

ADDENDUM NO. 2
TO GENERAL, MECHANICAL AND ELECTRICAL
FAITH SCHOOL DISTRICT 46-2
LOCKER ROOM REMODEL
FAITH, SOUTH DAKOTA

Addendum Dated: February 12, 2024

Original Plans and Specifications Dated: January 19, 2024

NOTE: The Plans, details and accompanying specifications shall be amended as follows, but where any article is amended the original article shall remain in effect and shall become a part of the original plans and specifications.

A. SPECIFICATION CHANGES AND CLARIFICATIONS:

1. Section 15200 – Heating Specification
 - a) Add Section 15200 to Specifications. See Attached 18 Pages.
2. Section 15250 – Automatic Controls
 - a) Add Section 15250 to Specifications. See Attached 12 Pages.
3. Section 15300 – Ventilation/ Air Conditioning Specifications
 - a) Add Section 15300 to Specifications. See Attached 16 Pages.

SECTION 15200 – HEATING SPECIFICATIONS

1. REFERENCE

- a. The General Conditions and Special Conditions attached are a part of this Specification.
- b. Where this specification and/or the General Conditions mention "contractor" or "this contractor", the reference is intended to apply to the mechanical contractor, whose responsibility it is to provide a complete heating system installation, with all appurtenances and electrical work, as shown and as specified.

2. SCOPE OF THE WORK

- a. Work included in this section of the specifications shall be the furnishing and installation of a new hot water heating system for the Locker Rooms and Toilet Rooms, complete in all respects and ready to operate.
- b. Any minor details in connection with the heating system not specifically mentioned but reasonably implied by the specification or drawings and necessary for its successful operation, shall be furnished and installed by this contractor without extra charge.
- c. The work shall include the furnishing and installation of the high efficiency boilers, combustion air intake, venting, expansion tank, hot water specialties, pumps, air vents, unit heaters, piping, valves, fittings, insulation, and all other parts and equipment shown on the drawings and specified herein; and as required for a complete and operating heating system. Also included is piping of a dry cooler, to supply fluid for cooling to the hybrid heat pumps.
- d. The work shall also include General Construction and Electrical work.
- e. All equipment shall be installed in a manner approved by the Engineer and in accordance with the installation drawings of the manufacturer of the equipment.

3. DESCRIPTION OF SYSTEM

- a. The existing heating system is a two-pipe, direct return, forced circulation hot water heating system, using the existing hot water boiler with variable water temperature.
- b. The hot water temperature is varied inversely with the outdoor air temperature.
- c. There is a brazed plate heat exchanger using a circulating pump which will circulate hot water (40% propylene glycol solution) to the air handling unit heating coil. The pump runs continuously under control of an outdoor thermostat when the outdoor temperature is below the adjustable outdoor temperature setpoint. The units shall be in Heating Mode. When the

adjustable outdoor air temperature is above setpoint, the air handling unit shall be in Cooling Mode.

d. The heating coil to the air handling unit shall be Enabled whenever the outdoor temperature is below 50°F (adjustable). The cooling system shall be enabled any time the outdoor temperature is above 50°F (adjustable).

e. There is an air cooled condensing unit for cooling outside, piped to the air handling unit system as shown.

4. ORDINANCES AND CODES

a. All work shall be installed in accordance with all applicable state codes and statutes, local codes and ordinances, State Boiler Code, Uniform Plumbing Code, International Mechanical Code, International Building Code, and Life Safety Code (NFPA-101) 2021 Edition, where applicable.

b. In addition, where applicable to specific installation, the following codes or standards shall apply: ASME Boiler and Pressure Vessel Code.

c. When specifications call for materials or construction of better quality or larger size than required by the codes, the provisions of the specifications shall govern. Any conflict between the specifications or plans and the codes, or suspected error in the specifications or plans, shall be brought to the attention of the Engineer immediately.

d. All fees, permits, licenses, etc., necessary to complete the work in this section shall be paid for by this contractor.

5. EXISTING SERVICES

a. Active Services: When encountered in work, protect, brace or support existing active sewers, water, gas, electric and other services as required for proper execution of work. If existing active services require relocation, make request in writing to the engineer for determination. Do not proceed with work until written directions are received. Do not prevent or disturb operation of active services that are to remain.

b. Inactive Services: When encountered in work, remove, cap or plug inactive services. Notify utility company or municipal agency having jurisdiction. Protect or remove these services as directed. All removal or abandoning of inactive services shall be in strict accordance with the Utility, Municipality, or applicable codes.

c. Interruption of Services: Where work requires temporary shutdown of services, shut down at night or such time as approved by the owner to cause least interference with established operating routine. Contractor shall work continuously, including overtime if required, to assure that services will be shut down only during time actually required to make necessary connection to existing work.

6. DRAWINGS

a. Contract drawings for the mechanical work are, in part, diagrammatic, intended to convey the scope of the work and indicate general arrangement of equipment, ducts, pipe, and approximate sizes and locations of equipment outlets. Mechanical trades shall follow these drawings in laying out their work, consult the construction drawings, shop drawings, and electrical drawings to familiarize themselves with all conditions affecting their work. Verify spaces in which work will be installed; if job conditions require reasonable changes in locations or arrangement, make such changes without extra cost to the owner.

7. DESIGN CONDITION

a. The heating system is designed to maintain 72°F in all rooms where heating is installed when the outside temperature is minus 16°F and the prevailing wind is 15 MPH. Temperatures in all areas affected by the opening of outside doors will vary depending on how long the doors are open.

b. Heating water temperature shall vary inversely with the outdoor air temperature in one to one inverse ratio. At minus 16°F outdoor air, the leaving water temperature shall be 180°F.

c. The air handling unit coil heating ratings are based on 150°F entering water, from the brazed plate heat exchanger.

8. BOILERS

a. There is an existing gas fired boiler serving the space. This boiler shall continue to serve the renovated areas.

9. IN-LINE CIRCULATING PUMP

a. Furnish and install Bell & Gossett, Armstrong, or Taco in the line circulating pump where shown on the drawings, of the size and capacity listed in the Pump Schedule. Pump shall be quiet and vibrationless.

b. Pump shall be of the horizontal type, and shall have resiliently mounted motor and shall operate quietly without hum or vibration. Motors larger than 1/2 HP shall have ball bearings. Pumps shall have iron body with steel shaft and bronze trim, including sleeve bearings and impeller. Pump shall have oil cup on the top, gauge tapping and gauge cock on inlet and outlet. Pump shall have ground and polished steel shaft with hardened integral thrust collar.

c. Single phase motor shall have automatic reset thermal overload.

d. Support pump and piping as required to support weight of pump.

e. Lubricate pump with the proper grade of factory furnished lubricant before operating.

- f. This contractor shall balance all flows so that pump is operating at the proper head and the pump motor is drawing current within its rated capacity.
- g. Seals on pump to be suitable for glycol solution.
- h. Provide a gate valve or full lug wafer type valve on suction.
- i. In pump discharge, contractor shall furnish and install a B&G Triple Duty valve incorporating a non-slam check valve, shutoff valve, and a throttling valve, or equal by Taco or Armstrong. Triple duty valve shall be same size as pump discharge. Furnish and install a concentric increaser to transition from triple duty valve size to system size.

10. BRAZED PLATE HEAT EXCHANGER

- a. Furnish and install where shown on plans, a brazed plate heat exchanger equal to Bell and Gossett Model BPX liquid-to-liquid instantaneous heater.
- b. Heat exchanger shall be brazed copper with 316L stainless steel thermal plates. Top and bottom plates shall also be 316L stainless steel. Connections to be stainless steel.
- c. Construction shall be ASME Code with both sides designed for 435 psig at 450°F.
- d. Converter performance shall be:

	<u>Hot Side</u>	<u>Cold Side</u>
Fluid Circulated	Water	40% Propylene Glycol Solution
Total Flow	12 GPM	10 GPM
Inlet Temperature	180°F	125°F
Outlet Temperature	160°F	160°F
Pressure Drop Allow/ Calc.	10/7.5 FTH ₂ O	10/6.5 FT
% excess shall be	0%	
Model shall be B&G	BP400-30	
Maximum plate count shall be no more than	30	
Minimum surface area shall be no less than	3.53 SF	

11. HOT WATER SPECIALTIES

- a. Furnish and install all hot water specialties for system between flat plate heat exchanger and the air handling unit coil, as shown; manufactured by Bell and Gossett, or approved equal by Armstrong or Taco.
- b. Provide supports for expansion tanks. Expansion tank shall be ASME stamped for 125 psi working pressure, equipped with hose bib and gauge glass with gauge cocks with ball check valves so system will not drain if glass is broken.

c. Expansion tank and tank airtrol shall be:

15 gallon Size 12-3/4" diameter x 33" long w/ATF-12 Airtrol

d. Furnish and install an in-line air separator, Equal to B & G In-line Air Separator IAS-1-1/4, suitable for 125 psi WP, complete with inspection opening, instrument and control tapings.

e. Furnish and install a relief valve where shown for the system serving the air handling unit coil. Relief valve shall me Watts all bronze, or equal by McDonnell Miller. Discharge shall be piped full size to drain pan. Relief valve shall be Watts Model # 174A, 3/4" with capacity of 1,320,000 btu/hr based on a set pressure of 45 psi.

f. Provide means of charging system at point shown, consisting of a charging tank as detailed. A hose bib is called for in the upper level near the air handling unit.

12. FLOW MEASURING AND BALANCING SYSTEM

a. Furnish and install one complete Venturi flow metering system as manufactured by Aeroquip Corp., Barco Division, Barrington, Illinois.

b. The system, including individual orifice stations and portable master meter, shall be supplied by one manufacturer. Each Venturi station shall be complete with quick disconnect valves and safety shut off valves; metal identification tag on chain indicating pipe size, Venturi series, station identification and meter reading at a specified flow rate. Sizes 2-1/2" and larger shall consist of plated cast iron Venturi insert held between specially machined self-centering 150# steel weld neck flanges. Venturi size and series shall be selected so design flow rate shall be between 10 and 40 inches of water pressure differential, with permanent pressure loss of not more than 25" of indicated flow rate differential pressure.

c. See plans for size and location.

d. After complete balance has been obtained, the balance cocks shall be permanently marked to indicate the correct setting.

e. Equal flow fittings as manufactured by B&G, Gerand, Accu-Setter by Flow Design, Inc., Autoflow, or K.G. may be used.

f. Contractor may use automatic flow balancing devices of sizes scheduled on the drawings.

13. PRESSURE GAUGES AND THERMOMETERS

a. Furnish and install, where shown or called for, 4-1/2" diameter pressure gauges, bottom connection. Provide a brass needle valve, Trerice #735.

b. Gauges for heating fluid systems shall be calibrated in feet, and shall have a range of 0-70 feet.

- c. Furnish and install, where shown, 9" adjustable stem thermometers in separable well, plain case and plain ring, range 30° to 180°F with separable socket (Trerice BX91406-06). Provide special length stems to accommodate insulation thickness. Equal units by Weiss or Weksler may be used.
- d. All gauges and thermometers shall be mounted so they can be readily read. All instruments shall have metal case.
- e. Gauges and thermometers shall be Trerice or equal by Weiss, MilJoco, or Weksler.

