated, all grounding electrode copper conductors shall be 600-volt, type THWN-THHN.

B. Connections to building structural steel members shall be made with Cadweld connections.

C. All ground connections shall be made in accordance with the NEC and the applicable State Electric Code. Ground shall be carried through conduits in the form of separate conductors.

D. Provide service ground in accordance with the National Electric Code.

E. Thoroughly bond and ground all metallic equipment including Conduits, enclosures, and metallic supports, all in full conformance with the utility company, National Electric Code and local requirements.

2.10 SLEEVES, BOXES AND CONCEALED CONDUITS

A. Provide all sleeves that will be required for the installation of conduit through walls, floor, etc.

B. Provide appropriate fire stops where fire walls or floors have been penetrated.

2.11 LIGHTING FIXTURES

A. Provide all lighting fixtures together with lamps of sizes and types as listed in the fixture schedule or as required to execute the work, and including all required accessories, plaster rings, fasteners, etc.

B. Adjust all fixtures to the satisfaction of the Architect.

C. Electrical subcontractors shall provide and install all transformers and/or ballasts required to operate all lamps specified, including remote ballasts and/or transformers and the enclosures for same. The electrical subcontractor shall be responsible for verification of compatibility between lamps specified, ballasts and/or transformers specified, and dimming and other control devices specified. Notify the architect of any incompatibility prior to ordering equipment.

D. The electrical subcontractor shall be responsible for verifying the coordination of all lighting equipment and control devices with ceiling and wall types specified or existing prior to ordering lighting equipment.

E. Equipment specified has been carefully selected to meet the needs of the project. Substitute equipment will be considered only if a complete substitution submittal is received by the owner, architect, or electrical engineer within a reasonable time frame from the date of the award of contract (i.e., early enough that rejection of proposed substitutes will not jeopardize timely shipping schedules for specified equipment).

F. The desired manufacturer and fixture have been specified first, with catalog number and notes. Other manufacturers or fixtures listed (if any) may be considered alternates. Carry cost of desired (first) alternate in any bid and list separately unit prices for all alternates as an add or deduct (cost of fixture + lamp, to owner, compared with desired manufacturer and fixture as specified).

G. Alternates may only be used with approval of the Architect and Electrical Engineer. Such approval requires receipt of complete substitution submittal including fixture cuts with photometric data. Submittals without this information will not be considered.

H. In addition to any submittal requirements stated in electrical specifications of contract documents, shop drawings and product data submittals shall include physical dimensions, photometrics, specific lamp type and mounting details.

I. Shop drawings must be submitted to and approved by the owner, architect, and electrical engineer prior to purchase of any lighting equipment or control equipment.

J. Refer to architectural reflected ceiling plan and other architectural drawings as required for coordination of lighting with mechanical, structural, plumbing, and other building systems, and for exact locations of fixtures. Do not scale lighting design drawings for exact location of light fixtures.

K. Final location of all exterior fixtures in landscaped areas shall be as directed by the architect in the field after rough grading and installation of major plantings.

L. Preliminary aiming of all adjustable lighting equipment shall be done during installation by the electrical subcontractor as indicated on the reflected ceiling plan / aiming diagram, where such a diagram is included in Contract Documents. The final aiming of all adjustable lighting equipment shall be done by the electrical contractor as directed by the owner after build-out is complete.

M. Provide complete lighting fixtures and control equipment, wired, and assembled, as specified and shown in drawings, with all accessories required to make a complete and functional installation.

N. All recessed incandescent fixtures shall be thermally protected unless otherwise noted.

O. Unless noted to the contrary provide white ceiling trims for all recessed luminaires. GC to paint all detachable white trims in field to match surfaces on which mounted, if not white.

P. Stem lengths, stem finishes and stem locations of all pendant fixtures to be verified and confirmed by owner and architect prior to ordering stems.

Q. All T8, T12 fluorescent and compact fluorescent ballasts shall be of the HPF electronic type where that option is available. Where HPF electronic ballasts are not available, use premium low energy HPF magnetic ballasts.

R. Where remote ballast is specified, electrical contractor shall verify interconnection wiring requirements and recommendations from both fixture and ballast manufacturer prior to installation. Wiring and insulation shall be adequate to handle peak and lamp strike voltages of ballast, even under conditions of lamp failure.

S. Provide lamps by Sylvania, General Electric, Philips or Osram unless specified or shown otherwise in drawings. All T8 and/or T12 fluorescent lamps to be GE "SP35" or equal by Osram. All compact fluorescent lamps to be GE "SPX35" or equal by Osram. All A-lamps to be "extended life" (/99) where that option is available.

2.12 DIMMING SYSTEM, CONTROL DEVICES, OUTLETS, SWITCH PLATES

A. Switch plate and control device color and finishes in locations visible to the public shall be as selected by the architect.

B. Dimmers and other control devices shall be located as shown in the drawings. Dimmers and control devices located in wall recesses or cabinets shall be provided with adequate ventilation per the manufacturer’s requirements. Enclosures must be reviewed with the owner, architect and electrical engineer prior to purchase or fabrication.

C. Dimmers and other control equipment shall be located and installed to permit easy maintenance.

D. All dimmers and other control equipment shall be clearly labeled by function to identify circuits controlled. Circuit numbers alone are not acceptable for control identification.

E. Where control devices with finned heat sinks such as Lutron "Nova" series are specified, fins shall not be removed to make devices fit boxes more conveniently. Refer to manufacturers' specifications for the number of gang boxes required to accommodate the specified equipment without breaking off fins.

F. Relays used for control of lighting (if any) shall be located to minimize the sound levels in normally occupied areas when activated.

2.13 EMERGENCY & EXIT LIGHTING

A. Size all central emergency battery units to provide minimum capacity for all connected remote heads in watts for ninety (90) minutes at not less than eighty-seven percent (87%) of system nominal voltage. All wiring of emergency lighting circuits shall be 2#10 minimum, with a maximum of 48 watts per circuit. System voltage shall be 12 vdc. Connect battery units to lighting circuits in areas where remote heads are located.

B. All emergency lighting shall conform to chapter 28.24 of the RI Fire Safety Code, and all exit lighting shall conform to chapter 28.23 of the RI Fire Safety Code.

C. Connect all exit signs to a separate, 120-volt, 20-amp circuit. Provide one circuit per floor and/or main section of the building. Provide locking devices for circuit breakers.

2.14 COMMUNICATIONS SYSTEM

A. The local Communications Co. will furnish and install all external wiring, cable, equipment, etc. and bring service into the building. Coordinate requirements with communications company.

B. Provide raceways as indicated on drawings.

C. Provide a duplex receptacle and a #6 AWG green insulated ground connection adjacent to the conduit stub up at incoming backboard.

D. Electrical Contractor shall provide outlets, wiring up to backboard, cover plates and accessories required to provide communications service within building. All wiring shall be concealed or in conduit.

2.15 FUSES

A. Provide "Buss" FRN dual time delay type. "One-time" type fuses are not acceptable. Provide one spare set (3) of each size and type used. Fuses to be Bussman, Schaumet or Economy.

2.16 TIME CLOCKS

A. Provide Intermatic #ET70215CR where indicated on plans. Provide auxiliary relays and related wiring in NEMA 1 enclosure if additional contacts are required.

2.17 ELECTRICAL IDENTIFICATION

A. Identification Device Colors: Use those prescribed by ANSI A13.1, NFPA 70, and these Specifications.

B. Colored Adhesive Marking Tape for Raceways, Wires, and Cables: Self-adhesive vinyl tape, not less than 1 inch wide by 3 mils thick.

C. Tape Markers for Conductors: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

D. Color-Coding Cable Ties: Type 6/6 nylon, self-locking type. Colors to suit coding scheme.

E. Underground Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape compounded for permanent direct-burial service, and with the following features:

1. Not less than 6 inches wide by 4 mils thick.
2. Embedded continuous metallic strip or core.
3. Printed legend that indicates type of underground line.

F. Engraved-Plastic Labels, Signs, and Instruction Plates: Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners 1/16-inch minimum thickness for signs up to 20 sq. in. and 1/8-inch minimum thickness for larger sizes. Engraved legend in black letters on white background.

G. Warning and Caution Signs: Preprinted; comply with 29 CFR 1910.145, Chapter XVII. Colors, legend, and size appropriate to each application.

1. Interior Units: Aluminum, baked enamel-finish, punched or drilled for mechanical fasteners.
2. Exterior Units: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate with 0.0396-inch, galvanized-steel backing. 1/4-inch grommets in corners for mounting.

H. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws, or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.

2.18 MOTION SENSORS

A. All motion sensors shall be manufactured by Watt Stopper or approved equal. Wire in accordance with manufacturer's instructions. Provide all required accessories for a complete and operational system. Provide infrared motion sensors unless noted otherwise.

PART 3 EXECUTION

3.01 CUTTING AND PATCHING

A. Walls, floors, and ceilings may be cut and repaired for installation of the electrical work, but no cutting of work of other trades will be permitted without the consent of the Engineer.

