

SECTION 15950 - HVAC CONTROLS AND SEQUENCE OF OPERATIONS

City of San Diego, CWP Guidelines

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing equipment and devices required for a complete HVAC control system, including electrical devices, and the following:
 - 1. Control system consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories required to operate mechanical systems, and to perform functions indicated.
 - 2. Pneumatic automatic temperature control systems with electric accessories.
 - 3. Sequence of operations for the HVAC equipment indicated.

1.2 RELATED SECTIONS

- A. The WORK of the following Sections applies to the WORK of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this WORK.
 - 1. Section 11000 Equipment General Provisions
 - 2. Section 15000 Piping Components
 - 3. Section 15050 Vibration Isolation
 - 4. Section 15410 Plumbing Piping
 - 5. Section 15550 Water Tube Boilers and Accessories
 - 6. Section 15750 Packaged Equipment
 - 7. Section 15855 Air Handling and Moving Equipment
 - 8. Section 15880 Air Distribution Devices and Accessories
 - 9. Section 15990 Testing, Adjusting and Balancing

1.3 CODES

- A. The WORK of this Section shall comply with the current editions of the following codes as adopted by the City of San Diego Municipal Code:
 - 1. Uniform Mechanical Code

1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:
 - 1. AMCA 500 Test Methods for Louvers, Dampers and Shutters
 - 2. ANSI/ASME B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

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|-----|---------------|--|
| 3. | ANSI/ASTM B32 | Solder Metal |
| 4. | ANSI/NEMA 250 | Enclosures for Electrical Equipment (1000 Volts Maximum) |
| 5. | ANSI/NFPA 90A | Installation of Air Conditioning and Ventilation Systems |
| 6. | ASTM B280 | Seamless Copper Tube for Air Conditioning and Refrigeration Field Service |
| 7. | ASTM D1693 | Environmental Stress - Cracking of Ethylene Plastics |
| 8. | FS-GG-G-76 | Gauges, Pressure and Vacuum, Dial Indicating (for Air, Steam, Oil, Water, Ammonia, Chloro-Fluorohydrocarbon Bases, and Compressed Gases) |
| 9. | FS-QQ-S-571 | Solder, Tin Alloy; Tin-Lead Alloy; and Lead Alloy |
| 10. | MIL-F-18280 | Fittings, Flareless Tube, Fluid Connection |
| 11. | MIL-S-29175 | Switch, Thermostatic, Low Voltage, Non-(Setback/Setup) and Setback/Setup, Limiting |
| 12. | NEMA DC 3 | Low-Voltage Room Thermostats |

1.5 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted in compliance with Section 01300 in addition to the requirements of Section 11000:
1. Shop drawings indicating complete operating data, system drawings, wiring diagrams, and written detailed operational description of sequences; and arrangement, velocities, and static pressure drops, where automatic dampers are indicated, for each system.
 2. Product data including description and engineering data for each control system components.
 3. [Two] [] samples of [each type of room thermostat and cover] [thermostat guard] [each exposed control component].

1.6 PROJECT RECORD DOCUMENTS

- A. The following shall be included in the PROJECT RECORD DOCUMENTS in compliance with Section 01300:
1. Accurate record of actual location of control components, including panels, thermostats, and sensors.
 2. Revised shop drawings reflecting actual installation and operating sequences.

1.7 OWNER'S MANUAL

- A. The following shall be included in the OWNER'S MANUAL in compliance with Section 01300:
1. Systems descriptions, set points, and controls settings and adjustments.
 2. Field reports indicating operating conditions after detailed check out of systems at Date of Substantial Completion.
 3. Inspection period, cleaning methods, recommended cleaning materials and calibration tolerances

1.8 QUALIFICATIONS

- A. The manufacturer and installer shall comply with the following:
1. Manufacturer: Company specializing in manufacturing the products indicated in this Section.
 2. Installer: Company specializing in installing the WORK of this Section and approved by manufacturer.

1.9 SEQUENCING AND SCHEDULING

- A. Installation of system components shall be coordinated with installation of mechanical systems equipment including air handling units, [packaged] air conditioning equipment and air terminal units.

1.10 MAINTENANCE SERVICE

- A. The WORK of this Section includes:
1. Service and maintenance of automatic controls system for [one] [] year from Date of Substantial Completion.
 2. [Two] [Four] [] complete inspections, to inspect, calibrate, and adjust controls as required, and submit written reports.

PART 2 -- PRODUCTS

2.1 PNEUMATIC AIR SUPPLY

- A. The pneumatic air supply system shall include the following:
1. Air Supply and Receiver: [simplex] [duplex] belt driven air compressors and tank with belt guard, silencers, flexible connections, air filters, automatic and manual drain assemblies, oil and particle filter for minimum 0.5 micron particles, pressure reducing valves, and pressure relief valves. Compressors and storage tanks shall be sized to limit compressor starts to maximum [10] [] per hour and [50] [30] percent running time.