14. HEAT TRANSFER FLUID & CHARGING TANK

- a. After system is thoroughly cleaned as specified hereinafter, fill with 40% NFP propylene glycol by Interstate Chemical Co., Inc, or Dowfrost HD by Dow Chemical, and deionized water to protect the system.
- b. Provide an engraved, laminated, plastic plate attached with four (4) screws to wall, where directed, size 12"x12", red with white letters stating:

"CAUTION - THIS HEATING SYSTEM IS FILLED WITH 40% PROPYLENE GLYCOL HEAT TRANSFER FLUID. DO NOT DRAIN. CHECK STRENGTH EVERY FALL. SEND SAMPLE TO THE INTERSTATE CHEMICAL COMPANY, ATTN: LAB, 2797 FREEDLAND ROAD, HERMITAGE, PA 16168-0600, REFERENCE: INTERSTATE CHEMICAL, EVERY TWO YEARS FOR ANALYSIS. ADD INHIBITOR AS DICTATED BY SAMPLE ANALYSIS REPORT. CONTACT THE LAB TO MAKE ARRANGEMENTS FOR SENDING IN SAMPLES"

(Use Dow Chemical and their address if Dowfrost HD is used)

- c. The mechanical contractor shall furnish and install an anti-freeze charging tank, consisting of a small tank or a pipe chamber made of 8" pipe 12" long with isolating valves, filler valve, and funnel, Watts 009 reduced pressure vacuum breaker and hose end connections.
- d. Contractor shall include in the operating instructions, complete information on the NFP heat transfer fluid, suppliers name and address, testing laboratory address and where test samples are to be sent, and written detailed instructions on how to take samples, add NFP or add inhibitors.
- e. It is estimated that 8 gallons of NFP will be needed to provide a 40% propylene glycol solution, and this contractor shall include the cost to furnish and install it. If additional NFP is required to obtain a 40% solution, the owner will furnish it, and the contractor shall install it at no additional cost.
- f. Provide test results showing strength of the solutions, and makeup of water to Engineer. A copy of results shall be included in the O&M Manuals.

15. HEATING SYSTEM PIPING

- a. From the existing heating system piping, run all heating fluid piping complete as shown. Run supply and return pipes as shown. Carefully route piping through building maintaining maximum headroom and clearances. Piping shall be concealed where possible. Support piping so that it does not touch structural.
- b. Extend heating fluid piping to new terminal units and air handling unit coil, as shown. Pipe and fittings shall be standard weight black steel pipe with 125 lb. cast iron fittings. Use welding fittings on all pipe larger than 2". All welding shall be done by "certified" welders approved by the engineer. Contractor may use Victaulic or Anvil Gruvlok piping, or Type M hard copper with 95/5 solder for all heating pipe, or use steel for sizes larger than 2", and Type M copper for all heating pipe 2" and smaller.
- c. Pitch new piping so all air in entire system can be vented. Provide an air vent at every location where the pipe turns down in the direction of flow, and at all high points. Provide means to vent air at high points.
- d. Arrange all piping so that system can be drained. Sections of piping individually valved shall have corresponding drain valves.
- e. All piping must be installed so it is free to expand and contract with changes of temperature without producing undue stress in the pipe or connections. Provide expansion loops and anchors where shown and as required to properly control the pipe movement.
- f. All piping shall be tested with a 125 lb. hydrostatic test.
- g. Offset piping as required to miss structural interferences, equipment, other pipes, conduits, etc.; and vent all high points.
- h. Route all piping so that equipment can be readily replaced or serviced, and maximum headroom clearance is maintained.

16. UNIONS

- a. Furnish and install Walworth #772, Crane, Stockham, General Fittings, or equal, ground joint unions in piping adjacent to each piece of equipment including air handling unit coil, to facilitate making repairs. Unions to be 125 lb. W.P.
- b. Unions in copper lines shall be all brass with sweat end, Nibco streamline Style C-108, or equal as made by Walworth, Crane or General Fittings.

17. PIPE HANGERS AND SUPPORTS

- a. All hangers shall be heavy wrought iron or malleable iron, split ring type, of ample capacity to support the pipe. Trapeze hangers shall not be allowed. Hanger for copper pipes shall be copper plated.
- b. Hangers shall be Grinnel fig. 104 or 108 with fig. 114 turnbuckle adjuster; or Blaw-Knox 6-b. On pipes 4” and smaller, use Grinnel fig. 97 or 69, or equal by Auto-Grip, Michigan, or F&S.
- c. Contractor shall use Grinnel CT99 or CT-6 copper plated steel hanger for copper pipe.
- d. Hangers shall adequately support the load. They shall be located within 2’ of changes in piping direction and concentrated loads; provide vertical adjustment to maintain pitch required for proper drainage; allow for expansion and contraction of piping.
- e. Horizontal steel pipe shall be supported as below:

<u>Pipe Size</u>	<u>Rod Diameter</u>	<u>Maximum Spacing</u>
Up to 1-1/4"	3/8"	8 feet
1-1/2" & 2"	3/8"	10 feet
2-1/2" & 3"	1/2"	12 feet

- f. Horizontal lines of copper tubing shall be supported as below:

<u>Nominal Tube Size</u>	<u>Rod Diameter</u>	<u>Maximum Spacing</u>
Up to 1"	3/8"	6 feet
1-1/4" & 1-1/2"	3/8"	8 feet
2" & 2-1/2"	1/2"	9 feet

Hangers for copper pipe shall be same as above and shall be copper plated.

- g. When support locations for vertical piping are not indicated on the drawings, support steel and copper piping at 12’ intervals.
- h. Attachment to overhead construction shall be by means of approved commercial attachments for the type of construction being attached to. Do not support pipe from other pipes, conduits, or ducts.
- i. Set concrete inserts in all poured beams and slabs as required.
- j. Hangers shall be attached to structural system.
- k. Cut and patch plaster or ceiling as required to install pipe and pipe supports.

l. Rods shall be threaded at both ends, or may be continuous threaded rod. No chain, wire or perforated strap may be used.

m. Equal hangers by Michigan or PHD.

18. ANCHORS AND EXPANSION LOOPS

a. All pipe shall be run so as to allow for expansion movement; anchor and support so as not to put any strain on terminal units or equipment.

19. AIR VENTS

a. Furnish and install air vents mounted on pipe nipple at each terminal unit, on each coil, and at all high points in the system. Coils shall be piped such that the air vents to each coil shall be at a high point in the supply/return piping.

b. Supply and return mains shall be run level or grade up in the direction of flow. Any time a pipe turns down in the direction of flow, the turn shall be made with a tee with an air vent mounted on top of a 4" long pipe nipple.

c. Air vents shall be manually operated, screw driver adjusted vents mounted on pipe nipple. On the ends of mains and at high points, mount a Keeney vent on a 4" piece of 1" pipe. On fin tube and convactor radiation, mount a Keeney #5S vent with tube on a 4" piece of 1" pipe; mount vent in an approved location and extend vent tube to it. Automatic air vents shall not be used.

d. Where necessary to vent mains above finished ceilings that are not lay-in, the main shall have a 4" pipe nipple mounted on the top with a 1/4" copper tube extended down to a manually operated vent, similar to Keeney #5S mounted in a flush ceiling mounted 4"x4"x2-1/2" electrical conduit box, with extension ring and blank stainless steel cover. Provide identifying tag in box.

20. INSULATION (Pipe)

a. Insulation shall be as manufactured by Schuller, Knauf, or Owens Corning, subject to meeting all requirements of this specification. No asbestos containing materials shall be used.

b. All new piping in the building shall be insulated.

c. Piping shall be insulated with fiberglass pipe insulation with AP-T Plus jacket, or equal. Jacket shall be high density, white, factory applied, foil-backed Kraft fire retardant paper jacket, reinforced with fiberglass yarn. The jacket shall have a pressure sensitive tape lap sealing system. The adhesive shall be protected by easy lift release paper. Insulation shall be furnished with matching pressure sensitive tape butt strips with the same adhesive and release paper. Insulate all fittings, valves and flanges to match. Use Zeston 25/50 PVC, CSG, Proto, or CertainTeed insulation fitting covers for all fittings, both exposed and concealed. The fitting covers shall have a maximum flame spread rating of 25 and a maximum smoke developed rating of 50. Seal fittings with adhesive and tape end joints. All seams to be turned away from line of

sight. Staples shall not be used for installing insulation cover or fitting covers; all joints shall be sealed with approved adhesive tapes.

d. Insulate all piping in a neat, workmanlike fashion in accordance with thickness listed hereinafter. Longitudinal laps of jackets shall be sealed and butt joints shall be wrapped with a 3" minimum wide strip of the jacketing material securely sealed in place. Vapor barrier adhesive to meet NFPA 90A flame spread of 25 and smoke 50, such as CMC 17-465, Childers CP 82, or equal.

In lieu of the above method of application for AP jackets, contractor may elect to use factory applied pressure sensitive laps and butt strips, Manville AP-T Plus or equal.

e. All fittings, flanges, unions, and valve bodies shall be insulated to the same thickness as the adjoining pipe insulation. Where the factory pre-molded, one piece PVC insulated fitting covers are to be used, and they shall be used on all concealed and exposed fittings, they shall be rated 25/50 and the proper factory pre-cut insulation shall be applied to the fitting. The ends of the insulation shall be tucked snugly into the throat of the fitting and the edges adjacent to the pipe covering tufted and tucked in fully insulating the pipe fitting. The one-piece PVC fitting cover will be secured by banding or taping the ends to the adjacent pipe covering. The circumferential edges of the cover shall be wrapped with vapor barrier pressure sensitive color matching tape. The tape shall extend over the adjacent pipe insulation, and have an overlap on itself at least 2 inches on the downward side. Contractor to take special care in insulating Victaulic fittings so that entire fitting, including bolts, nuts, etc., are completely insulated.

f. Insulation shall be applied on clean, dry surfaces and only after tests and approvals required by the specifications have been completed. All pipe insulation shall be continuous; (through wall and ceiling openings and sleeves). Where piping penetrates fire walls, contractor shall furnish and install UL approved firestopping. Install firestopping in accordance with manufacturer's recommendations.

Insulation on all cold surfaces must be applied with a continuous, unbroken vapor seal. Hangers, supports, anchors, Victaulic fittings, etc., that are secured directly to cold surfaces must be adequately insulated and vapor sealed to prevent condensation. All surface finishes must be extended to protect all surfaces, ends, and raw edges of insulation.

g. Specified adhesives, mastics and coatings shall be applied at the manufacturer's recommended minimum coverage per gallon.

h. All insulation shall have a composite fire hazard as tested under NFPA 225, not exceeding flame spread of 25 and smoke developed rating of 50. Accessories such as adhesives, mastics, cements, fitting covers, and fitting insulating material shall have same component ratings as listed above.

i. All work shall be in compliance with the manufacturer's recommended installation procedures, and a neat workmanlike job will be insisted upon throughout the project. Poorly insulated fittings or butt strips will not be accepted. Use scissors to cut cover--do not tear. No staples will be permitted.

j. All new piping listed below shall be insulated with insulation thickness as follows:

<u>Type of Piping</u>	<u>Pipe Size</u>	<u>Insulation Thickness</u>
Hot Water Heating	All Piping	1/2"
Condensate Drain from Cooling Coils		1/2"

k. The insulation and vapor barrier on condensate piping shall be continuous, without joints, through walls and ceilings. Support pipes on galvanized saddles.

l. Heating equipment, including air separator, shall be insulated with 2" thick Schuller Spin-Glass fiberglass blocks suitable for 850°F tightly wired on or banded; cover with 1-1/4" galvanized wire mesh securely attached over the block; cover with 1/2" insulating cement applied in two smooth layers and finished with white factory presized, 8 ounce canvas, cover.

21. PANEL RADIATOR

a. Panel radiators shall be manufactured of cold rolled low carbon steel, fully welded and consisting of header pipes at each end, connected by flat oval water tubes. Provide perforated top cover in fins. Basis of design is Runtal.

b. Tube thickness shall be

High Pressure – 0.048" minimum wall thickness

c. Radiator header pipes shall be square 0.109" minimum wall thickness and include all necessary supply, return, and air vent connections. Internal baffling shall be provided as required.

d. Piping connections shall be 3/4" NPT taper threaded sockets, located as shown on drawings, with air vent connections 1/8" NPT taper threaded sockets.

e. Panel radiation shall be for the following working pressure

High Pressure – 128 psi max (tested at 184 psi)

f. Radiator expansion will not exceed 0.016" per linear foot at 215°F. Expansion compensation to be provided in the piping.

g. Radiators are phosphatized and primed with flat white baked enamel.

h. Panel radiator finish shall be painted, with a gloss baked enamel, for a total paint thickness of 2 to 3 mils. Architect to select color from standard colors available. Submit color chart for selection.

i. Wall mounting brackets shall be provided with radiators. Mount radiation to slope slightly upward in direction of flow to vent air. Air vent shall be installed up high point of radiator.

j. Radiators shall be the sizes, capacities, and quantities as shown on the plans. Furnish and install center trim, end trim, and end cap trim as required for finished look.

k. Connection to panel radiator may be made using flex connector, 3/4", female sweat end by male threaded end. Between pieces of radiation, use a flex connection.

l. Where pipe connection returns solution to the system furnish and install a ball Style Venturi type balancing valve.