B. Sleeves required for proper installation of work included under this section shall be provided.

3.02 IDENTIFICATION AND NAME PLATES

A. STARTERS AND CONTROLLERS: Name plates shall be provided for each safety switch and for each starter or controller. The usage of each switch and starter shall be etched on the plate and the plate mounted on the switch or starter cover after all painting has been completed.

B. DISTRIBUTING PANELS: Name plates for power and distributing panels shall be provided with the designation shown on the drawings etched on the plate. Provide breaker schedule inside all panels designating usage for each breaker.

3.03 APPARATUS OF OTHER TRADES

A. ELECTRICAL MOTORS AND HEATING APPARATUS: Shall be mounted by the trade furnishing the apparatus.

B. POWER WIRING: Provide all power wiring to equipment. Wire through starters and contractors and provide disconnect switches as noted. Power wiring includes correct phase connections for proper motor shaft rotation. Power to rooftop air conditioning units shall not penetrate roof. Route through base of rooftop unit, through wall of rooftop unit to NEMA 3R safety disconnect.

C. CONTROL DEVICES: Mechanical equipment control devices such as thermostats, firestats and similar devices for equipment controlled by magnetic starters and contractors are required to be furnished and installed under another contract, unless noted otherwise. For equipment, which is not controlled by magnetic starters or contactors, the power wiring provided under this division shall include wiring through line voltage control devices which are required to be furnished and mounted under another contract.

D. MOTOR AND ELECTRIC HEATER SIZES AND LOCATIONS: All motor and electric heater sizes and locations indicated are approximate. Make connections to equipment as actually installed. Before connecting to any piece of such equipment, check name plate data against the information shown on the drawings and call attention to any discrepancies discovered in instructions.

E. POWER WIRING: Provide all power wiring for plumbing, heating, ventilating, and air conditioning systems as shown in the drawings and according to wiring diagram furnished by the respective trades.

F. VENTILATION: Make all connections to exhaust fans required for proper operation.

G. APPARATUS TO BE INSTALLED: The subcontractor shall provide all electrical apparatus and lighting shown on the plans, not specifically excluded above, and shall install that material in accordance with plans and specifications in such a manner to meet applicable requirements of the latest NEC.

3.04 CONDUIT WORK

A. Flexible conduits may be used for drops from junction boxes to lay-in light fixtures and from safety switches to mechanical equipment. EMT, if used, shall employ compression type fittings.

B. Exposed conduits shall run parallel with, or at right angles to the building walls.

C. No bends shall be made with a radius less than six times the diameter of the conduit, or more than ninety degrees.

D. Lay underground conduits at 24" minimum below grade.

E. Secure conduit in place and protect where necessary to prevent damage to the work during construction. Plug ends of conduit with cork, oakum, or "Push-Pennies" to avoid filling with mortar or debris. O.Z. Type "CA" caps shall be used for type "B" conduit bushings.

3.05 CONDUCTORS

A. Provide a complete system of conductors for all feeders and branch circuits as shown in the drawings. The wiring system shall be complete to each outlet, junction box, safety switch, or motor starter shown on the drawings which require electrical connections.

B. No wires shall be pulled until the conduit system is complete. No grease, oil, or lubricant other than powdered soapstone, or pulling compound, UL listed and compatible with conductor insulation, shall be used to facilitate the pulling of wires. The minimum bending radius for final termination shall conform to NEC Table 373-6 (a).

3.06 OUTLET BOXES

A. Locations of outlets shown in the drawings are relative and approximate. Exact locations shall be determined regarding the job and the outlets accurately set according to drawings, dimensions, building conditions and Engineer's direction. The right is reserved to change the exact location of any switch, or other outlets in any room before it is permanently installed.

B. Install all outlet boxes in new construction flush with walls unless noted otherwise.

C. All concealed outlets for electric lights, switches, or wall receptacles, provide outlet boxes installed with plaster rings where required, and set flush with building finishes. Boxes shall be firmly anchored in place.

3.07 WIRING DEVICES

A. Provide new wiring devices for outlets where indicated on the drawings.

3.08 SWITCHES, LIGHTING

A. Set at 4' - 0" A.F.F., unless specified otherwise.

3.09 WALL RECEPTACLES

A. Set at 18" A.F.F., 6" above counters, unless indicated otherwise.

3.10 LIGHTING

A. All lighting fixtures, shown scheduled on drawing, shall be installed, wired, connected to current sources, provided with lamps, and ready to use.

3.11 FOOD SERVICE EQUIPMENT CONNECTIONS

A. Coordinate and cooperate with the owner with respect to all electrical work for the food service equipment.

B. Outlet locations and circuitry shall be indicated in the drawings. The exact locations of stub-ups and outlets shall be field coordinated with the owner and equipment supplier.

C. Final connections of a fixed type from roughing points to the equipment shall be furnished and installed by the Electrical Contractor. All flexible connections shall be in Sealtite.

D. Exhaust hoods complete with lighting fixtures and raceways will be furnished and installed by the owner. The Electrical Contractor shall provide hood lighting control switch and shall interwire lights.

E. Hood fire protection systems will be furnished with the hoods. The Electrical Contractor shall provide 120-volt source to fire protection control panel, wiring from control panel to building alarm system coordinated with Fire Department, to cooking equipment electric shutdown, to sensors in the hood, all in accordance with wiring diagrams to be furnished by the hood fire protection supplier.

F. The electrical Contractor shall also do all interconnection wiring for refrigerated rooms including time clocks, defrost heaters etc. as shown on the drawings and in accordance with Manufacturer's wiring diagrams.

3.12 TESTING

A. Upon completion of the work, individual systems shall be tested, including all feeders, branches, outlets, lighting, motors, and apparatus, and appliances, for operation. All instruments, labor, and materials required for any essential intermediate and final test designated shall be provided.

B. Tests shall not alter the subcontractor's guarantee of equipment. All work and materials found to be in non- compliance with the Contract Documents shall be replaced and retested by the Subcontractor at no additional cost to Owner.

END OF SECTION 26 10 00

Section 31 00 00
EARTHWORK

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. All work specified in this Section shall conform to the Rhode Island Department of Transportation Standard Specifications for Road and Bridge Construction, most recent edition, with amendments, with compilations and the attached supplementary specifications.

1.02 SPECIAL CONDITIONS

A. The Contractor shall notify “Dig-Safe” in Rhode Island at 1-888-344-7233, prior to any excavation. The “Dig-Safe” number shall be provided to the Engineer.

B. RELATED SECTIONS

31 10 00 Site Preparation
31 23 11 Soil and Aggregate Materials
31 25 00 Erosion and Sediment Control
32 92 00 Loam & Seed

1.03 DESCRIPTION OF WORK

A. Work under this section includes, but is not necessarily limited to, the following:

1. Preparing and grading subgrades for structural footings, drainage structures, sidewalks, pavements, and landscaping.

2. Excavating all materials and backfilling structures, including open cut rock excavation and trench rock excavation for installation of site utilities.

3. Filling, backfilling, and compacting fill to the satisfaction of a qualified soils testing laboratory engineer conforming to these specifications where applicable.

4. Rough grading to required tolerances.

5. Filling, as directed, excess cut under footings, foundations, and trenches.

6. The placing of earth for forming, shaping and compaction of embankments.

7. Maintaining benchmarks, monuments, and other reference points, obtaining accurate replacement of final grade of any disturbed or destroyed, or that must be removed due to the nature of the work, furnishing certification by a professional surveyor that all disturbed items have been accurately relocated.

8. Written notice of readiness of footing excavations, fill materials, fill areas, compacted fills, and items requiring review and/or inspection.

9. Maintain excavations and trenches free of water.

10. Excavating, stock piling and placing material suitable for filling and backfilling.

11. Remove from site all debris, unsuitable material and excess excavated material as specified and/or as directed by the Engineer.

12. Excavation and grading of storm water detention and retention facilities and compensatory wetlands.

13. Restoration to original grades and condition, properties damaged by any activity related to the work, taking adequate precautions to avoid settlement or cave-in of properties higher than site, silting, erosion, or other damage to properties lower than site.

1.04 OTHER WORK

A. All excavation for trenches required for direct burial cables, direct lines, handholes, manholes, transformer pads, pole bases, and the like shown on the site or electrical drawings or specified herein or in the electrical division of these specifications, shall be the responsibility of this Contractor.

PART 2 PRODUCTS

2.01 MATERIALS

A. Fill and backfill materials shall be in accordance with Section 31 23 11 – Aggregate and Soil Materials unless specifically indicated otherwise.

PART 3 EXECUTIONS

3.01 GENERAL EXCAVATION REQUIREMENTS

A. Where used herein, "Finished Grade" refers to final grade at elevation indicated. Spot elevations govern contour elevations. Subgrade under lawn areas shall be maintained at 6" lower than "Finished Grade", unless indicated otherwise.

B. The extent of excavation open at any one time shall be controlled by the conditions, but shall always be confined to the limits prescribed by the Engineer.

C. No excavated material shall be placed on lawns, driveways or other private property without written consent of Owner. All disturbed areas shall be restored by the Contractor at no cost to Owner.

D. The Contractor shall take all necessary measures to protect trees not to be removed from the site of the work against damage from machinery and from excavated material. Branches and roots shall not be cut unless permitted by the Engineer.

E. Trees, cultivated plants, shrubs and hedges which might be damaged by the Contractor's operations shall be protected or shall be transplanted, maintained, watered and replanted. Trees to be saved shall be protected by the installation of a snow fence installed at the drip line. If such trees, plants, shrubs or hedges are damaged to the degree that their growth or beauty is affected, they shall be replaced by the Contractor at his own expense. All surfaces which have been damaged by the Contractor's operations shall be restored to a condition at least equal to that in which they were found just prior to the start of construction. Damaged trees shall be replaced at a cost of six hundred dollars per caliper inch.

F. The restoration of existing property shall be done as promptly as practicable and not left to the end of the construction work.

G. All existing pipes, poles, wires, curbing, property line markers, fences, walls, or other structures which, in the opinion of the Engineer, must be preserved in place without relocation shall be carefully supported and protected by the Contractor. In the event of damage, they shall be restored to their original condition by the Contractor at his own expense.

H. As excavation approaches existing utilities or other underground structures, digging with machinery shall cease and the excavation shall be done manually, as directed.

I. Excavation and backfill operations adjacent to existing utilities, structures and construction shall be done in such a manner as will prevent the loss of ground or caving in of excavations, the undermining, damage or disturbing of existing pipelines, utilities and structures or any completed construction of the project. Backfill shall be placed, compacted, and done in such a manner as to prevent future settlement and damage to the existing pipelines, utilities, structures, or construction. Existing pipelines, utilities, structures, new construction, or property damaged due to excavation, backfilling, and settlement of the backfill, shall be the responsibility of the Contractor and shall be corrected in a manner satisfactory to the Engineer at no additional expense to the Owner.

J. Unsuitable excavated material shall systematically be separated and removed from suitable material to the satisfaction of the Engineer.

K. Unsuitable material shall be promptly removed and disposed of off-site at no expense to the Owner.

L. Surplus suitable material shall be the property of the Owner and stored on site as directed, or at the Owner's request, this material shall be removed from the site by the Contractor at no additional cost to the Owner.

M. Boulders over 10" in length, if encountered, shall be removed from subgrade of cut areas. Remove obstructions to depth of 12" below subgrade.

N. If excavation goes beyond lines shown in detail, Contractor shall replace material with gravel borrow.

O. Excavations shall be carried out to design depths.

P. If excavation is carried beyond line or below grade, except as directed, or subgrade is made unsatisfactory by act or neglect of Contractor, he shall remove such unsatisfactory material. No extra payment will be made for replacement with satisfactory fill, additional concrete, or other suitable materials as directed.

Q. Contractor shall provide adequate dust control during earthwork operations. Public ways and haul routes shall be cleaned and swept daily if required by intensity of the work, traffic and weather. Contractor to wet down areas as required and requested by the Engineer or Owner. Provide off-site water as necessary.

R. Contractor shall provide and maintain temporary barricades and traffic controls as required.

3.02 PREPARATION

A. Protect existing structures, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Provide erosion control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and facilities.

3.03 PROJECT CONDITIONS

A. “Dig-Safe” Damage Prevention System: All Contractors performing drilling, boring, auguring, jetting, sheeting or pile installation, demolition, excavation or like work shall, prior to commencement of these activities, contact utility companies having responsibility for underground transmission systems for information relative to locations of existing underground transmission systems and for information relative to locations of existing underground utilities and/or appropriate dig-safe damage prevention and notification agency. Provide Dig-Safe number to Owner in writing prior to start of excavation.

B. Adequate protection measures shall be provided to protect workmen and pedestrians passing by the site. Streets adjacent property shall be fully protected throughout the operations.

C. Shoring, sheeting, and bracing and/or prefabricated trenching boxes shall be provided to prevent caving, erosion, or gullying sides of excavation.

D. Provide for surface drainage and erosion control during the period of construction in a manner to avoid creating a nuisance to adjacent areas. Keep all excavations free of water during the entire progress of the work, regardless of the cause, source, or nature of the water.

3.04 CUTTING PAVEMENT

A. Excavations made on pavement shall be made in a careful manner so as to cause the least amount of damage to the pavement. Roadway pavement in state highways, local roads, sidewalks, and easements having bituminous concrete pavement shall be cut prior to trench excavation. Pavement and/or cement concrete will be cut 6 inches either side of the maximum allowable trench width. Any damage to the cut line due to the excavations, backfilling or removal of temporary pavement shall be re-cut to neat lines at no additional cost to the Owner, prior to replacement of the specified finished pavement. The width of pavement removed shall be kept as narrow as practicable. Existing pavement and base course disturbed or damaged beyond the payment lines indicated shall be replaced by the Contractor to match existing pavement and base course, at no additional cost to the Owner.

B. Contractor shall remove and dispose of existing bituminous concrete pavement off-site as is necessary to perform work of this contract as indicated. Removal of pavement shall be done in a neat manner by saw cutting a neat edge.

C. Contractor shall saw cut, remove and provide off-site disposal of concrete and bituminous walk pavement as is necessary to perform the work of this contract. Removal of concrete and bituminous walks shall be performed in a neat manner at the nearest joint of the remaining walk pavement.

D. Excavated pavement shall not be mixed with other excavated material which is to be used as backfill, and shall be removed immediately from the site of the work.

3.05 GENERAL EXCAVATION

A. Explosives and blasting are not permitted for this project. Rock and/or ledge, if encountered, shall be removed by mechanical means only.

B. All excavations shall be classified as "earth excavation" or "rock excavation".

C. Definition of "earth excavation" shall include the removal of all suitable and unsuitable soils not otherwise classified herein, and the removal of boulders and rock fragments less and one (1) cubic yard in volume, from the following areas:
   1. Within the design excavation sections.
   2. Beyond the design excavation sections where unsuitable materials are encountered.

D. Definition of "rock excavation" shall include the following:
   1. Rock excavation shall consist of removal of intact bedrock and boulders or detached bedrock fragments which have a volume of one (1) cubic yard or more. Boulders and detached rock fragments which have a volume of less than one (1) cubic yard are considered "earth excavation".
   2. Materials that cannot be removed effectively with soil excavating equipment, such as rock material or aggregate conglomerate deposits so firmly cemented as to possess the physical characteristics of solid rock.
   3. Concrete or masonry structures larger than one (1) cubic yard in volume, and not less than 13-inches in the least dimension.
   4. Reinforced concrete larger than one (1) cubic yard in volume, reinforcement area more than ½ percent of cross-sectional area perpendicular to reinforcement in either direction, and not less than 8-inches in the least dimension.
   5. Soft or disintegrated rock or hardpan which can be removed with a hand pick or power operated excavating machine, or loose or previously blasted rock, will not be considered "rock excavation".

E. Definition of "unsuitable soils" shall include those soils due to their consolidation properties, degree of saturation, gradation or other deleterious characteristics will not provide a stable subgrade or side slopes; cannot be used as, or support embankment, or cannot be placed and compacted as backfill, or do not otherwise conform to the requirements of these Specifications.

F. When, during excavation, material is encountered that the Contractor may classify as rock excavation, such material shall be uncovered and the Engineer notified by the Contractor. The Contractor shall not proceed with excavation of this material until the Engineer has classified material as earth excavation or rock excavation. Failure on the part of the Contractor to uncover such material and notify the Engineer will cause forfeiture of the Contractor's right of claim for payment of rock excavation.

G. Before rock removal commences, the Contractor shall uncover all ledge to be removed. Elevations shall be taken by a registered land surveyor not employed by the Contractor. Surveyor will be paid by the Contractor. After completing rock removal, elevations shall be taken again by the surveyor. Amounts of ledge removed will be agreed to by Contractor and Owner.

H. A RI Registered Land Surveyor, not an employee of the Contractor but paid for by the Contractor, shall develop cross sections to show and determine rock quantities for payment purposes. Cross sections shall be reviewed by the Engineer. Payment for rock removal shall be based on "Methods of Measurement" or "pay lines" as stated within the project specifications and drawings. The Contractor shall be paid only in accordance with calculated quantities and not for actual rock removed.

I. Wherever rock is shattered below grade and is unfit for foundations, the shattered rock shall be removed and replaced as specified. No extra payment will be made for overbreak or backfill as required.

J. When, during excavation, material is encountered that Contractor may classify as unsuitable, such material shall be uncovered and the Engineer notified by Contractor. Contractor shall not proceed with excavation of this material until the Engineer has classified material as unsuitable. Failure on part of Contractor to uncover such material and notify the Engineer will cause forfeiture of Contractor's right of claim for payment of unsuitable material.

3.06 TRENCH EXCAVATION

A. Trenches shall be excavated in such a manner and to such widths as will give suitable space to allow pipes to be laid and joints to be formed and to allow for sheeting and shoring, dewatering and for removing and replacing unsuitable materials. Trenches shall be excavated to lines and grades shown on the drawings.