22. CONNECTIONS TO EQUIPMENT

a. Furnish and install all piping and connections to the new radiation, cabinet unit heaters, and air conditioning units, as shown.

b. Provide drains for condensate pan in air handling units to the exterior as shown, and the contractor furnished drip pans for the air handling units, to nearest floor drain in the boiler room. Use Type M hard copper. Turn pipe down into floor drain. Provide deep trap on condensate drains at the air handling units. Trap shall be at least 2 times deeper than the negative pressure of the air conditioning units, in inches of water. Contractor may use Schedule 40 PVC pipe for condensate piping.

c. Install all control valves. Install control valves furnished by Controls Contractor.

d. Install all wells for instruments and controls.

23. SLEEVES AND PLATES

a. Furnish and set sleeves where piping passes through floors, walls, roof, and partitions. Sleeves through non-load bearing wall shall be of #24 G&S gauge galvanized iron. Sleeves through concrete floors, and structural concrete shall be standard weight galvanized steel pipe. All sleeves shall be of sufficient size to include continuous pipe insulation, and finished in such a manner as to be easily covered with chrome plated wall or floor plates.

b. Where allowed by the Engineer, uncovered, exposed pipe through walls or floors shall be fitted with at least 1/16" thick wall or floor plates, around pipe. Plates shall have chrome plated finish, and shall be hinged.

c. Sleeves through beams and columns will not be permitted without permission.

- d. Pack sleeves or holes through walls and floors with Dow Corning 3 silicon elastomer Fire Stop Sealant or 3M fire Barrier to prevent sound transmission and fire and smoke migration. Install as per manufacturer's recommendation.
- e. Where sleeves are inadvertently omitted: Holes shall be drilled with diamond tip core drill. Air hammers or impact hammers shall not be used.
- f. Sleeves in second floor mechanical room shall be black steel pipe, 4" above floor, with leak plate. See detail.

24. VALVES

- a. Furnish and install shut off, isolation or check valves where indicated on plans and as specified. Valves shall be one brand throughout the job. Specialty valves shall be one of the brands listed hereinafter. All valves shall be designed for 125 lbs. steam working pressure and be so stamped. A permanent metal tag or disc shall be attached to the valve handle wheel indicating the manufacturer's figure number. All valves shall be mounted in an accessible location so that they can be operated and serviced, and with their stems above the horizontal.
- b. Valves 2" and smaller shall be all bronze with threaded ends and rising stems, except valves in copper lines shall have solder ends for use with copper tubing.
- c. Gate valves 2" and smaller shall be equal to Watts Series GV or GVS.
- d. Check valves 2" and smaller shall be equal to Watts CVY or CVYS.
- e. Valves 2" and smaller may be ball valves, shall be bronze, 2 or 3-piece construction, full port configuration, with reinforced TFE seats and seals, shall have blowout-proof stem design, and shall have adjustable packing gland. Valve shall be designed for 150 psi steam and shall be designed for at least 400 psig, WOG cold non-shock. Valve shall have sweat ends for copper lines, and threaded ends for steel pipe. Ball shall be chrome plated steel. Valve handle shall be zinc plated steel with vinyl grip.

Ball valves used for balancing flow shall have memory stop.

Watts	B-6080 (NPT), 6081 (C to C)
Apollo	Apollo 77-100 Series
Milwaukee	BA300

25. PAINTING

- a. No painting of piping or insulation included in this section, but all pipe, insulation, and equipment to be left clean and ready for painting.

26. ELECTRICAL WIRING

- a. It is the responsibility of this contractor to instruct the electrical contractor as to the location and proper application of the equipment and apparatus furnished under this contract.
- b. All wiring shall be in accordance with the latest edition of the National Electric Code.
- c. All wiring shall be in accordance with the Electrical Specifications for this project.

27. TEMPORARY HEAT

- a. See General Conditions and Special Conditions bound hereinbefore.
- b. Air conditioning units shall not be used for temporary heat.
- c. This contractor shall provide approved temporary heat as required.

28. CLEANING, TESTING AND ADJUSTING SYSTEM

- a. This contractor shall test all piping with a cold hydrostatic test of not less than 100 psi for 24 hours. This test shall be made in the presence of the engineer or his representative. Test lines before insulating. Care shall be taken so as not to put the test pressure on the boiler.
- b. All equipment furnished under this contract shall be tested and operated by the contractor to demonstrate that it is in good working order. The entire heating system shall be balanced by an independent NEBB or AABC certified balancing company retained by the contractor. If job is completed in warm weather, the contractor shall balance the system as soon as weather is cold.
- c. Flush system thoroughly with clean water before putting glycol solution in.
- d. The entire heating system installed under this contract shall be cleaned as follows: Fill entire system with a 1% solution of Ferrosol Neutral pH pre-operational cleaner, vent and circulate the solution in the system for 72 hours, rinse with fresh water for 24 hours, drain, install 40% Dowfrost and water solution.
Install any bypass piping required for cleaning new piping. Remove bypass upon completion of cleaning. Cap takeoffs at mains.
- e. All pipe and equipment shall be thoroughly cleaned both inside and out.
- f. All equipment requiring lubrication shall be oiled or greased in accordance with the manufacturer's instructions prior to turning the job over to the owner.
- g. Prior to final acceptance, this contractor shall remove all packing crates, rubbish and debris from the site and leave the building in neat, clean condition.

h. After boilers are clean, put on the line, adjust all controls, and demonstrate that all safety and operating controls are operating satisfactorily, including low water cutoff, operating, and high limit controls.

29. CUTTING AND PATCHING

a. This contractor shall do all cutting, patching and repairing of building necessary to install new piping and equipment. Where necessary, holes shall be neatly cut and repaired to the satisfaction of the engineer. Holes in concrete shall be drilled with core drill. Holes shall be sized for the particular size pipe.

b. Finish painting will be done by others, but any patched areas shall be finished to match adjoining area and be ready for painting.

c. Smudges, fingerprints and areas soiled by the contractor shall be cleaned to original condition.

30. PROTECTION OF EQUIPMENT

a. This contractor shall, at all times, protect materials and equipment to be installed in such a manner that when finally installed it will present the same new appearance as when uncrated; cover stored material with weather proof canvas, keep other trades from abusing same, and avoid final setting of equipment in such locations where protection may be difficult.

b. Equipment that has been scratched, dented, or damaged shall be replaced with new equipment or, at the option of the engineer, shall be returned to the manufacturer for repair.

c. At time of final inspection, not only is all equipment to be working satisfactorily, but shall be neat and clean.

31. SHOP DRAWINGS

a. Furnish for approval, electronic or hard copies of certified shop drawings on all equipment to be furnished under this contract. All shop drawings shall be submitted at one time within 45 days after the award of the contract.

b. Similar equipment or component parts shall be of one brand throughout the entire project.

c. Prior to submitting drawings, the contractor shall check to see that equipment meets the specifications, that sizes and quantities are correct, and shall sign or stamp his approval. Job name and location must be clearly marked on each drawing or group of individual drawings.

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- d. This contractor shall be responsible for fitting equipment in the space available and verifying all dimensions.
- e. If equipment submitted for approval varies from that specified, all variations shall be specifically noted on the drawings. Failure to do so will be cause, at the option of the engineer, to reject the equipment even though the incomplete shop drawings are approved.
- f. Drawings shall show all features required by the specifications.
- g. Shop drawings of equipment with electrical components, motors, controllers, etc. shall give complete electrical information such as make, model, type and current. The cost of electrical modifications required by submitted material and/or equipment that is in excess of that provided for the specified brand, shall be the contractor's responsibility.
- h. Where catalogs or catalog cuts are submitted, they shall clearly indicate which particular model and type is being submitted for approval, and any items listed on the submittal as "optional" shall clearly indicate whether the optional item is being furnished.
- i. In general, equipment is specified by brand name with several "equals" listed. Where one of the "equal" brands is used, or if an "equal" brand is approved by addenda and used by the contractor, he shall verify the space and other requirements of the "equal" brand used, and shall be responsible for all additional costs created by using the "equal" brand.

32. OPERATION AND MAINTENANCE MANUALS

- a. Prior to or at the time of final inspection, two (2) hard copies and one (1) electronic copy of Operation and Maintenance Manuals for this contractor shall be delivered to the Engineer.
- b. The Operation and Maintenance Manual shall include the following items:
 - 1) All approved shop drawings
 - 2) Service manuals
 - 3) Parts lists
 - 4) Written certification of:
 - A. Heating and cooling piping water flow balance tests and pressure tests
 - B. Piping flushing
 - C. Complete and correct operation of control systems
 - 5) Written certification shall mean that the item being certified has been:
 - A. Witnessed by each individual signing the certificate. The certification shall state system tested, how tested, make, model, and serial number of test equipment, date tested, condition of test (i.e.: 125 psi for 8 hours), test results and specification item number
 - B. Signed by the contractor, factory representative (if applicable). All certifications shall be typewritten and signed and dated in ink by each individual required.

C. Contractor to provide certification that required system instructions have been performed. Certification of instruction shall be typewritten, include length, date, place, and subject of instruction, and shall be signed and dated in ink by each person being instructed, and the instructor.

c. Operation and Maintenance Manual shall be supplied for mechanical items. The operation and maintenance manual shall be compiled in the following manner:

1) The contractor shall bind all documents in a vinyl cover, 3 ring binder, complete with nameplate attached to the cover. The nameplate shall contain the type of system, name of project, and the contractor's name.

2) The Operating and Maintenance Manual shall be divided into distinct sections for each major piece of equipment and all certifications.

3) Each division of the Operation and Maintenance Manual which is designated for equipment shall contain the following items:

A. Service manual

B. Parts list

C. Shop drawings

D. A typewritten sheet containing all continual maintenance instructions required

E. A typewritten sheet listing the design conditions, capacities, how controlled, voltage, manufacturer and model number

F. A section which contains wiring diagrams, warranties and other pertinent equipment information

G. A separate division shall be included which provides a complete layout of the control system installed, a detailed explanation of each function of each item in the control system, the shop drawings of the control system and service operating and installation instructions for each piece of control equipment installed

H. Each listing stated above shall be typed on 8-1/2"x11" size paper. All drawings shall be neatly folded and placed in envelopes for easy removal. The envelope shall designate on the outside what drawing is contained within the envelope. The envelopes shall be securely bound in the 3-ring binder.

d. This contractor shall furnish on-site training for the owner's staff of equipment furnished under this contract. Training shall be provided by a factory authorized representative. Coordinate training with the owner's staff.

33. COORDINATION AND COOPERATION AMONG TRADES

a. Contractors shall not install their materials without consideration for other trades on the basis of "we were here first". The drawings are generally schematic. In general, in congested areas, plumbing waste lines and ductwork would have first priority over other pipes and conduits. Should pipes, conduits or ducts be installed without regard to others, they shall be relocated without cost as instructed by the engineer so as to permit all trades to install their material, so as

to maintain maximum headroom and clearance, and so as to obtain the most desirable installation as determined by the engineer.

b. This contractor shall coordinate the installation of his piping and equipment with the General, Ventilation and Electrical Contractors before starting installation.

34. GUARANTEE

a. All equipment, material and workmanship shall be guaranteed for a period of one year from date of acceptance. Any defects which may appear during the guarantee period due to faulty workmanship or material shall be repaired or replaced to the satisfaction of the engineer at no additional cost to the owner.

b. Where the selection of materials or the method of installation is left to the responsibility of the contractor, he shall pursue the best available materials or practice suitable for the purpose intended.

c. It is the primary responsibility of this contractor to turn over to the owner a complete and working system, thoroughly tested, balanced, and adjusted with the best available instruments to the satisfaction of the engineer.