B. Final decision as to suitability of excavated material for use as backfill or fill shall be made by the Engineer. If, in the judgment of the Engineer the excavated material is unsuitable, the Contractor shall import bank run gravel to make up the deficiency.

C. Comply with all Federal, State and local codes, ordinances and requirements of authorities having jurisdiction to maintain stable excavations.

3.07 UNAUTHORIZED EXCAVATION

A. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction from the Owner or the Engineer.

B. Fill unauthorized excavations with materials approved by the Engineer at no additional cost to the Owner.

C. Where indicated widths of utility trenches are exceeded, provide stronger pipe, or special installation procedures, as required by the Engineer, at no cost to the Owner.

3.08 APPROVAL OF SUBGRADE

A. Notify the Engineer when excavations have reached the required subgrade.

B. When the Engineer determines that unforeseen unsatisfactory soil is present, continue excavation and replace with systematically placed and compacted backfill or fill material as directed. Unforeseen additional excavation and replacement material will be paid according to the Contract provisions for changes in Work.

C. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the Engineer at no cost to the Owner.

D. Compacted fill surfaces which become disturbed, contaminated or otherwise unacceptable to the Owner or the Engineer shall be removed and replaced with acceptable fill at no additional cost to the Owner.

E. Cold Weather Subgrade Protection

1. When the atmospheric temperature is less than 32 degrees Fahrenheit, the Contractor shall protect excavation subgrades and lean concrete from freezing. Cold weather subgrade protection may consist of an earth fill cover, hay cover, insulation cover, heating or other means of protecting the subgrade materials from freezing.

2. Subgrades, which have been permitted to freeze by the Contractor, will be judged to be unsuitable for placement of concrete, pavement or fill by the Owner, Owner's Representative or Engineer. The Contractor, at his own expense, shall conduct additional excavation of frozen subgrade soil, and replacement with materials acceptable to the Owner, Owner's Representative or Engineer

3.09 STORAGE OF SOIL MATERIALS

S. Stockpile excavated materials acceptable for backfill and fill soil materials, including acceptable borrow material. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Provide erosion control measures around perimeter of stockpiles. Cover to prevent wind-blown dust.

1. Stockpile soils materials away from edge of excavations. Do not store within drop line of remaining trees. Establish soil and material stockpiles on site only at locations acceptable to the Owner.

3.10 BACKFILL

A. Backfill excavations promptly, but not before completing the following:

1. Acceptance of construction below finish grade including, where applicable, damp proofing, waterproofing, and perimeter insulation.

2. Surveying locations of underground utilities for record documents.

3. Testing, inspecting, and approval of underground utilities.

4. Concrete formwork removal.

5. Removal of trash and debris from excavation.

6. Removal of temporary shoring and bracing, and sheeting.

7. Installing permanent or temporary horizontal bracing supported walls.

T. No backfill shall be placed except in the presence of the Owner or Owner's Representative.

3.11 FILL

A. Preparation: Remove vegetation, topsoil, debris, wet and unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placing fills.

1. Plow, scarify, strip, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing surface.

B. When subgrade or existing ground surface to receive fill has a density less than that required for fill, break up ground surface to depth required, pulverize, moisture-condition or aerate soil, and re-compact to required density.

U. Place fill material in layers according to Section 31 23 11 – Aggregate and Soil Materials to the required elevations in accordance with the drawings and as follows:

1. Under loam and seed areas, use common borrow material.

2. Under concrete sidewalks and bituminous concrete pavement, use gravel borrow.

3. Under drainage piping and drainage structures, use bedding material.

3.12 TRENCH BACKFILL

A. Trenches and other excavations shall not be backfilled until all required inspections have been satisfactorily performed and until the work as installed conforms to other requirements specified in the several sections covering the installation of the work. Trenches and other excavations shall be backfilled as soon as practicable with the specified material.

B. All pipes under this contract are to be laid in bedding material as indicated on the contract drawings. Prior to backfilling the trench, the space on the both sides of the pipe and beneath the pipe shall be backfilling with bedding material as indicated on the contract drawings. This layer shall be carefully tamped using tools acceptable to the Engineer to obtain maximum compaction around and under the pipe at the same time being extremely careful not to cause movement of the pipe in either a lateral or vertical direction.

C. In each trench, gravel borrow, as directed by the Engineer, which does not contain any stones, rock, or clay lumps that are in excess of 3” in their greatest dimension shall be deposited in the trench uniformly on both sides of the pipe and to a minimum height of 2" over the pipe for the entire width of the trench above the "Sand Fill" to the pipe spring line. This layer shall be thoroughly compacted to the above described requirements.

D. The balance of the backfill to subgrade or finish grade as indicated shall be made using trench excavated materials in loam and seed areas and gravel borrow under paved, parking lot areas, and under slabs on grade, unless the Contractor is otherwise directed by the Engineer. This layer shall be thoroughly compacted in accordance with Section 31 23 11 – Aggregate Materials.

E. Compaction by water-jetting, puddling or ramming is prohibited. Where it is necessary to obtain maximum compaction, power tampers shall be used. The method of compacting shall be reviewed by the Engineer.

F. During filling and backfilling operation, pipelines will be reviewed by the Engineer to determine whether any displacement of the pipe has occurred. If the inspection of the pipelines shows poor alignment, displaced pipe or any other defects, the defects designated by the Owner shall be remedied in a satisfactory manner, by the Contractor, at no additional expense to the Owner.

G. Metallic tape, of the type designated in Specification Section 33 05 26 – Utility Identification Tape, shall be placed as directed in the trench backfill.

3.13 MOISTURE CONTROL

A. Uniformly moisten, moisten condition, or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

2. Remove and replace, or scarify and air-dry satisfactory soil material that is too wet to compact to specified density.

3. Fill materials shall not be frozen when placed, or be allowed to freeze prior to, or after compaction, or placement.

4. Soil bearing surfaces below completed slabs and foundations shall be protected against freezing. Frost protection shall be provided in a manner acceptable to the Owner’s

Representative as soon as possible after foundations are constructed.

5. Do not excavate to full indicated depth when freezing temperatures may be expected, unless the mats, footing, or slab is poured immediately after the excavation has been completed. Protect the excavation from frost if placing of concrete is delayed. Concrete for foundations or slabs shall not be placed on frozen soil. Where footings, slabs, or mud mats are exposed to freezing temperatures, they shall be protected to prevent damage to the concrete by freezing or frost penetration into the soil upon which they rest. Where foundations are exposed over the winter during construction, provide at least two and one-half (2.5) feet of earth cover above the bottom surface of concrete, plus hay or other protection if temperatures are severe, as directed by the Owner's Representative.

B. Wet weather: If fill material placement, spreading, rolling, or compaction operations are interrupted by heavy rain or other unfavorable conditions, do not resume such operations until ascertaining that the moisture content and density of the previously-placed soil are as required by these specifications.

3.14 COMPACTION

A. Compaction shall be in accordance with the requirements of Section 31 23 11 – Aggregate and Soil Materials.

3.15 GRADING

A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between existing adjacent grades and new grades.

2. Cut out soft spots, fill low spots, and trim high spots to conform to required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Lawn or Unpaved Areas: Plus or minus 0.10 foot.

2. Pavements: Plus or minus ½ inch.

3.16 COMPACTION EQUIPMENT

A. Contractor shall use, for compaction of subgrade and fill in designated areas, equipment at number of coverages stipulated depending upon suitability of equipment for the work, as follows:

1. Rubber-tired roller-compactor, having 4 wheel equipped with pneumatic tires of such size and ply as can be maintained at pressures between 80 and 100 psi with 25,000 lb. wheel load during rolling operation. Roller-wheels shall be located abreast, and so designed that each wheel will carry approximately equal load in traversing over even ground. Spacing of wheels shall be such that distance between nearest edges of adjacent tires will not be greater than one-half width of one tire at operating pressure for 25,000 lb. wheel load. Roller shall have body suitable for ballast loading such that load per wheel may be varied, if so directed, between 10,000 lb. and 25,000 lb. Roller shall be towed at speeds not exceeding 10 miles per hour.

2. Acceptable drum type vibratory compactor operating at not less than 2,000 vibrations per minute.

3. In any event, regardless of equipment used, compaction of soil shall meet the relative

densities stated in this section.

3.17 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and re-establish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or lose compaction due to subsequent construction operations or weather conditions. Scarify or remove and replace material to depth directed by the Engineer; reshape and re-compact at optimum moisture content to the required density.

C. Settling: Where settling occurs within one (1) year after project completion, remove finished surfacing, backfill with additional approved material, compact, and reconstruct surfacing.

3.18 FIELD QUALITY CONTROL

A. Testing Agency Services: Allow testing agency to inspect and test each subgrade and each fill or backfill layer. Do not proceed until test results for previously completed work verify compliance with requirements.

B. Field in-place density tests may be performed by the nuclear method according to ASTM D 2922, provided that calibration curves are periodically checked and adjusted to correlate to tests performed using ASTM D 1556. With each density calibration check, check the calibration curves furnished with the moisture gages according to ASTM D 3017.