SECTION 15250 – AUTOMATIC CONTROLS

1. REFERENCE

- a. The General Conditions and Special Conditions attached are a part of this Specification.
- b. Where this specification and/or the General Conditions mention "contractor" or "this contractor", the reference is intended to apply to the controls contractor, whose responsibility it is to provide a complete automatic control system installation, with all appurtenances and electrical work, as shown and specified.

2. GENERAL

- a. Work included in this section of the specifications shall be the furnishing and installation of a building automation system of automatic controls, complete in all respects, and ready to operate. Systems to be controlled include one (1) water –to-water brazed plate heat exchanger, one (1) air handling unit, one (1) air cooled condensing unit, four (4) VAV boxes, a circulating pump for fluid between the AHU and the heat exchanger, terminal units, and all appurtenances.
- b. Any minor details in connection with the installation of the new system not specifically mentioned but reasonably implied by the specification or drawings and necessary for its successful operation, shall be furnished and installed by this contractor without extra charge.
- c. The work shall include the furnishing and installation of controls related to the boilers, expansion tank, hot water specialties, pumps, air vents, cabinet unit heaters, radiation, hot water coils, temperature controls, piping, valves, fittings, insulation, and all other parts and equipment shown on the drawings and specified herein; and as required for a complete and operating heating system.
- d. The work shall also include General Construction and Electrical work.
- f. Control systems training of the Owner’s operation and maintenance personnel is required in cooperation with the Owner. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instruction shall be scheduled for a minimum of 8 hours.
- g. Work shall include electrical construction which shall be done in accordance with the Technical Specifications, Ventilation/Air Conditioning, and Electrical Specification Sections. Contractor shall also refer to the Heating Specification bound herein.

3. DEMOLITION AND SALVAGE

- a. This contractor shall visit the site and refer to the Construction drawings showing renovation changes etc., and shall inspect the building noting all heating, ventilation, and air conditioning equipment, ductwork, piping, exhaust fans, etc., that is not to be incorporated in the renovation

project, or remain in use in the existing building. The Controls Contractor shall remove controls to existing heating and cooling equipment, and all appurtenances that is not incorporated into the addition and is not required to maintain systems in the existing building.

b. All equipment or material to be removed shall be removed by the contractor and shall be stored, where directed and, at the owner's option, shall remain the property of the owner; however, if the owner elects not to retain ownership, then it shall become the property of the contractor who shall promptly remove it from the premises and lawfully dispose of it.

4. DESCRIPTION OF MECHANICAL SYSTEMS TO BE CONTROLLED

a. The existing heating system is a two-pipe, direct return, forced circulation hot water heating system, using a gas fired hot water boiler.

b. There is a primary loop pump (and a standby) that circulates hot water to all existing terminal units, new radiation, new reheat coils at the VAV boxes, and the air handling unit hot water coil serving the Locker Rooms. The existing primary pump(s) is controlled by an outdoor thermostat which runs the pump any time the outdoor air is below 50°F (adjustable). The primary loop temperature varies inversely with the outdoor air temperature.

5. SYSTEMS OF VENTILATION

a. The Locker Room area is served by one (1) AHU, which shall provide cooling to the space in the summer and tempered/warm air in the winter. The air handling unit is furnished with an integral variable frequency drive on the supply fan motor. Variable air volume boxes with reheat coils in the conditioned space will increase or decrease fan speed through the VFD, to condition the space to thermostat setpoint.

6. EXISTING SERVICES

a. Active Services: When encountered in work, protect, brace or support existing active sewers, gas, water, electric and other services as required for proper execution of work. If existing active services require relocation, make request in writing to the engineer for determination. Do not proceed with work until written directions are received. Do not prevent or disturb operation of active services that are to remain.

b. Inactive Services: When encountered in work, remove, cap or plug inactive services. Notify utility company or municipal agency having jurisdiction. Protect or remove these services as directed. All removal or abandoning of inactive services shall be in strict accordance with the Utility, Municipality, or applicable codes.

c. Interruption of Services: Where work requires temporary shutdown of services, shut down at night or such time as approved by the owner to cause least interference with established operating routine. Contractor shall work continuously, including overtime if required, to assure that services will be shut down only during time actually required to make necessary connection to existing work.

7. ORDINANCES AND CODES

- a. All work shall be installed in accordance with all applicable state codes and statutes, local codes and ordinances, State Boiler Code, Uniform Plumbing Code, International Mechanical Code, International Building Code, and Life Safety Code (NFPA-101) 2021 Edition, where applicable.
- b. In addition, where applicable to specific installation, the following codes or standards shall apply: ASME Boiler and Pressure Vessel Code.
- c. When specifications call for materials or construction of better quality or larger size than required by the codes, the provisions of the specifications shall govern. Any conflict between the specifications or plans and the codes, or suspected error in the specifications or plans, shall be brought to the attention of the Engineer immediately.
- d. All fees, permits, licenses, etc., necessary to complete the work in this section shall be paid for by this contractor.

8. DESIGN CONDITION

- a. In general, the heating system is designed to maintain 72°F (+/- 2°F) in all rooms where heating is installed when the outside temperature is minus 16°F and the prevailing wind is 15 MPH. Temperatures in all areas affected by the opening of outside doors will vary depending on how long the doors are open.
- b. Heating water temperatures shall vary inversely with the outdoor air temperature in one to one inverse ratio. At minus 16°F outdoor air, the heat exchanger leaving water temperature shall be 150°F (adjustable).
- c. The entering air to all radiation is assumed to be 65°F. The new panel radiation is based on a 20°F drop in water temperature and 170°F average water temperature.
- d. Air handling unit coil ratings are based on 150°F entering water and a temperature drop as scheduled. DX Cooling coil is based on 45° entering refrigerant.
- e. The hot water heating system shall supply water to the reheat coils at 180°F. Hot water serving the reheat coils also serves the radiation.

9. DRAWINGS

- a. Contract drawings for the mechanical work are, in part, diagrammatic, intended to convey the scope of the work and indicate general arrangement of equipment, ducts, pipe, and approximate sizes and locations of equipment outlets. Mechanical trades shall follow these drawings in laying out their work, consult the drawings, shop drawings, and electrical drawings to familiarize themselves with all conditions affecting their work. Verify spaces in which work will be

installed; if job conditions require reasonable changes in locations or arrangement, make such changes without extra cost to the owner.

10. TEMPERATURE CONTROLS

a. General: The contractor shall furnish all control system equipment under this section of the specifications, including thermostats, sensors, relays, dampers, panels, damper operators and control valves. The controls shall be coordinated into an automatically operating system and, before final acceptance, the contractor shall demonstrate that all controls are functioning properly.

Controls will be Siemens as supplied by G & R Controls.

b. Scope: The control system shall consist of all room sensors/thermostats, air stream thermostats, sensors, controllers, DDC controls, valves, dampers, damper operators, and other necessary devices and equipment, to include a complete system to fulfill the intent of the specifications and provide control of equipment specified hereinafter.

The Mechanical Contractor shall install all control valves, wells, etc., furnished by the Temperature Controls Contractor. The Ventilation Contractor shall install all dampers furnished by the Temperature Controls Contractor.

c. Wiring: Power shall be furnished to the temperature control panel in the Mechanical Room.

All wiring in connection with the temperature controls shall be furnished and installed by the controls contractor in accordance with Electrical Specifications. This includes all wiring for activators, dampers, sensors, controls, control panels, etc.

Control system shall be hard wired. Wireless devices will not be permitted.

d. Balancing of Systems: The Temperature Control Subcontractor shall cooperate and work with the NEBB or AABC certified balancing subcontractor provided by the Mechanical Contractor to properly balance out water and air flow in all systems to obtain a satisfactory working system.

e. Service and Guarantee: The control system shall be free from defects in workmanship and material under normal use and service. If within twelve (12) months from date of acceptance by the engineer, any of the equipment herein described is proved to be defective in workmanship or material, it shall be replaced or repaired free of charge. After completion of the installation, the contractor shall regulate and adjust all thermostats, control valves, motors, and other equipment. He shall place them in complete operating condition subject to approval by the engineer, and shall provide any service incidental to the proper performance of the temperature control system under guarantee outlines in the above one year period.

f. Adjustment and Calibration: After the system is completely installed, the contractor shall provide a qualified technician to check out the various temperature control cycles as herein specified to the satisfaction of the engineer or owner. The temperature control contractor shall submit direct to the engineer or owner, a tabulation of all test and adjustment readings of outdoor

air, mixed air, discharge air, and all room temperatures for each unit. All thermostats and their thermometers shall be calibrated after installation. Factory calibration is not satisfactory.

g. Special Requirements:

1) Carefully rough in all thermostats or sensors at 44", unless required otherwise by ADA - verify mounting height with owner. Thermostats or sensors with day/night selector switches shall be mounted at ADA height of 44". Where special finishes are encountered and when in doubt, the engineer shall be contacted promptly. Failure to execute the above requirements shall be cause for relocating thermostats with the contractor bearing all expenses encountered in such a procedure.

2) Avoid attaching to ducts as much as possible.

3) Do not mount anything on the outside of the building before carefully checking location with the engineer.

4) Damper motors shall be securely mounted and aligned so motor shaft and crank are in the same plane. All controls and tubing not concealed shall be protected. Damper actuators shall be adequately sized to operate the dampers under all operating conditions encountered.

h. Control Instruments: Thermostats/sensors shall be single or dual temperature, day/night, gradual acting, and located where shown. All thermostats shall allow for occupant adjustment. Insertion thermostats shall be panel mounted with remote sensors. All thermostats and thermometers shall be field calibrated.

The contractor shall furnish all labor and material to provide brass wells, tappings, etc. for the sensors for the control system. All wells to have conductive filler. Wells, flow switches, or sensors shall be installed between the equipment, pump, etc., and its isolation valves. Pressure differential switches shall be piped using copper pipe and fittings. For all pressure switches, provide brass isolation cocks on each side of the pressure differential switches. Pressure differential switches shall be used to prove air flow across fans.

i. Dampers: Furnished by the Temperature Control contractor shall be low leakage, multi-blade, parallel blade; with gasketed edges on all four edges, built in rigid channel frame. Blades shall be at least 18 gauge. Damper shall be tight fitting. Damper operators shall be electric Belimo, Johnson Controls, Siemens, or Honeywell. The AHU is furnished with integral outside air and return air dampers. All other control dampers shall be furnished by the Temperature Controls Contractor. Control dampers shall be low leakage type equal to Ruskin CD-60.

j. Control Sequences: Furnish and install all material, controls, and labor to accomplish the control sequences stated hereinafter.

1) Master DDC Control Panel: Furnish and install control panel where shown. Control panel shall be factory built totally enclosed, lockable, mounted where shown – top 6 ft. above floor. This shall be a completely programmable DDC control panel that shall incorporate all software and hardware necessary to provide time scheduling, viewing and commanding of the

equipment specific controllers via the Operator's Workstation. All application specific DDC controllers shall be networked back to the Master DDC Control Panel via a Local Area Network (LAN).

2) Air Handling Unit #1: Serves the renovated Locker Rooms, Second Level Classroom and two Offices to provide cooling and tempered air for ventilation. AHU #1 has a DX cooling coil, hot water heating coil, OA, and RA dampers. Controls for AHU #1 shall be direct digital control with electric/electronic operators for valves and dampers.

The system is to have DDC controls as specified hereinbefore, with all auxiliary control panels required to accomplish the control cycles specified hereinafter, and to control other LAN panels for miscellaneous points.

The controllers shall provide outputs to accommodate control of various auxiliary gears as desired for the application.

All actuators for valves and dampers will be manufactured by and supplied by the Temperature Control Contractor. The temperature control contractor shall provide the electric wiring. All equipment shall be compatible. All actuators shall be spring return failsafe type.

Provide control of the following using pre-programmed control modules selected and integrated into complete system control programs:

Air handling unit #1 is equipped with a hot water (glycol solution) coil, DX cooling coil, outside air, and return air dampers. The Temperature Control Contractor shall furnish the outside air and return air dampers. Furnish and install a 3-way operated valve on the heating coil, complete with electric/electronic actuators.

Furnish all necessary controls and devices so that the system is controlled and monitored from the local "stand alone" DDC controller.

The AHU shall be started and programmed from the EMS clock. A sensor in the mixed air shall maintain its setting of 45°F/85°F (adjustable) by modulating the outside air damper, return air damper. The dampers shall be sequenced such that the outside air damper and return air damper modulate together, in opposition to each other, to maintain the desired mixed air temperature both summer and winter.

The outside air damper shall positively close whenever the air handling unit is off, and shall close on the night cycle on heating or cooling.

A low limit manual reset freezestat sensor with 8' averaging bulb located downstream of the heating coil set at 40°F shall positively close the outside air damper, and start AHU #1 if it is not already running.

AHU #1 discharge temperature shall be controlled by a leaving air temperature sensor set at 57.5°F (adjustable). The sensor shall be adjustable from the DDC panel, or from the central EMS. The discharge temperature shall be maintained by modulating the control valve on the coil.

Provide DDC control to switch from Heat-to-Cool with an outdoor sensor set at 55°F (adjustable), and to shut the heating coil valve. On the cooling cycle, an electronic thermostat (sensor), located in the discharge, will maintain its setting by modulating the DX cooling coil refrigerant.

Furnish and install a CO2 sensor in return air duct near the mixing box and in space at 5'0" above floor, to modulate outside air, based on rise in CO2 levels. Outside

air damper shall modulate from 10% to 30% (adjustable) outside air to maintain indoor air quality. Also furnish and install a humidity sensor in the space served to maintain building humidity.

The AHU discharge air temperature setpoint shall be reset based on room cooling demand and/or room humidity level. The discharge air temperature setpoint based on room cooling demand shall be reset from 65 to 57.5 degrees F (adjustable) as a VAV box room cooling demand rises above 85%. The discharge air temperature setpoint based on room humidity sensor, shall reset from 65 to 57.5 degrees F (adjustable) as the room humidity approaches the room humidity summer set point. (Typically 50%, adjustable).

When the economizer is enabled then the AHU discharge air temperature setpoint is equal to the room cooling demand discharge air temperature set point. When the economizer is disabled the AHU discharge air temperature setpoint is equal to the lower discharge air temperature set from the room cooling demand or the room humidity level. When the economizer cannot maintain the discharge air temperature at set point the DX cooling shall modulate to maintain the cooling coil leaving air temperature at set point, 50 degrees F, (adjustable).

AHU #1 shall have variable speed abilities, the AHU uses an integral VFD with direct drive fan. Provide static pressure sensor and required DDC controls to maintain its setting. Static pressure shall be resettable from the local DDC panel or the central EMS.

Furnish and install high static sensor on supply and low static sensor on return to shut down fan on activation. Device shall be a manual reset sensor.

3) Air Cooled Condensing Unit (ACCU 1): When the outdoor air is above 55°F (adjustable), the ACCU shall be energized. The ACCU shall not run unless the AHU is running. On the cooling Cycle, the VAV system shall maintain building comfort by modulating the compressors.

4) Reheat Coils and VAV Terminals: Provide room sensor (thermostat) for each VAV box to maintain space setting by modulating a damper in the box.

The terminals shall be equipped with pressure independent direct digital controls supplied by the control contractor and mounted by the terminal unit manufacturer. Control contractor shall provide data sheets on all components to be mounted, indicating component dimensions, mounting hardware and method to the terminal manufacturer. Control packages illustrating wiring and piping diagrams shall be supplied by the terminal manufacturer.

Controls shall be compatible with inlet velocity sensors supplied by the terminal manufacturer. Furnish and install all required control wiring. The sensor shall be multi-point center averaging type as listed above. Controls shall be DDC and shall be controlled from the same room sensor as the reheat coil.

Controls shall be field set by control contractor for the 10% minimum (adjustable) and maximum flow rates. Unit operation shall be verified by dynamic checkout, operated on a fan system using statistical process control methods. Bench calibration only of controls is not acceptable. Flow measuring taps and flow curves will be supplied with each terminal for field balancing air flow. Each terminal shall be equipped with labeling showing unit location, size, and scheduled CFM.

Controls Contractor shall take power to each VAV.

5) Direct Radiation: Where plans indicate that direct radiation is to be controlled, provide electric modulating two way radiator valve with sensor/thermostat. Valves shall be for hot water. Sensors/thermostats shall be sequenced from Occupied to Unoccupied from master DDC panel.

Where direct radiation is controlled from the same thermostat that controls a VAV box, the system shall be calibrated such that the VAV shall be handling minimum air in the heating cycle. As sensor calls for cooling of space, modulate radiation to close.

Where existing radiation is to remain, and is served with pneumatic controls, it shall be repiped and new DDC controls shall be installed.

Direct radiation shall not be operable in the Cooling Mode.

6) CO2 Sensor: Furnish a CO2 sensor exterior to the building, outside the mechanical room to provide a baseline CO2 measurement for use with the control system. Furnish CO2 sensors in breathing zones of occupied spaces as shown.

7) Heat Exchanger: There is a flat plate style heat exchanger for the AHU heating coil. Modulate the control valve to maintain a hot water supply setpoint to the AHU heating coil whenever the heating system is enabled. The setpoint will be based on outside air temperature. At -16°F, boiler side EWT shall be 180°F, system EWT to AHU shall be 150°F (SEE SPECIFICATIONS FOR BRAZED PLATE HEAT EXCHANGER). On call for heating the heat exchanger heating valve will modulate open. Circulating pump for AHU heating coil shall be energized anytime the heating system is activated.

8) Exhaust Fan: Furnish an occupancy sensor in the Locker Room to start/stop the respective exhaust fan for the space anytime the space is in use.

k. Electrical Wiring: Electrical wiring and related work included in this project consists of installation of raceway for system conductors, extension and modification of control circuits, dedicated circuits to each local panel and processor, and circuit extension to areas shown.

Provide dedicated circuits, 3 wire (line, neutral, ground) to each panel or processor. Circuit shall originate at a 20 amp, 1 pole breaker in existing branch circuit panel, and extend in metal raceway to load.

All wiring shall be in accordance with the Electrical Specifications for this project.

l. Field Hardware: Furnish and install all field hardware required to complete the system, including all insertion type temperature sensors, space temperature sensors, EP and PE pneumatic relays, pressure differential switches for proving air or water flow, electrical relays and switches necessary for all points.

Temperature sensors shall have an end-to-end accuracy of plus or minus 1/2°F, and all temperature sensors utilized in mixed air streams shall be averaging with a minimum of 6 ft. of capillary.

m. Input/Output Abbreviations: The following abbreviations and definitions are used in Input/Output (I/O) summary tabulated hereinafter.

PSS - Programmed start/stop point capable of being incorporated into any of the energy conservation strategies such as programmed start/stop; temperature compensated optional start/stop; duty cycling; load shedding; run time; etc.

EN/S - Enable stop points are those capable of being incorporated in all the above programs but, basically, programmed off and then programmed to a condition that they can be manually started at the local switch.

RI - Run Indication

FA - Flow Alarm - by sensing water or air flow

TI - Temperature Indication

A(Hi-Lo) - High and/or Low temperature alarm indication

Hi - High Alarm

Lo - Low Alarm

LL - Liquid Level alarm

PI - Pressure Indication

PA - Pressure Alarm

X/S - Supervised Alarm circuit

RH - Relative Humidity

Cond Temp - Condensate Temperature

Hydron/Heat - Hot water heating system pressure switch

AHU - Air Handling Unit

MZU - Multi-Zone Unit

BIN - Binary Point

FD - Fire Detection

AI - Analog Input

FI - Flow Indication

n. Input/Output Summary: Provide required application specific controllers, local panels, and any other appurtenances as required to manage all the points listed.

<u>Point</u>	<u>Indication</u>	<u>Alarm</u>	<u>Control</u>
ACCU	RI	Hi/Lo PA	PSS
AHU	RI	FA	PSS
Leaving Air	TI	TA(Hi-Lo)	Remote Reset
Return Air	TI	TA(Hi-Lo)	--
Space Temp	TI	A(Hi-Lo)	--

11. SLEEVES AND PLATES

- a. In walls or floors, sleeves shall be neatly core drilled. Oversized holes shall have sleeves neatly grouted in place.
- b. Where allowed by the Engineer, uncovered, exposed pipe through walls or floors shall be fitted with at least 1/16" thick wall or floor plates, around pipe. Plates shall have chromium plated finish, and shall be hinged.
- c. Pack sleeves or holes through walls and floors with Dow Corning 3 silicon elastomer Fire Stop Sealant or 3M fire Barrier to prevent sound transmission and fire and smoke migration. Install as per manufacturer's recommendation. Fire sealant to comply with LEED requirements.
- d. Holes shall be drilled with diamond tip core drill. Air hammers or impact hammers shall not be used.

12. PAINTING

- a. No painting of piping or insulation included in this section, but all pipe, insulation, and equipment to be left clean and ready for painting.

13. CLEANING, TESTING AND ADJUSTING SYSTEM

- a. All equipment furnished under this contract shall be tested and operated by the contractor to demonstrate that it is in good working order. The entire heating system shall be balanced by an independent NEBB certified balancing company retained by this contractor. If job is completed in warm weather, the contractor shall balance the system as soon as weather is cold.
- b. System functional performance testing is part of the Commissioning Process. Functional performance testing shall be performed by the contractor and witnessed and documented by the Commissioning Agent.

14. CUTTING AND PATCHING

- a. This contractor shall do all cutting, patching and repairing of building necessary to install new piping and equipment. Where necessary, holes shall be neatly cut and repaired to the satisfaction of the engineer. Holes in concrete shall be drilled with core drill. Holes shall be sized for the particular size pipe.
- b. Finish painting shall match adjoining surfaces.
- c. The General Contractor shall provide finished painting to match adjoining finish on all areas where cutting and patching is required.

- d. Finish painting will be done by others, but any patched areas shall be finished to match adjoining area and be ready for painting.
- e. Smudges, fingerprints and areas soiled by the contractor shall be cleaned to original condition.
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15. PROTECTION OF EQUIPMENT

- a. This contractor shall, at all times, protect materials and equipment to be installed in such a manner that when finally installed it will present the same new appearance as when uncrated; cover stored material with weather proof canvas, keep other trades from abusing same, and avoid final setting of equipment in such locations where protection may be difficult.
- b. Equipment that has been scratched, dented, or damaged shall be replaced with new equipment or, at the option of the engineer, shall be returned to the manufacturer for repair.
- c. At time of final inspection, not only is all equipment to be working satisfactorily, but shall be neat and clean.

16. SHOP DRAWINGS

- a. Furnish for approval, three (3) **hard copies** and one (1) electronic copy of certified shop drawings on all equipment to be furnished under this contract. Three (3) **hard copies** of all such drawings shall be submitted and will be retained in the engineer's office. All shop drawings shall be submitted at one time within 45 days after the award of the contract.
- b. Similar equipment or component parts shall be of one brand throughout the entire project.
- c. Prior to submitting drawings, the contractor shall check to see that equipment meets the specifications, that sizes and quantities are correct, and shall sign or stamp his approval. Job name and location must be clearly marked on each drawing or group of individual drawings.
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- d. This contractor shall be responsible for fitting equipment in the space available and verifying all dimensions.
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i. In general, equipment is specified by brand name with several "equals" listed. Where one of the "equal" brands is used, or if an "equal" brand is approved by addenda and used by the contractor, he shall verify the space and other requirements of the "equal" brand used, and shall be responsible for all additional costs created by using the "equal" brand.