C. When testing agency reports that subgrades, fills, or backfills are below specified density, scarify and moisten or aerate, or remove and replace soil to the depth required, re-compact and retest until required density is obtained.

3.19 DISPOSAL OF SURPLUS AND WASTE MATERIAL

A. All unsuitable material, and suitable material not required for the proper completion of the contract, shall become the property of the Contractor, and shall be removed and properly disposed of off-site at no additional cost to the Owner.

B. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, debris, and pavement, and legally dispose of it off the Owner's property, at no additional cost to the Owner.

C. Reuse: Transport surplus satisfactory soil to designated storage areas on the Owner's property. Stockpile or spread soil as directed by the Engineer.
   1. Remove waste material, including unsatisfactory soil, pavement, trash, and debris, and legally dispose of it off the Owner's property, at no cost to the Owner. Contractor to obtain and pay for all necessary permits or licenses for off-site disposal.

END OF SECTION 31 00 00

DOCUMENT 31 10 00
SITE PREPARATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. All work specified in this Section shall conform to the Rhode Island Department of Transportation Standard Specifications for Road and Bridge Construction, 2004 edition, amended March 2018, with compilations and the attached supplementary specifications.

C. RELATED SECTIONS
   1. 31 00 00 – Earthwork
   2. 31 25 00 – Erosion and Sedimentation Control

1.02 DESCRIPTION OF WORK

A. This work shall consist of clearing and grubbing, clean-up, cutting and removing isolated trees and stumps, stripping and stockpiling topsoil, removing and disposing of all vegetation, bollards, fence posts, cut off fence posts and associated concrete foundations, hazard markers, signs, sign posts and any other obstructions and undesirable materials within the project site which are not designated or permitted to Section 31 00 00 Earthwork.

B. Refer to Specification Section 31 00 00 Earthwork for earthwork controls: not part of this section.

C. Refer to specification Section 31 25 00 Erosion and Sedimentation Control for erosion control measures: not part of this section.

1.03 PROTECTION

D. Storage of construction materials and construction vehicle parking shall be allowed only in areas designated by Engineer and approved by Owner. Any damaged plant materials resulting from neglect by the Contractor shall result in a monetary and/or plant material exchange.

E. All other non-treed areas indicated to remain in their natural state shall also be protected by the Contractor. Any resulting damage due to the Contractor's neglect shall be restored to the satisfaction of the Engineer. If restoration is not satisfactory, then sufficient monies to cover damages shall be withheld from the Contractor.

F. Contractor shall identify location of septic system and tank, prior to construction. Coordinate protection / relocation if necessary, with owner & architect.

G. Contractor shall protect trees and environmentally sensitive areas by installing tree and shrub protective devices, or any such barriers necessary to protect these areas. Trees and shrubs to be saved within work area shall be protected by tree protective devices or snow fence. Refer to the Contract Drawings for locations and details.

1.04 RESTRICTIONS

H. Prior to clearing operations, the Contractor shall clearly and plainly mark the ground, by use of colored tape, limits of clearing and grubbing, as indicated on plans. No clearing or cutting shall be done prior to such field determination. Contractor shall relate the tree lines from the horizontal control geometry and other control points as referenced in plan.

I. When limits of clearing have been physically marked together with building corner stakes, the Contractor shall then notify the Engineer for an on-site review of the clearing limits. Failure of the Contractor to notify the Engineer prior to commencing this work may result in forfeiture of payment for this work.

J. It is the declared and acknowledged intention that, other than those areas required for existing and new building and physical structures, roads, storm drainage facilities, walks, parking areas, and site grading, the remainder of site shall remain in its natural state.

1.05 SAFETY

K. All operations required under this section shall be conducted in a safe manner employing whatever means are necessary to provide safety to all persons on the project site.

PART 2 PRODUCTS

2.01 TREE PROTECTION DEVICE

A. Wood framing shall consist of nominal lumber 6 feet in length; the width and thickness shall vary from 2-inch by 2-inch to 2-inch by 6-inch, depending on trunk diameter. Binding material shall consist of single strand 9-gauge wire or ½-inch strapping.

2.02 SHRUB PROTECTION DEVICE

A. Standard snow fence, 4 feet in height, installed around the shrub or grouping of shrubs to be protected. Standard steel posts shall be utilized to maintain the position of the fencing. Steel posts shall be a minimum of 6 feet in length.

PART 3 EXECUTIONS

3.01 CLEARING

A. Clearing shall consist of felling and cutting up or trimming of trees, and satisfactory disposal of trees together with downed timber, snags, brush, shrubs, fences, logs, rubbish, rock walls or other debris occurring within areas indicated on the plans as new construction.

B. Trunks of trees may not be cut off more than 6" above original ground surface, in areas to be cleared where grubbing is not required.

C. Trunks of trees at the top of slopes, where rounding of slopes occur to meet existing ground and tree line, shall be cut off flush with or below the final slope line.

3.02 GRUBBING

A. Grubbing shall consist of removal and satisfactory disposal of stumps and buried roots larger than 1-1/2" diameter, to a depth of 18" below surface of original ground, except stumps within proposed structural foundation areas shall be entirely removed.

B. Areas to be grubbed shall be as follows:
1. New roadway and paved surfaces where depth of fill is less than 3 feet, measured from subgrade to original ground surface.
2. Areas occupied by building to a horizontal distance of 6’ outside the building walls or to the toe of slopes for buildings on fill.
3. In cut areas for the entire width of the cut.
4. In non-paved areas required to be filled, if depth of fill is less than 3 feet.
5. Except for structural foundation areas and within drainage structure footprints, no grubbing shall be required in areas where the height between the subgrade and original ground surface exceeds 3'. The remaining stumps may be left provided they do not extend more than 6" above the ground surface.

3.03 ISOLATED TREES

A. Isolated trees and stumps designated to be removed shall be cut and their stumps as well as any other designated stumps shall be removed by excavation or grinding.

B. Brush, shrubs or other vegetation designated to be removed shall be cut at ground level and disposed as indicated elsewhere in these Specifications.

3.04 STRIPPING

A. The Contractor shall remove to the extent ordered and satisfactorily, transport and store all suitable topsoil for use as loam.

B. Storage area shall be on site. If no storage areas are indicated on plans or available on-site, the Contractor shall make provisions to store topsoil elsewhere for use of the Project. Engineer’s approval of storage areas will be required.

C. All stripped topsoil shall remain the property of the Owner (unless otherwise stipulated in writing) and no material shall be hauled off-site until the Engineer is notified. Failure of the Contractor to notify the Engineer prior to hauling any topsoil off-site shall result in forfeiture of payment for this work.

D. Stripped topsoil shall be obtained from open fields or grassed areas containing organic material suitable for loaming operations. The depth of stripping shall vary based on subsurface information provided elsewhere in these specifications and on actual site conditions. In any event, soils shall be removed to the minimum depth of topsoil. Mixing of subsoil shall be accepted. The depth of soil removal shall be verified in the field. All stripped topsoil shall be screened and tested for suitability for use under lawns and adjusted as required.

E. Any stripped topsoil not required for this project shall remain the property of the Owner unless Contractor is directed to remove surplus topsoil from site, which he shall do at no additional cost to the Owner.

3.05 UNSUITABLE MATERIAL

A. Excavated unsuitable material shall be separated and classified as unsuitable material, unsuitable non-hazardous material (sludge) and unsuitable hazardous material.

3.06 TREE AND SHRUB PROTECTION DEVICE

A. TREE PROTECTION DEVICES

1. This work shall consist of applying wood framing around the trunk or trunks of the tree from the ground level to a height of 6 feet.
2. The wood framing shall be placed around the trunk in sufficient quantity to protect the trunk from mechanical damage. The binding material shall be tight enough to prevent the wood from being moved. None of the binding materials shall come in contact with the trunk or any portion of the tree. In no instance shall nails or any other type of fasteners enter the tree. The wood framing shall be removed when all mechanical work within the surrounding area has been completed.

B. SHRUB PROTECTION DEVICE

1. This work shall consist of furnishing and installing of standard snow fence around the shrub or grouping of shrubs designated to be protected as indicated on the plan details or as directed by the Engineer.
2. All installations will include reflective tape on the guy wires or ropes as warning devices for vehicular or pedestrian traffic. Each guy wire or rope is to be marked with a minimum of two 12” long by 1’ wide strips of reflective tape.
3. Upon completion of construction, with the approval of the Engineer, protective devices are to be dismantled and removed from the site.

END OF SECTION 31 10 00

SECTION 31 22 13
ROUGH GRADING

PART 1 - GENERAL

1.01 SUMMARY

A. Includes But Not Limited To:
   1. Perform rough grading work required to prepare site for construction as described in Contract Documents.

1.02 RELATED SECTIONS

A. Section 31 00 00: Earthwork

1.03 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:
   1. Schedule conference after completion of site clearing but before beginning grading work.
   2. Identify benchmark to be used in establishing grades and review Contract Document requirements for grades, fill materials, and topsoil.
   3. Examine site to pre-plan procedures for making cuts, placing fills, and other necessary work.