17. COORDINATION AND COOPERATION AMONG TRADES

a. Contractors shall not install their materials without consideration for other trades on the basis of "we were here first". The drawings are generally schematic. In general, in congested areas, plumbing waste lines and ductwork would have first priority over other pipes and conduits. Should pipes, conduits or ducts be installed without regard to others, they shall be relocated without cost as instructed by the engineer so as to permit all trades to install their material, so as to maintain maximum headroom and clearance, and so as to obtain the most desirable installation as determined by the engineer.

b. This contractor shall coordinate the installation of his piping and equipment with the General, Mechanical, Ventilation, Fire Protection, and Electrical Contractors before starting installation.

18. GUARANTEE

a. All equipment, material and workmanship shall be guaranteed for a period of one year from date of acceptance. Any defects which may appear during the guarantee period due to faulty workmanship or material shall be repaired or replaced to the satisfaction of the engineer at no additional cost to the owner.

b. Where the selection of materials or the method of installation is left to the responsibility of the contractor, he shall pursue the best available materials or practice suitable for the purpose intended.

c. It is the primary responsibility of this contractor to turn over to the owner a complete and working system, thoroughly tested, balanced, and adjusted with the best available instruments to the satisfaction of the engineer.

SECTION 15300 – VENTILATION/AIR CONDITIONING SPECIFICATIONS

1. REFERENCE

- a. The General and Special Conditions bound hereinbefore form a part of these specifications.
- b. Where these specifications and/or the General and Special Conditions mention "contractor" or "this contractor," the reference is intended for the ventilation contractor, whose responsibility it is to provide a complete ventilation and air conditioning installation as shown on the plans and as specified hereinafter.

2. SCOPE OF THE WORK

- a. Work included in this specification is furnishing and installing of an air handling unit, return air fan, all ductwork, equipment, and appurtenances specified and as shown on the drawings, to ventilate and cool the renovated Locker Room area..
- b. All equipment shall be installed in a manner approved by the engineer and in accordance with the installation drawings of the manufacturer of the equipment.
- c. Install all dampers furnished by the Temperature Control contractor.
- d. A new air cooled condensing unit provide refrigerant to the air handling unit cooling coil to cool the spaces. A heating coil in the air handling unit shall provide tempered ventilation air to the renovated area.
- e. Work shall also comply with Technical Specifications, Temperature Controls, and Electrical Sections of the specifications.

3. SYSTEMS OF VENTILATION

- a. The area is served by one (1) AHU which shall provide cooling to renovated areas of the building in the summer and tempered air in the winter. The air handling unit has an integral variable frequency drive for the supply fan motor and shall work in conjunction with variable air volume boxes in the conditioned spaces to increase or decrease fan speed, to condition the space to thermostat setpoint. Reheat coils in the variable air volume boxes provides the building additional heat when the boiler is operating.

4. ORDINANCES AND CODES (Ventilation & Air Conditioning)

- a. All work shall be installed in accordance with all applicable state codes and statutes, local codes and ordinances, International Mechanical Code, International Building Code, and Life Safety Code (NFPA-101) 2021 Edition, where applicable.

b. In addition, where applicable to specific installation, the following codes shall apply: NFPA-90A, Air Conditioning and Ventilating Systems; NFPA-90B, Warm Air Heating and Air Conditioning Systems.

c. When specifications call for materials or construction of better quality or larger size than required by the codes, the provisions of the specifications shall govern. Any conflict between the specifications or plans and the codes, or suspected error in the specifications or plans, shall be brought to the attention of the Engineer immediately.

d. All fees, permits, licenses, etc., necessary to complete the work in this section shall be paid for by this contractor.

5. DEMOLITION AND SALVAGE

a. This contractor shall visit the site and refer to the General Construction drawings showing changes etc., and shall inspect the building noting all ventilation and air conditioning equipment, ductwork, piping, etc., that is not to be incorporated in the new project, or remains in operation in the existing building.

b. All equipment or material to be removed shall be removed by the contractor and shall be stored, where directed and, at the owner's option, shall remain the property of the owner; however, if the owner elects not to retain ownership, then it shall become the property of the contractor who shall promptly remove it from the premises, and lawfully dispose of it.

6. DRAWINGS

a. Contract drawings for the ventilation and A/C work are, in part, diagrammatic, intended to convey the scope of the work and indicate general arrangement of equipment, ducts, pipe, and approximate sizes and locations of equipment outlets. Mechanical trades shall follow the drawings in laying out their work, consult the GC drawings, shop drawings, and electrical drawings to familiarize themselves with all conditions affecting their work. Verify spaces in which work will be installed; if job conditions require reasonable changes in locations or arrangement, make such changes without extra cost to the owner.

7. CENTRAL STATION AIR HANDLING EQUIPMENT

a. Furnish and install, where shown on plans, a modular, double wall central station air handling unit. Basis of design is AAON. Equal by Daikin, Temptrol, York, Trane, or Carrier. Size, type, and performance shall be as indicated in the unit schedule. Basis of design was chosen for ability to fit within the space. Footprint of equal units shall not impede on clearance requirements for electrical panels, and other trades. Each unit shall be complete with factory furnished components as specified or as shown on the plans, and ARI certified per Standard 430.

b. Units shall be draw-thru design with coils, motor, blower, and drain pan assembly, completely within the cabinet enclosure. Units shall be ETL or UL Listed in compliance with UL/ANSI

Standard 1995. Unit and refrigeration shall comply with ASHRAE 15, Safety Standard for Mechanical Refrigeration.

c. Structural members for air handling units shall be manufactured of 16 gauge pre-painted, galvanized sheet metal.

d. Units shall be specifically designed for indoor application, with double wall construction throughout, and rigid polyurethane foam insulation, with R Value equal to 6.25 minimum, and density of 2 lbs. per cubic foot, tested in accordance with ASTM D1929-11, installed within the space between the double wall panels. Access to the blower, coils, and other items needing periodic checking or maintenance shall be through removable access panels with half turn latches. Panel fastening screws are not acceptable. Air side service access panels shall be fully gasketed, and will have an internal metal liner to protect the door insulation.

e. Air handling units shall have a sloped 304 stainless steel condensate drain pan with a connection provided on each side of the unit.

f. Internal wiring shall be color coded, and a laminated wiring diagram shall be permanently affixed to the inside of the unit.

g. Blower unit shall have direct drive, unhooded, backward curved plenum fan.

h. Coils shall be as shown on the schedule. Coils shall be fabricated of seamless copper tubes and extended aluminum fins mechanically bonded to the tubes. Headers on the coils shall be extra heavy wall seamless drawn copper tubing with die formed end closures for added strength.

i. Coil shall be certified in accordance with AHRI Standard 410 and be hydrogen leak tested. Coil shall be designed and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and aluminum end casings. Fin design shall be sine wave rippled. Coil shall have single serpentine circuitry, 8 rows and 12 fins per inch. Coil shall have external piping connections. Supply and return connections shall be sweat connection. Coil connections shall be labeled, extend bond the unit casing, and be factory sealed on both the interior and exterior of the unit casing to minimize air leakage.

j. Access to cooling coil shall be through hinged access door with lockable quarter turn handles.

k. Hot water heater coil shall be certified in accordance with AHRI Standard 410 and be hydrogen leak tested. Coil shall be designed and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and aluminum end casings. Fin design shall be sine wave rippled. Coil shall have half serpentine circuitry, 1 row and 12 fins per inch. Coil shall have external piping connections. Supply and return connections shall be sweat connection. Coil connections shall be labeled, extend bond the unit casing, and be factory sealed on both the interior and exterior of the unit casing to minimize air leakage.

l. Heating coil shall be located in the preheat position upstream of the cooling coil.

- m. Coil access shall be through service access door with piano hinges and lockable quarter turn handles.
- n. The unit shall use 2" thick, pleated air filters. Filters shall be removable from the side of the cabinet. Contractor shall field build and install filter holder, as part of intake plenum ductwork.
- o. Unit shall be provided with internal control panel, with separated low and high voltage control wiring.
- p. Each unit shall have a single point power connection terminal block for field connection to the electrical power source. Include with each unit, a factory wired 24 volt control circuit transformer and a fan contactor for start/stop operation of the blowers motor.
- q. Blower and motor assembly shall be dynamically balanced.
- r. Motor shall be a high efficiency, TEFC Motor, suitable for use with integral variable frequency drive. Blower and motor assembly shall be mounted on rubber isolators.
- s. Unit to sit on 5" rails furnished with the unit.

8. AIR COOLED CONDENSING UNIT

a. Furnish and install air cooled condensing units as shown on plans. Design is based on AAON Model CF Series, or equal unit meeting these specifications. The unit shall have a capacity shown, at 45°F saturated suction temperature when operating in 95°F ambient air. The unit shall operate on 208 volts, 60 hertz, 3 phase electrical service. Total unit power consumption shall not exceed KW scheduled.

The condensing unit shall be completely factory assembled on a rugged steel channel base, and be individually performance tested at full and part load conditions. The unit shall be leak tested and shipped with a holding charge of Refrigerant 410A. SEER/EER shall be equal to or exceed requirements set forth in ASHRAE 90.1 and performance scheduled on plan, and shall comply with ANSI/ASHRAE 15 Safety Standard for Mechanical Refrigeration, National Electric Code, CSA, and ETL.

b. Unit casing and all structural members shall be fabricated of continuous galvanized steel and galvanized steel channel. Exterior casing shall be designed for outdoor application and painted with a finish capable of withstanding, at minimum, 1000 hours in a salt spray or fog atmosphere with no visible corrosive effect, in accordance with ASTM B117-95 test procedure.

c. Compressors shall be scroll type with thermal overload protection, independently circuited. Compressors shall have a 5 year non-prorated warranty.

1) Each compressor shall include a crankcase heater.

2) Compressors shall be mounted in an isolated service compartment which can be accessed without affecting unit operation. Lockable hinged access doors shall provide access to

the compressors. Compressors shall be isolated from the base pan with the compressor manufacturer's recommended rubber vibration isolators, to reduce any transmission of noise from the compressors into the building area. Provide protecting cage for coil to guard against hail damage. Provide removable heavy duty "cage" guard around unit to prevent entrance beneath unit.

d. Each refrigeration circuit shall be equipped with automatic reset low pressure and manual reset high pressure refrigerant safety controls, Schrader type service fittings on both the high pressure and low pressure sides, and service valves for liquid and suction connections. Liquid line filter driers shall be factory provided. Finished field installed refrigerant circuits shall include the low side cooling components, refrigerant, thermal expansion valve, liquid line and insulated suction line.

e. Unit shall include 4 stages of capacity control and two independent refrigerant circuits. Each circuit shall consist of one constant capacity hermetic compressor and one digital scroll modulating capacity (10% to 100%) hermetic compressor. Hot gas bypass or "froststats" for capacity modulation are not allowed.

- 1) Unit shall include a variable capacity scroll compressor on the lead refrigeration circuit which shall be capable of modulation from 10-100% of its capacity.

f. Each compressor shall be equipped with a 5 minute off, delay timer to prevent compressor short cycling.

- 1) Condensing unit shall be provided with adjustable on/off condenser fan cycling head pressure control and adjustable compressor lockout to allow cooling operation down to 35°F.

g. Condenser fans shall be vertical discharge, axial flow, direct drive fans. Fan motor shall be weather protected, single phase, direct drive, and open drip proof with inherent overload protection.

h. Coils shall be designed for use with R-410A refrigerant and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and aluminum end casings. Fin design shall be sine wave rippled. Coils shall be designed for a minimum of 10°F of refrigerant sub-cooling.

i. Coils shall be helium leak tested.

j. Unit shall be provided with a terminal block for field installation of controls.

k. Field power connection, control interlock terminals, and unit control system shall be centrally located in a weatherproof enclosure. Panel access doors shall key lock. Deadfront panels shall protect service personnel against accidental contact with line voltage components. Power and starting components shall include factory fusing of fan motors and control circuit, starting contactors for fan motors, solid state compressor overload protection in all three phases, inherent

condenser fan motor overload protection, and unit power terminal block for field connection to remote disconnect switch.

Safety and operating controls shall include unit control stop switch, recycling pumpdown control, manual pumpdown switch, oil safety switch, high and low pressure switches, and fan cycling controls. Unit controls shall provide recycling pumpdown protection at all times, including timeclock system shutdowns on nights and weekends. Unit shall be factory equipped with part-winding start and control transformer.