PART 2 PRODUCTS

2.01 MATERIALS

A. Materials used for filling shall be as specified in Section 31 00 00 – Earthwork.

PART 3 EXECUTION

3.01 PREPARATION

A. Before making cuts, remove topsoil over areas to be cut and filled. Stockpile this additional topsoil with previously stripped topsoil.

3.02 PERFORMANCE

B. Tolerances: Maximum variation from required grades shall be 1/10 of one foot 28 mm.

C. When the existing grade around existing plants to remain is higher than new finish grade, perform regrading by hand. Do not expose or damage shrubs or tree roots.

D. Compact fills as specified in Section 31 00 00.

E. If soft spots, water, or other unusual and unforeseen conditions affecting grading requirements are encountered, stop work, and notify Engineer.

END OF SECTION 31 22 13

NORTH KINGSTOWN MUNICIPAL OFFICE BUILDING

North Kingstown, Rhode Island 02852 AA# 22133.1

DOCUMENT 31 23 11
SOIL AND AGGREGATE MATERIALS

PART 1 - GENERAL

1.01 SUMMARY

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Materials and construction methods shall conform, as far as applicable, to the requirements of the Standard Specifications for Road and Bridge Construction of the Rhode Island Department of Transportation, 2004 edition, amended March 2018, together with all the errata, addenda, additional revisions, and supplemental specifications.

C. Section includes:

1. Requirements for furnishing and placing materials including, but not limited to, gravel borrow, common borrow, structural fill, riprap, riprap bedding, clean sand, ¾-inch crushed stone.
2. Locations of specified materials as detailed on the Drawings or as directed by the Engineer for excavation below normal depth, utility support, replacement of unsuitable material or elsewhere, as directed.

D. Related sections:

1. Section 31 00 00 – Earthwork

1.02 REFERENCES

E. American Association of State Highway and Transportation Officials (AASHTO):

1. T 27, Sieve Analysis of Fine and Coarse Aggregates
2. T 11, Materials Finer than No. 200 Sieve in Mineral Aggregate by Washing

F. American Society for Testing and Materials (ASTM):

1. D 1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3)

1.03 SUBMITTALS

G. In accordance with 01 33 00 - Shop Drawings, Product Data and Samples.

H. Samples: Furnish one (1) five-gallon pail of a representative soil sample for each material proposed for fill and/or backfill, including location of source on Transmittal.

I. Shop Drawings:

1. For each material proposed for fill and/or backfill, provide sieve analysis in accordance with AASHTO T 27 and T 11 when gradation requirements are given in these specifications.

2. For each material proposed for fill and/or backfill, provide compaction test report in accordance with ASTM D 1557-12 Method C Modified when compaction requirements are given in the specifications.

1.04 DELIVERY, STORAGE AND HANDLING

J. The Contractor shall be responsible for taking all necessary precautions to store and protect all materials and equipment brought to the site for incorporation into the Work. This includes, but is not limited to, protecting materials from weather and theft.

PART 2 PRODUCTS

2.01 GENERAL

A. All fill and backfill materials shall be free of debris, cinders, combustibles, frost, ice, roots, sod, wood, cellulose, organic material, and any otherwise deleterious material.

2.02 MATERIALS

A. Gravel Borrow

1. Gravel borrow shall conform to the requirements of Section M.01.02 and M.01.09 of the Rhode Island Standard Specifications.

2. Material used for bedding utility pipes, including electrical conduit, shall conform to the requirements of Section M.01.04 and M.01.09 of the Rhode Island Standard Specifications.

B. Common Borrow

1. Common borrow shall conform to the requirements of Section M.01.01 of the Rhode Island Standard Specifications.

C. Riprap and Riprap Bedding

1. Riprap and riprap bedding shall conform to the requirements of Section M.10.03 of the Rhode Island Standard Specifications.

D. Clean Sand

1. Clean sand shall consist of natural sand, manufactured sand, or a combination thereof.

2. Clean sand shall be in accordance with the following gradation requirements:

Sieve	% Passing
3/8”	100
No. 4	95 – 100
No. 8	80 – 100
No. 16	50 – 85
No. 30	25 – 60
No. 50	10 – 30

No. 100	2 – 10
No. 200	< 2

3. Not more than 45% passing any sieve shall be retained on the next consecutive sieve.

4. Fineness modulus shall be between 2.3 and 3.1.

E. 3/4-Inch Crushed Stone

1. 3/4-Inch Crushed Stone shall conform to the requirements of Section M.01.07 and M.01.09 of the Rhode Island Standard Specifications.

2.03 SOURCE QUALITY CONTROL

A. Testing, Inspection

1. The Engineer may elect to sample materials supplied at the source. Assist the Engineer in obtaining samples.

PART 3 EXECUTION

3.01 INSTALLATION

A. Gravel Borrow

1. Methods of placement, shaping and compaction of gravel borrow shall conform to Section 301 of the Rhode Island Standard Specifications and shall be in accordance with the following:

a) Spread in layers of uniform thickness not exceeding 8 inches before compaction and moistened or allowed to dry as directed.

b) Compact thoroughly by means of suitable power-driven tamper or other power-driven equipment.

c) Compaction shall conform to 95 percent of the maximum dry density per ASTM D 1557-12 and shall be within 2 percent of optimum moisture content.

d) The percolation rate for the compacted gravel borrow shall not exceed 5 minutes per inch.

2. Prior to placing pavement, all backfills shall have been properly compacted to eliminate settling of backfill. No pavement shall be placed over poorly compacted backfill. Backfill and base course shall be compacted, brought to the proper elevation, and dressed so that new pavement construction shall be at the required grade. The Contractor shall maintain the surfaces of all excavated and disturbed areas until the pavement is placed. If there is a time lapse of more than 24 hours between the completion of preparation of subgrade or placing of gravel borrow base course and placing of paving, or if subgrade of gravel borrow base course has been eroded or disturbed by traffic, the subgrade or base course shall be restored before placing paving.

3. The Contractor shall remove and stockpile of all surplus material and remove and acceptably dispose of all unsuitable material.

4. Before permanent paving is installed, the base shall be brought up to grade, and temporary pavement and excess gravel shall be removed.

B. Common Borrow

1. Methods of placement, shaping and compaction of common borrow shall conform to the requirements of Section 200 of the Rhode Island Standard Specifications and shall be in accordance with the following:

   a) Spread in layers of uniform thickness not exceeding 8 inches before compaction and moistened or allowed to dry as directed.

   b) Compact thoroughly by means of suitable power-driven tamper or other power-driven equipment.

   c) Compaction shall conform to 92 percent of maximum dry density per ASTM D 1557-12 and shall be within 2 percent of optimum moisture content.

C. Riprap and Riprap Bedding

1. Methods of placement, shaping and compaction of riprap and riprap bedding shall be in accordance with Section 920 of the Rhode Island Standard Specifications.

D. Clean Sand

1. Clean sand shall be placed in layers of uniform thickness not exceeding 8 inches before compaction and moistened or allowed to dry as directed.

2. Compact by means of suitable power-driven tamper of other power-driven equipment.

3. Compaction shall conform to 92 percent of the maximum dry density per ASTM D 1557-12 and shall be within 2 percent of optimum moisture content.

E. 3/4-Inch Crushed Stone

1. Methods of placement, shaping and compaction of 3/4” Crushed Stone shall conform to Section 703 of the Rhode Island Standard Specifications.

3.02 FIELD QUALITY CONTROL

A. Refer to Specification Section 01 45 00 - Quality Control Services for Testing and Inspection requirements.

3.03 TOLERANCES

A. See Rhode Island Standard Specifications.

END OF SECTION 31 23 11

SECTION 31 25 00
EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. All work specified in this Section shall conform to the Rhode Island Department of Transportation Standard Specifications for Road and Bridge Construction, most recent edition, with amendments, with compilations and the attached supplementary specifications.

C. Related sections:
   1. 31 10 00 Site Preparation

1.02 DESCRIPTION OF WORK

A. Furnish and install temporary control measures as shown on the plan or as needed during the progress of the work or as ordered by the Engineer during the life of the contract to control water pollution through use of mulches, grasses, netting, fiber mats, silt fences, brush and baled hay checks, and sandbags and filter fabrics and other erosion control devices and methods.

B. The Contractor shall attend a pre-construction meeting to discuss in detail his intended construction sequence and accompanying soil erosion and sediment control program.

C. The Contractor is responsible for compliance with the rules and regulations governing the enforcement of the Rhode Island Freshwater Wetlands Act.

D. The temporary pollution control provisions contained herein shall be coordinated with the permanent erosion control by the Contractor who shall submit plans showing the methods of control to be utilized prior to commencing of work depicting the various areas to assure economical, effective and continuous erosion control throughout the construction and post construction period.

E. Plans include specific requirements on erosion and sediment control including requirements of regulatory agencies and limits on area of soil which can be disturbed during any one time period for this project.

1.03 SUBMITTALS

A. All submittals shall be in accordance with the general provisions of the Contract and shall include the following:
   1. Manufacturer's specifications and product data.

PART 2 PRODUCTS

2.01 MATERIALS

A. Silt Fence: Silt fence shall be Enviro Fence by Mirafi, Propex Silt Stop manufactured by Amoco Fabrics Company, or approved equal.

B. Construction Access: Construction access shall be in accordance with Section 211 of the Rhode Island Standard Specifications.

C. Catch Basin Inserts: Catch basin sediment traps shall be Siltsack manufactured by Terrafix Geosynthetics, Inc. or approved equal.

PART 3 EXECUTION

3.01 PREPARATION

A. The Engineer has the authority to limit the surface area of erodible earth material exposed by clearing and grubbing, the surface area of erodible earth material exposed by excavation, borrow and fill operations and to direct the Contractor to provide immediate permanent or temporary pollution control measures to prevent contamination of adjacent streams or other water courses, lakes, ponds, or other areas of water impoundment. Such work may involve the use of temporary mulches, mats, seeding, check dams or other control devices or methods necessary to control erosion. Cut slopes shall be seeded and mulched as the excavation proceeds, to the extent considered desirable and practicable.

B. The Contractor will be required to incorporate all permanent erosion control features into the project at the earliest practicable time. Temporary pollution control measures will be used to correct conditions that develop during construction, that were not foreseen during the design stage, that are needed prior to installation of permanent pollution control features, or that are needed temporarily to control erosion that develops during normal construction practices, but are not associated with permanent control features on the project, at no additional cost to the Owner.

C. Where erosion is likely to be a problem, clearing and grubbing operations should be so scheduled and performed that grading operations and permanent erosion control features can follow immediately thereafter if the project conditions permit; otherwise, temporary erosion control measures may be required between successive construction stages. Under no conditions shall the surface area of erodible earth material exposed at one time, by stripping of topsoil, exceed five (5) acres without review by the Engineer.

D. The Contractor shall have on-site all necessary silt fence and storm drainage piping etc., prior to undertaking any work that may cause erosion.

E. The Engineer will limit the area of excavation, borrow and embankment operations in progress commensurate with the Contractor’s capability and progress in keeping the finish grading, mulching, seeding, and other such permanent pollution control measures current. Should seasonal limitations make such coordination unrealistic, temporary erosion control measures shall be taken immediately to the extent feasible, justified and indicated on plans at no additional costs to Owner.

F. If overland water flow becomes a problem in the construction progress, then the Contractor shall take it upon himself to construct any and all ditches, temporary roads, fills and pipe culverts as necessary to alleviate a water problem which may affect progress of work. This work shall be performed at no additional expense to the Owner.

G. Under no circumstances shall the amount of surface area of erodible earth material exposed at one time by excavation, borrow or fill within the right of-way exceed five (5) acres without prior review by the Engineer.

H. The Engineer may increase or decrease the amount of surface area of erodible earth material to be exposed at one time by clearing and grubbing, excavation, borrow and fill operations as determined by his analysis of project conditions.

I. In the event of conflict between these requirements and pollution control laws, rules and regulations of the federal, state or local agencies, the more restrictive laws, rules, or regulations shall apply.

J. Silt Fence:

1. Unless directed otherwise, silt fences shall be placed as indicated on project plans or as directed by the Engineer.
2. Installation shall be per plan details.

3.02 SILT FENCE

A. Unless directed otherwise, silt fences shall be placed at the locations indicated on the plans.

3.03 CONSTRUCTION ENTRANCES

A. Stabilized construction entrances shall be installed as shown on the project plans and at all points of access to reduce or eliminate tracking or flowing of sediment onto City roads.

B. Construction entrance shall be as wide as or wider than all points of ingress and egress.

3.04 CATCH BASIN INSERTS

A. Install catch basin inserts in accordance with manufacturer's recommendations.

B. Catch basin inserts shall be inspected every two weeks and after every storm event.

3.05 SPECIAL INSTRUCTIONS

A. Silt fence shall be inspected during storm events, after each rainfall of one-inch magnitude or greater, prior to weekends, and prior to any forecasted storm events.

B. If temporary erosion and pollution control measures are required due to the Contractor's negligence, carelessness, or failure to install permanent controls as a part of the work as scheduled, and are ordered by the Engineer, such work shall be performed by the Contractor at his own expense.

C. It is also the Contractor's responsibility to maintain the placement of silt fences and other erosion control devices remove silt from ditches and culverts and to repair any erosion of ditches and slopes.

D. In case of repeated failures on the part of the Contractor to control erosion, pollution, and/or siltation, the Engineer reserves the right to employ outside assistance or to use his own forces to provide the necessary corrective measures. Such incurred direct cost plus project engineering costs will be charged to the Contractor and appropriate deductions made from the Contractor's monthly progress payment.

E. Any erosion, siltation or general damage resulting from neglect by the Contractor to undertake temporary and permanent erosion control measures as required or directed shall result in the responsibility of the Contractor to correct the areas as determined by the Engineer.

F. The Contractor shall also be required to install and maintain temporary erosion control measures within a time frame agreeable to the Engineer.

G. Temporary pollution control may include construction work outside the project limits where such work is necessary as a result of utility installations and equipment storage sites.

H. The erosion control features installed by the Contractor shall be acceptable maintained by the Contractor.

I. When a reasonable ground cover has been established, with the approval of the Engineer, the Contractor will remove all temporary erosion control measures, and the Contractor shall regrade and seed the area from which these measures were removed. Grading and seeding will be by hand if access to mechanical equipment is not possible.

END OF SECTION 31 25 00

SECTION 32 17 23
PAVEMENT MARKINGS

PART 1 GENERAL

1.01 SUMMARY

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Materials and construction methods shall conform, as far as applicable, to the requirements of the Standard Specifications for Road and Bridge Construction of the Rhode Island Department of Transportation, 2004 edition, amended March 2018, together with all the errata, addenda, additional revisions, and supplemental specifications.

C. Section includes:

1. Epoxy resin white line.
2. Epoxy resin yellow line.
3. Epoxy resin white pavement arrows and legends.

1.02 SUBMITTALS

A. In accordance with 01 33 00 – Shop Drawings, Product Data and Samples

PART 2 PRODUCTS

2.01 MATERIALS

A. Materials for white epoxy resin pavement markings shall conform to requirements of Section T.20 of the Rhode Island Standard Specifications.

B. Materials for yellow epoxy resin pavement markings shall conform to the requirements of Section T.20 of the Rhode Island Standard Specifications.

C. Materials for epoxy resin white pavement arrows and legends shall conform to the requirements of Section T.20 of the Rhode Island Standard Specifications.

PART 3 EXECUTION

3.01 INSTALLATION

A. Installation of white epoxy resin pavement markings shall conform to the requirements of Section T.20 of the Rhode Island Standard Specifications.

B. Installation of yellow epoxy resin pavement markings shall conform to the requirements of Section T.20 of the Rhode Island Standard Specifications.

C. Installation of epoxy resin white pavement arrows and legends shall conform to the requirements of Section T.20 of the Rhode Island Standard Specifications.

3.02 TOLERANCES

A. See Rhode Island Standard Specifications.

END OF SECTION 32 17 23

SECTION 32 92 00
LOAM AND SEED

PART 1 GENERAL

1.01 RELATED SECTIONS

A. 31 00 00 – Earthwork

1.02 QUALITY ASSURANCE

A. Subcontract seeding work to a firm specializing in such work unless the Contractor is fully experienced and qualified.

B. Each seed bag or container shall display a label which identifies the contents as a true representation of the seed mix and percentages required by specification. No seed shall be applied to a site until the Owner's Representative has determined the mixture meets all requirements.

C. Do not make substitutions without written approval. If specified seed mixes are not available, obtain approval for substitution from the Owner's Representative.

1.03 SUBMITTALS

A. In accordance with Specification Section 01 33 00 submit the following:

1. Certifications and/or labels of proposed seed mixtures stating common and scientific names of grasses, percentages by weight, and percentages or purity and germination.
2. Submit test samples of loam or borrow material being used.
3. Product information for all proposed weed control chemicals.

1.04 DELIVERY, STORAGE AND HANDLING

A. Fertilizer

1. Delivered mixed as specified in standard size, unopened containers showing weight, analysis, and name of manufacturer.
2. Store in a weatherproof place.

B. Seed

1. Protect all products from weather or other damaging or deteriorating conditions.
2. Seed mixes which have been damaged or have deteriorated in transit or storage are not

acceptable.

1.05 WARRANTY

A. Maintenance of seeding to be performed by installer includes:

1. Watering.
2. Re-grading and replanting eroded areas.
3. Seeding or patching sparse or bare areas.

B. Maintain seeded areas immediately after placement until grass is accepted.

PART 2 PRODUCTS

2.01 LOAM

A. Fertile, natural topsoil, typical of locality, without admixture of subsoil, refuse or other foreign materials, and obtained from well-drained arable site. Mixture of sand, silt and clay particles in equal proportions. Free of stumps, roots, heavy or stiff clay, stones larger than 1 inch in diameter, lumps, coarse sand, noxious weeds, sticks, brushes, or other deleterious matter.