1. Mount ACCU #1 on 6" concrete pad, with 1", 45° beveled edges, using 4000 psi concrete.

9. VARIABLE VOLUME TERMINAL

a. Furnish and install single duct variable volume terminals with reheat coils, of sizes and capacities scheduled or as shown on the plans. Basis of design is Price. Equal units by Nailor, Tuttle & Bailey, MetalAire, Titus, Carnes, or Trane may be used. Terminals shall be certified under the ARI Standard 880 Certification Program, and bear the ARI Seal.

b. Unit casing shall be constructed of not less than 22 gauge ASTM-A-525 galvanized steel, with round inlet collars of the proper diameter and rectangular slip and drive discharge openings. The casing shall be constructed to hold leakage to a maximum of 3% of unit's maximum rated CFM or 10 CFM, whichever is greater, at 3.0 inches inlet static pressure.

c. Interior surface of unit casing shall be acoustically, thermally lined with not less than 1/2" thick, 1-1/2 pound dual density fiberglass insulation which complies with UL 181 and NFPA-90A. All exposed insulation edges shall be coated with an NFPA 90A approved sealant to prevent the entrainment of fibers into the airstream.

d. The damper assembly shall be constructed of two 24 gauge blades sandwiched with an integral seal to provide minimum leakage. Damper leakage shall not exceed 2% of unit's maximum rated capacity or 10 CFM, whichever is greater, with inlet duct pressures up to 5" water gauge. Damper bearings shall be nylon type for noise free operation, requiring no lubrication. Aluminum shaft shall have an integral marker to indicate the damper position. Stickers or other removable markings are not acceptable.

e. The sensor shall be a cross flow design. Straight inlet conditions shall not be a requirement.

f. Terminals shall be equipped with pressure independent DDC controls which can be reset to modulate airflow within the cataloged CFM. Maximum airflow limiters are not acceptable.

g. Control devices shall be field set by dynamic calibration. Scheduled minimum air flow rates shall be set while units are operated on a fan system. Flow measuring taps and flow curves shall be supplied with each terminal for field balancing air flow. Each terminal shall be equipped with labeling showing unit location, size, minimum and maximum CFM setpoints, damper fail position, and thermostat action. Electric/electronic DDC actuators shall be provided by the controls contractor, and field installed.

h. Discharge and radiated sound power shall be submitted for all octave bands for 125 through 4000 Hz. Sound performance shall be ARI certified. NC data only will not be acceptable.

10. CEILING FAN

a. Ceiling fans shall be Gemini as manufactured by Loren Cook Company or equal by Greenheck, Carnes, Twin City Fan, Penn, or Pace. See Schedule on plans, for sizes and configuration.

b. Unit shall have twin blower wheels mounted in one common blower housing, and shall have integral backdraft damper. All fans shall be AMCA rated for both air and sound. Motor shall be permanently lubricated. Inlet grille shall be anodized aluminum. Motor leads shall terminate with plug and convenience outlet.

c. Where fans discharge through the wall, furnish and install manufacturer's wall cap. For Crawlspace ventilation terminate with Seiho SFX model, anodized wall cap.

11. EXHAUST FAN

a. Furnish and install an in-line exhaust fan for each Locker Room as scheduled. Fan shall be duct mounted, direct driven centrifugal square inline.

b. Fan shall be equal to Loren Cook Model SQN-D as scheduled.

c. Fan shall be listed by Underwriters Laboratories (UL 705) and UL listed for Canada (cUL 705). Fan shall bear the AMCA certified ratings seal for sound and air performance, and shall be manufactured at an ISO 9001 certified facility.

d. The fan shall be of bolted construction utilizing corrosion resistant fasteners. Housing shall be minimum 18 gauge galvanized steel with integral duct collars. Bolted access doors shall be provided on three sides, sealed with closed cell neoprene gasketing. Housing shall be pre-drilled to accommodate universal mounting feet for vertical or horizontal installation. Unit shall bear an engraved aluminum nameplate. Nameplate shall indicate design CFM and static pressure. Unit shall be shipped in ISTA certified transit tested packaging. Fan shall be capable of end discharge and discharge through any side panel except where the motor is located.

e. Fan wheel shall be centrifugal backward inclined, constructed of 100% aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA standard 204-05, balance quality and vibration levels for fans.

f. Motor shall be an electronically commutated motor rated for continuous duty and furnished either with internally mounted potentiometer speed controller or with leads for connection to 0-10 VDC external controller. Motor HP on listed on the drawings is minimum acceptable.

12. FLEXIBLE CONNECTIONS

- a. Furnish and install sound and vibration isolating flexible connections on the inlet and outlet of each unit to which duct connections are made. Connections shall be made from "Ventglas" Neoprene-coated glass fabric as furnished by Ventfabrics, Inc. or equal. At least one inch slack shall be allowed in these connections to insure that no vibration is transmitted from fan to ductwork.
- b. Flexible connectors shall be 3" wide factory lock seamed to #1 prime galvanized 24 gauge sheet metal on both sides.
- c. Flexible connectors shall be equal to Ventfabrics, 5520 North Linch, Chicago, Illinois; Cain Manufacturing Inc., 1111 Fifth Avenue North, Birmingham, Alabama; or Duro Dyne Corporation, Route 110, Farmingdale, New York 11735, or equal.
- d. If the units are furnished with approved, completely isolated fan and drives, the flexible duct connections to the air handling unit and the spring isolators may be omitted.

13. SHEET METAL WORK

- a. All ductwork shall be fabricated of the best grade of domestically produced hot dipped G-90 galvanized iron sheets, regular spangle, chemically treated, free of oil, as manufactured by Wheeling Steel Corporation, Armco, Wirton, USX, Inland, or equal. Sheets shall be "Tight-Coat" grade or equal, and shall be guaranteed not to fracture when run through a lock-former.
- b. Duct sizes shown on plans are "net" inside dimensions. Where these specifications call for duct to be lined with insulation, the size of the ducts shall be increased to maintain the net inside sizes shown on the plans.
- c. All ductwork shall be fabricated and installed in accordance with the recommendations of the American Society of Heating, Refrigeration and Air Conditioning Engineer's (ASHRAE) Guide, 1983 Edition, or SMACNA 1990 Third Edition. Galvanized sheet metal gauges and type of transverse joints for various size ducts are listed below:

Metal gauges for rectangular low and medium pressure ducts up to 4" WC.

Steel			
U.S.	Maximum		
Std.	Side		
<u>Gage</u>	<u>Inches</u>	<u>Transverse Joint Connection</u>	<u>Bracing</u>
26	Up to 12	S drive, pocket or bar slips on 7'10" centers.	None.
24	13 to 18	Same as above.	None.
24	19 to 30	S drive	1"x1"x1/8" angles @60" top & bottom

22 31 to 42 Same as above. 1-1/2"x1-1/2"x1/8" @60"
top & bottom

All duct joints and seams shall be sealed.

<u>Seal Class</u>	<u>Sealing Required</u>	<u>Static Pressure Construction Class</u>
A	All transverse joints, longitudinal seams & duct wall penetrations	4" WG & Up
B	All transverse joints & longitudinal seams	3" WG
C	Transverse joints	2" WG

In addition to the above, the variable air volume systems supply duct of 1" WG and 1/2" WG construction class that is upstream of the VAV boxes shall also meet Seal Class C.

d. All ductwork shall be made air tight. The engineer reserves the right to order any open seams made tight by soldering and/or riveting. All ducts shall be complete in themselves; no single thickness partitions between ducts will be allowed.

e. All rectangular ductwork insulated or uninsulated shall be cross broken on all sides, or shall have machine formed reinforcing ribs on 12" centers on all ductwork and fittings.

f. All ducts shall be substantially supported to the ceiling construction or adjacent construction by means of 1" wide galvanized 16 gauge hangers placed not more than 8' on centers horizontally. Hangers shall be riveted or bolted to ducts and fastened to construction by means of expansion bolts or other approved means.

g. Install all ducts substantially as shown on plans. Changes in direction shall be made with bends with minimum radius of 1-1/2 times width of duct. Contractor shall use 45° rectangular duct taps for supply, return, and exhaust branch ducts with a volume damper with locking quadrant (Parker or Young) located within 2' of the transition. Where dampers are above hard ceilings, furnish and install for each damper a Ventlock #677 regulator with 2-5/8" cover plate painted white, with tamperproof screws and cover. The 45° rectangular branch connection shall be built as detailed, with openings closed at the corners. The connection shall be such that there will be no exposed duct liner edges. Branch duct shall be attached with clinch lock joint. Branch connections shall be designed and built so that ends of duct liner insulation is not exposed.

h. All open ducts shall be temporarily closed with metal covers until such time that grilles and registers are installed.

i. All ductwork shall be plumb and level, and a first class installation will be insisted on throughout--not only from workable standpoint but appearance too. Flexible duct shall not be used.

- j. Furnish and install all miscellaneous ductwork and sheet metal work shown on plans.
- k. Ducts may be prefabricated at the contractor's risk but, should it be necessary to reroute ductwork due to pipes, conduits, wire, or structural interference, the contractor shall do so at no additional cost.
- l. Where ducts pass through walls, the space between the duct and the opening shall be sealed with 3M, Dow or equal fire stop, installed as per manufacturer's recommendation.
- m. Round duct to VAV boxes above ceilings shall be 24 gauge galvanized, 3 duct diameters long ahead of VAV box. Use high efficiency takeoffs and sheet metal round duct on supply to VAV box. Insulate on outside, overlapping lined duct.

14. PROHIBITED LOCATION OF PIPING AND DUCTWORK

- a. The mechanical drawings show the general arrangement and routing of the piping and ductwork, but this contractor shall vary the exact location to avoid interference with electrical equipment.
- b. No piping, ductwork, or appurtenances shall be installed above electrical panels, switchboards, or motor control centers; or through or above the clearance space in front of this electrical equipment, in compliance with Article 384 of the National Electric Code. The mechanical contractor shall verify this space requirement with the electrical contractor on this project, prior to routing any piping in the vicinity of electrical equipment.
- c. In general, the contractors will maintain a minimum of 6" clearance from the face of any electrical equipment as far as routing of pipe and ducts, and this clearance shall extend up to the structural floor or ceiling above for the purpose of maintaining this clearance. Dropped, suspended, and similar ceilings not intended to add strength to the building structure are not structural ceilings.

15. INSULATION

- a. Duct insulation shall be CertainTeed ToughGard 2 Textile/ToughGard R duct liner, Owens-Corning Mat-faced, Knauf, or Schuller Microlite duct insulation. All duct insulation shall meet NFPA Bulletin 90A or 90B and ASTM 1071 Type I, and shall have a minimum NRC value for 1" thickness of .70 (1/2" thickness of .45), and have a maximum thermal conductivity (k) at 75°F of 0.31, with flame spread under 25 and smoke developed under 50. Minimum density shall be 2 pound. The glass fiber liner shall have a coated or composite, abrasion resistant air stream surface. All portions of duct designated to receive duct liner shall be completely covered with duct liner. Transverse joints shall be neatly butted and there shall be no interruptions or gaps. Duct liner shall be cut to assure overlapped and compressed longitudinal corner joints.
- b. Duct insulation to be installed on the inside of the ducts and shall be attached with Minnesota Mining Adhesive #33, meeting ASTM C916, 100% coverage, applied with spray gun. It shall rate "zero" on flame spread when tested against NFPA Standard 90A. Approved equal adhesive

shall be Tuff Bond or Swift Company. "Butter" all raw exposed edges. In addition, all duct insulation on ducts 18" and wider shall be mechanically attached with stick clips, pin welders or sheet metal screws with large washers 12" on center both ways. Fasteners shall not compress the liner greater than 10% of the liner thickness.