B. Not less than 4 percent, no more than 20 percent organic matter as determined by loss on ignition of oven-dried samples.

C. Loam test samples dried to constant weight at temperature of 230° F, plus or minus nine degrees.

D. Use loam, having prior vegetative growth that did not contain toxic amounts of either acid or alkaline elements.

E. Approved suitable material from excavation within the project limits shall be used before new material is furnished.

2.02 LIME, FERTILIZER AND SEED

A. Ground agricultural limestone shall contain not less than 85 percent of total carbonates.

B. Complete fertilizer, at least 50 percent of nitrogen derived from natural organic sources of urea form and containing following percentages by weight:

1. Nitrogen 10%
2. Phosphorus 10%
3. Potash 10%

C. Pure, live, fresh seed from commercial sources meeting and, labeled in accordance with State and Federal laws, rules, and regulations. All seeds shall have a minimum germination rate of 85 percent.

1. Seeding mixture for lawn areas shall conform to the following grass types and percentages.

	Minimum Proportion by Weight	Percent Purity	Percent Germination
Palmer Perennial Ryegrass	20%	99%	90%
Ranger Perennial Ryegrass	20%	99%	90%
Baron Kentucky Bluegrass	30%	95%	85%
Merion Kentucky Bluegrass	30%	95%	85%

Inert Materials 2.5% (maximum)

2.03 WEED CONTROL

A. Post-emergent weed control for seeding: apply "Trimec," or approved equal. Use of material must be approved prior to application.

2.04 WATER

A. Clean, fresh potable water.

PART 3 EXECUTION

3.01 GENERAL

A. Supply suitable quantities of water, hose and appurtenances.

3.02 LOAM

A. Spread loam on areas to a minimum depth of 4", or as indicated on the plans or as directed by the Engineer, fine grade and compact.

3.03 LIME, FERTILIZER AND SEEDING

A. Apply lime by mechanical means at rate of 3,000 pounds per acre.

B. Apply fertilizer at the rate of pounds per acre.

C. Remove weeds or replace loam and reestablish finish grades, if any delays in seeding lawn areas and weeds grow on surface or loam is washed out prior to sowing seed and without additional compensation.

D. The approved seed mixture shall be applied at a rate of 6 pounds per 1,000 square feet by means of a seeder device capable of penetrating ground to a depth of 1 inch. Seed machines shall be equipped with disc-type penetrating action and seeder tubes that plant seeds. The seeder shall be like Jacobson Model 524-100, 548-100 or equal.

E. Distribute seeds over area in two separate passes, each one perpendicular to the other (north-south, east-west orientation). Each pass shall be in a linear progression and shall conform to the field direction that permits the longest, straight line application procedure.

F. Broadcast seeding will be permitted only with written permission of the Owner. All requests shall be in writing with detailed and itemized procedure to be followed.

G. Water lawn areas adequately at time of sowing and daily thereafter with fine spray and continue throughout maintenance and protection period.

H. Seed during approximate time periods of March 15 to May 15 and August 15 to October 1, and only when weather and soil conditions are suitable for such work, unless otherwise permitted.

3.04 APPLICATION OF WEED CONTROL

A. Apply post-emergent weed control to new seeding areas only.

B. Apply post emergent weed control at 1.2 to 1.5 ounces per 1,000 square feet, or according to manufacturer's recommendations.

3.05 ACCEPTANCE OF SEEDING:

A. Provisional Acceptance: Provisional acceptance period shall be defined as the elapsed time, between application of seed and the establishment of a good, healthy uniform growth of grass.

1. Provisional acceptance will not occur until the seeded areas are well established, exhibiting a vigorous growing condition, devoid of bare spots greater than 1 square foot and have been mown at least twice.

2. It will be the Contractors responsibility to maintain seeding areas in an approved condition until provisional acceptance.

3. The Contractor shall keep all seeded areas watered and in good condition, reseeding if and when necessary, during the provisional acceptance period.

4. The following guidelines shall be adhered to when mowing all newly seeded areas. These guidelines, while inclusive of all four growing seasons, does not necessarily imply that the Contractor is responsible for mowing throughout all four seasons, as provisional acceptance may be granted if grass is determined to be satisfactory after as few as two complete mowing.

a. Initial or spring mowing: Shall take place when lawn areas (new seeding, established lawns,) have grown to a blade height of 2 inches. Turf shall be cut using a mower with sharp cutting blades. Height of cut shall be set at 1-1/2 inches. This height of cut shall be maintained through spring period of growth (April through mid-June). Frequency of mowing during this growth period shall be every 7 days, or whenever grass growth exceeds 1-1/2 inches. Regardless of how quickly the turf grows during this period, NO MORE THAN ONE-THIRD of the leaf shall be removed in anyone mowing. Adherence to this procedure requires additional and more frequent mowing beyond the established regimen (once every 7 days, etc.), especially during and after rainy periods, or climatic conditions promoting rapid growth.

b. Summer: The height of the cut shall be raised to 2 to 2-1/2 inches commencing with the start of summer. This height of cut shall be maintained until the return of cooler temperatures in early September. The frequency of mowing during this summer period shall be once every 7 to 10 days. A longer interval than 7 days may be necessary if turf growing rate slows down in response to summer heat, drought, etc.; Contractor shall be responsible for determining the proper cutting interval that conforms best to local growing conditions and climatic factors, but period between cuts shall not exceed 10 days without prior approval of Owner.

c. Fall: The height of cut shall be reduced to 1-1/2 inches in mid-September when there is a noticeable change towards cooling daytime temperatures, usually between September 10 and 20. Beginning on September 10, the frequency of cuts shall be set at 1 cut every 7 days; this schedule shall remain in effect until mid-October.

d. Late Fall: Between mid-October (October 15) and November 10, the Contractor shall begin to lower the height of cut in incremental stages so that the final cut shall establish the winter dormant height of turf at 1 inch. Mowing frequency during this period shall be set at one cut every 12 to 15 days depending on turf growth rates. Starting on October 15, it is expected that the Contractor shall need no more than 3 cuts to lower the grass to its final height of 1 inch. NO more than one-third of the leaf shall be removed in anyone mowing operation. Final cuts shall be performed on or prior to November 10, unless an extension date is approved by Owner.

e. Grass clippings shall be returned to the turf surface during regular mowing operations.

5. During this period, water turf as necessary to maintain an adequate supply of moisture within the root zone. An adequate supply of moisture is the equivalent of 1 inch of absorbed water per week that is delivered at weekly intervals in the form of natural rain or is augmented as required by periodic watering.

6. It shall be the Contractor's responsibility to obtain necessary documentation to show that provisional acceptance has been granted. This shall be done upon written request to inspect grass work on site submitted by the Contractor to the Engineer. Provisional acceptance will not be granted until Contractor has obtained, in writing, a statement from the Engineer indicating that grass is satisfactory under the terms of the provisional acceptance.

B. Final Acceptance: Final acceptance period shall be defined as the elapsed time between provisional acceptance and final closeout of the project.

1. All seeded areas shall be guaranteed by the Contractor for not less than one growing season from the time of provisional acceptance. Growing season shall be defined as follows:

a. If provisional acceptance is received during April, May, June or July, the next growing season shall end on October 15.

b. If provisional acceptance is received during September, October, November or December, the next growing season shall end on June 1.

2. At the end of the guarantee period, inspection will be made by the Engineer upon written request submitted by the Contractor at least 10 days before the anticipated date. Lawn areas not demonstrating satisfactory stand as outlined above, (except if damaged by vandalism) as determined, by the Engineer shall be renovated, re-seeded, and maintained meeting all requirements as specified herein.

3. After all necessary corrective work has been completed, the Engineer shall certify in writing the final acceptance of the lawn area.

4. Decision of Owner as to necessity to replace lawns or repair any defects on workmanship, or cause of any destruction or loss, impairment, or failure to flourish, shall be conclusive and binding upon Contractor. Replacements shall be the same as specified. All replacements shall be planted as specified herein at Contractor's expense.

5. "Vandalism," as noted above, is intended to mean any acts, whether intentional or accidental, by other persons, which clearly result in damage, and which may reasonably be considered to be beyond the Contractor's reasonable control, as determined by the Owner's Representative.

C. Maintain lawn areas and other seed areas at maximum height of 2-1/2 inches by mowing at least three times. Weed thoroughly once and maintained until time of final acceptance. Re-seed and refertilize with original mixtures, watering or whatever is necessary to establish over entire area of lawn and other seeded areas a close stand of grasses specified, and reasonably free of weeds and undesirable coarse native grasses.

3.06 TEMPORARY COVER CROP

A. Sow a temporary cover crop of buckwheat, domestic rye grass or other acceptable seed if there is insufficient time in the planting season to complete seeding, fertilizing, and permanent seeding at the option of Contractor or order of Engineer. Cut and water cover crops as necessary until the beginning of the following planting season, at which time it shall be plowed or harrowed into soil, the areas shall be fertilized, and permanent seed crop sown as specified.

END OF SECTION 32 92 00