Duct liner product shall be kept clean and dry from time of manufacture through jobsite installation completion. Keep fabricated finished liner ductwork clean and dry through jobsite installation and system commissioning. Provide temporary waterproof enclosures to keep lined ductwork dry during construction.

c. All supply and return ductwork, to include duct from return air fan to relief louver, shall be lined with 1/2" duct insulation. Round ductwork to VAV boxes above ceilings shall be insulated on the outside with 1/2" blanket, with continuous vapor barrier, and all sealed joints. Overlap lined duct and seal insulation to provide a continuous vapor barrier. Exhaust ductwork shall be insulated with 1/2" liner. Outside air ducts and plenums shall be lined with 2" insulation.

16. VOLUME DAMPERS

a. Furnish and install volume dampers in all branches to registers, grilles, or diffusers, and where indicated on the plans and where called for in these specifications. Dampers shall be of the multiple opposed blade, low leakage type, with no blade wider than 6". Blades shall be made of 16 gauge sheet and shall operate together by means of a tie bar. Blades shall be mounted in bearings assembled in a 1"x1/2"x1/8" channel frame, and the entire assembly shall be firmly attached to the duct. Provide accessible locking type quadrant. Mark end of shaft to indicate damper position. Dampers shall be Ruskin or equal by Pottorff, Honeywell or Johnson Controls.

b. Volume dampers may be single blade type for ducts 18"x8" and smaller. Dampers for ducts larger than 18"x8" shall be multiple opposed blade type as specified above.

17. SUPPLY REGISTERS

a. Furnish and install all aluminum supply registers where shown. Supply registers shall be of one brand throughout (unless there are specialty registers called out hereinafter) and shall be the same brand as the return air registers specified hereinafter. Registers shall be installed plumb and square with building lines and tight to surface.

b. Supply register shall be a double deflection louvered register with horizontal front louvers. Opposed blade damper not required, as balancing will be done with volume damper in the branch.

c. Register shall have a 1-1/4" border with tight fitting mitered corners (hairline joint) and with counter sunk screw holes so that screw fits flush with frame surface. The entire visible portion of the register shall have a baked flat white painted finish. The attachment screws shall be furnished with the registers and shall be 1-1/4"x #8 oval head and shall be factory painted to match the register finish. Each register shall be furnished with a sponge rubber gasket under the frame border to prevent streaking.

d. Registers shall be equal to:

Titus	300RL-5
Tuttle & Bailey	T547
Krueger	#880H
Annemostat	#S2HO
Carnes	RTDA
Metal Aire	4004S
J&J	990H
EH Price	520

18. CEILING DIFFUSERS (Louvered)

a. Contractor shall furnish and install diffusers at each point indicated on the plans. These outlets are to consist of three or more expanding flared members with an inner assembly detachable without the use of tools. The air discharge pattern shall be adjustable either radially out along the ceiling or diverging downward.

b. Adjustability of the unit shall permit changing the air discharge from horizontal to a downward discharge pattern by means of concealed deflecting tabs without changing the appearance of the unit.

c. The outer cone shall be flanged for lay-in panel type. The air diffuser shall be steel, painted white.

d. Each diffuser shall have an equalizing deflector at the diffuser. Diffuser shall have a minimum 1” neck collar.

e. Diffusers for lay-in shall be equal to:

Anemostat	EPLA
Krueger	Series 1400
Tuttle & Bailey	1300A
Carnes	SJTB
Metal Aire	5800A
J&J	1500

19. RETURN REGISTERS

a. Furnish and install all aluminum registers where shown. Registers shall be of one brand throughout (unless there are specialty registers called out hereinafter) and shall be the same brand as the supply air registers specified hereinbefore. Registers shall be installed plumb and square with building lines and tight to wall surface.

b. Register shall have a 1-1/4" border with tight fitting mitered corners (hairline joint) and with counter sunk screw holes so that screw fits flush with frame surface. The entire visible portion of the register shall have a baked flat white painted finish. The attachment screws shall be furnished with the registers and shall be 1-1/4"x #8 oval head and shall be factory painted to match the register finish. Each register shall be furnished with a sponge rubber gasket under the frame border to prevent streaking.

c. Registers shall be equal to:

Titus	#23RL
Tuttle & Bailey	T-70
Krueger	#S580H
Annemostat	#S3HOD
Carnes	RTAA
Metal Aire	SRH
EH Price	530

20. REFRIGERANT PIPING

a. Furnish and install, in accordance with manufacturer's recommendation, all refrigerant piping, fittings, valves, site glasses, hangers, and refrigeration specialties, including a filter dryer, as required to connect and put into satisfactory operation the air conditioning equipment shown. Where new condensing units are shown, refrigerant piping shall comply with this specification.

b. Furnish and install expansion valves and solenoids where required, or called for.

c. Furnish and install cartridge filter dryer.

d. Furnish and install all refrigerant and oil to fully charge the units. Further, this contractor shall furnish and install, at no additional cost, all replacement refrigerant or oil that may be required for a period of one year from date of written notice of acceptance.

e. Furnish and install Type L copper liquid and suction lines in accordance with manufacturer's recommendations. Evacuate units and charge with refrigerant and oil. Refrigerant piping shall be installed under the direct supervision of an approved refrigeration mechanic. Lines shall be purged with oil pumped nitrogen. Fittings shall be wrought copper, assembled with silver solder (1100°F). Pipe shall be ACR nitrogen filled and capped refrigerant pipe.

f. All suction piping inside the building shall be insulated with 1" thick Armaflex. Slide insulation over the piping where possible. Where absolutely necessary, the insulation may be slit. All slit pieces shall be wrapped with vaporproof tape at 12" intervals. The slits and all joints shall also be taped. Support pipes as required, and provide galvanized saddles between the insulation and the pipe hangers.

g. Support refrigerant piping with angle iron supports and U-bolts.

- h. Support refrigerant pipes on walls or joists with Unistrut channel and pipe clamps.
- i. Sleeve or core drill exterior wall for refrigerant pipes, and pack space with fiberglass and seal with GE silicone caulk.
- j. Seal wall where refrigerant pipes pass through.
- k. Support refrigerant pipes from ACCU #1 as detailed.
- l. Provide Unistrut channels attached to the wall vertically and horizontally on 5' centers and rack the refrigerant pipes on the channels using Unistrut clamps. Provide Armoflex pipe insulation under the clamps.

21. LOUVER

- a. Wall louver shall be natural finish, extruded aluminum, factory built, 6" depth without flange, 0.100 frame, 0.081" stormproof blades set at 37-1/2° angle, with framed aluminum bird screen mounted on inside, manufactured by Ruskin, or equal by Air Balance, Penn, or Airlite. Blades shall have weather lip at edge and moisture eliminator baffle centered full length. Large louvers shall have concealed mullions. Color of louvers shall be as selected by the Architect.
- b. Set louver 1/4" back from face of wall. Where louver enters wall, make tight by sealing with GE silicone.
- c. Provide special wall sleeve through building, as required, to adapt to fit wall panel.
- d. Louvers to have baked enamel finish of color selected by architect.
- e. Coordinate openings in wall with general contractor who will furnish and install steel lintels. Make weathertight installation using GE silicone caulk.

22. CUTTING AND PATCHING

- a. This contractor shall do all cutting, patching and repairing of existing building, necessary to install new ductwork, piping, and equipment, and as required to modify or change existing ductwork to allow for the new addition. Where necessary for this contractor provide openings, holes shall be neatly cut and repaired to the satisfaction of the engineer. Offset ductwork as required to avoid obstructions. Holes in concrete or masonry or stone shall be drilled with core drill. Where ducts pass through existing walls and floors, neatly patch opening around ducts and pack with 3M Fire Barrier so that there can be no smoke migration.
- b. The general contractor shall provide finished painting to match adjoining finish in all areas where cutting and patching is required. Remove and replace ceiling tile where required to install system. Any soiled or damaged ceiling tile caused by this contractor shall be replaced. Ceiling suspension system shall not be damaged. Any wires that must be removed shall be replaced in approved manner. Coordinate any work in existing areas with general contractor.

c. Where necessary to cut into existing ceilings or floors, this contractor shall patch as required to maintain the fire barrier.

23. CLEANING, TESTING AND ADJUSTING SYSTEMS (HVAC)

a. All ducts and equipment shall be thoroughly cleaned, both inside and outside.

b. The sheet metal contractor shall retain the services of an independent NEBB or AABC certified balance contractor to test and balance all systems. Submit qualifications of the testing and balancing subcontractor to the engineer for review.

c. A complete test shall be made of each system, adjusting fan speed, dampers and registers so as to get the air flow called for on the plans. Pulleys shall be adjusted or changed so as to get the total air flow from each fan unit. Any additional dampers which may be required to balance the system shall be furnished and installed by this contractor. After balancing each system, the contractor shall take readings of the air flow from each opening and submit the tabulation to the engineer for approval. Tabulation shall show register size, required CFM, measured velocity and actual CFM. Balance report shall be included in O&M Manuals.

d. All equipment requiring lubrication shall be oiled or greased in accordance with the manufacturer's instructions prior to turning the job over to the owner.

e. Prior to final acceptance, this contractor shall remove all packing crates, rubbish and debris from the site and leave the building in neat, clean condition. Remove all shipping, invoice and packing slip labels, etc.

f. This contractor shall work with the temperature control contractor and plumbing contractor to balance the air flow and temperature drops in air systems.

24. COORDINATION AND COOPERATION AMONG TRADES

a. Contractors shall not install their material without consideration for other trades on the basis of "we were here first". The drawings are generally schematic; in congested areas plumbing waste lines and ductwork would have first priority over other pipes and conduits. Should pipes, conduits or ducts be installed without regard to other trades, they shall be relocated without cost, as instructed by the engineer so as to permit all trades to install their material, so as to maintain maximum headroom and clearance, and to obtain the most desirable installation as determined by the engineer.

b. This contractor shall confer with the electrical contractor to make sure pipe and ducts permit installation of recessed light fixtures and shall work with the ceiling contractor to work out any conflicts with the ceiling tile or suspension system before permanently locating any ducts, ceiling diffuser, registers, or grilles.

c. Coordinate duct layout with pertinent contractors.

25. SHOP DRAWINGS

a. This contractor shall furnish, for approval, three (3) **hard copies** and one (1) electronic copy of certified shop drawings on all equipment to be furnished under this contract. Three (3) **hard copies** of all such drawings will be retained for the engineer's use. Prior to submitting drawings for approval, the contractor shall check to see that the equipment meets the specifications, that sizes and quantities are correct, and shall stamp or sign his approval and job name and location. All shop drawings shall be sent to:

HKG
524 S. ARCH STREET
ABERDEEN, SD 57401

b. The contractor shall be responsible for fitting equipment in the space available and verifying all dimensions.

c. If equipment submitted for approval varies from that specified, all variations shall be specifically noted on the drawings; failure to do so will be cause, at the option of the engineer, to reject the equipment even though the incomplete shop drawings were approved.

d. Shop drawings of equipment shall be specifically for this job. Catalog sheets of various components will not be acceptable. Shop drawings shall show specific arrangement of components for this job, overall dimensions, weights, electrical characteristics, required clearances, motor locations, number and type of filter, etc., job name and location.

e. All shop drawings shall be submitted at one time and within 45 days after award of contract.

f. In general, equipment is specified by brand name, with several "equals" listed. Where one of the "equal" brands is used, or if an "equal" brand is approved by addenda and used by the contractor, he shall verify the space and other requirements of the "equal" brand used, and shall be responsible for all additional costs created by using the "equal" brand.

26. GUARANTEE

a. The equipment is to be guaranteed to operate in a quiet, satisfactory manner under specified conditions.

b. It is to be further guaranteed that the true intent and scope of the plans and specifications will be fulfilled.

c. All equipment bearing a manufacturer's guarantee, such as motors, controls, etc., shall be construed to have an extended guarantee to the owner by the manufacturer. Any such equipment that shows defective material or workmanship within the guarantee period is to be replaced by this contractor in accordance with the manufacturer's guarantee.

d. Any defective material or workmanship that is not involved in the manufacturer's guarantee but forms a part of the system, that shows such defects within one year, is to be replaced by this contractor without charge to the owner.