2. Pressure Control: zinc or aluminum castings, rated for service with elastomeric diaphragm, adjustable electric contacts, set to start and stop compressor at [50 and 65 psig] [60 and 80 psig] [70 and 90 psig] [100 and 125 psig][,] [and second compressor at [50 and 65 psig] [60 and 80 psig] [70 and 90 psig]].
3. Electrical Alternation Set: with motor starters to operate compressors [alternately] [on time schedule].
- [4. Pressure Regulators: rated for service with elastomeric diaphragm, balanced construction to automatically prevent pressure buildup, and producing flat, reduced pressure curve for system capacity demand.]
- [5. Particle Filters: rated for service with threaded connections, quick-disconnect service devices, aluminum bowl or plastic bowl with metal guard equipped with manual draincock, to separate liquid and solid particles.]
- [6. Combination/Filter/Regulators: rated for service with elastomeric diaphragm, designed and constructed to automatically prevent pressure buildup, and to produce flat, reduced pressure curve for system capacity demand; with threaded pipe connections, quick-disconnect service devices, aluminum bowl or plastic bowl with metal guard equipped with manual draincock to separate liquid and solid particles.]
7. Airborne Oil Filter: rated for service with filtration efficiencies of 99.9 percent for particles of 0.025 micron or larger of airborne lubricating oil.
8. Pressure Relief Valves: ASME Code Rated and Labeled for high pressure side and sized for installed capacity of pressure regulators at low pressure; valves shall be set at maximum 20 percent above low pressure.

2.2 CONTROL AND INSTRUMENTATION TUBING

A. Control and instrumentation tubing, fittings and joints shall comply with the following:

1. Copper Tubing: ASTM B280, Type K, seamless, hard drawn or annealed.
 Fittings: ANSI/ASME B16.22, wrought copper, solder type.
 Joints: ANSI/ASTM B32 [or FS QQ-S-571 alloy 58-5] [95-5] [60-4] tin antimony.
2. Copper Tubing: ASTM B280, Type K, seamless, hard drawn or annealed.
 Fittings: UL approved [to MIL-F-18280] rod or forged brass rated to 200 psig at 100 degrees F (1380 kPa at 38 degrees C).
 Joints: ball sleeve compression type.
3. Polyethylene Tubing: Black, flame retardant, virgin polyethylene, conforming to modified ASTM D1693 test.
 Fittings: UL approved [to MIL-F-18280] rod or forged brass rated to 200 psig at 100 degrees F (1380 kPa at 38 degrees C).
 Joints: Compression or barbed type.

2.3 REFRIGERATED AIR DRYER

A. The refrigerated air dryer shall comply with the following:

1. Dryers: commercial quality, refrigerated, compressed air dryer complete with heat exchangers, moisture separator, and internal wiring and piping and including air inlet and outlet connections connected through manual by-pass valve.
2. Heat Exchangers: air to refrigerant coils including centrifugal type moisture separator located at discharge of compressed air complete with automatic trap assembly; and with automatic control system to bypass refrigeration system on low or no load conditions.
3. Refrigeration Unit: hermetically sealed, operating to maintain dew point of [5] [13] [] degrees F at 20 psig and housed in steel cabinet with access door and panel.
4. Accessories: air inlet temperature gauge, air inlet pressure gauge, on/off switch, high temperature light, power on light, refrigeration gauge, air outlet temperature gauge, air outlet pressure gauge.

2.4 THERMOSTATS

A. Control systems shall include the following:

1. Pneumatic Room Thermostats: adjustable proportioning type, [single] [dual] setpoint, containing [single bimetallic element for heating or cooling only] [dual bimetallic elements for] [heating and cooling] [day or night], minimum 10 degrees F set point adjustment[;] [and] adjustable dead band[;] and including locking covers with [set point adjustment,] [setpoint indication,] [concealed setpoint,] [with thermometer.] [without thermometer.]
2. Room Thermostat Accessories:
 - Thermostat Covers: [brushed aluminum.] [] .]
 - Insulating Bases: for thermostats located on exterior walls.
 - Thermostat Guards: [metal] [locking transparent plastic] [] mounted on separate base.
 - Adjusting Key: as required for thermostat.
3. Outdoor Reset Thermostat: remote bulb or bimetal rod and tube type, for proportioning action with adjustable throttling range; scale range of [-10 to 70 degrees F [] with adjustable setpoint.
4. Immersion Thermostat: remote bulb or bimetallic rod and tube type, for proportional action with adjustable setpoint and adjustable throttling range.
5. Airstream Thermostats: remote bulb or bimetallic rod and tube type, for proportional action with adjustable setpoint in middle of range and adjustable throttling range.
6. Fire Thermostats: UL approved and listed, factory set in accordance with ANSI/NFPA 90A with normally closed contacts, manual reset.

7. Heating/Cooling Valve Top Thermostats: proportional acting for proportional flow, molded rubber diaphragm, [remote bulb] liquid filled element, direct and reverse acting at differential pressures to 25 psig, cast housing with position indicator and adjusting knob.

2.5 CONTROL VALVES

- A. Control valves shall comply with the following:

1. Globe Pattern:

Up to 2 inches: bronze body, bronze trim, rising stem, renewable composition disc, screwed ends[,] [with backseating capacity repackable under pressure].

Over 2 inches: iron body, bronze trim, rising stem, plug-type disc, flanged ends, renewable seat and disc.

2. Butterfly Pattern: iron body, [bronze] [aluminum bronze] [stainless steel] disc, resilient replaceable seat for service to [180 degrees F] [250 degrees F] wafer or long ends, extended neck.

3. Operators:

Rolling diaphragm, spring loaded, piston type with spring range [2 to 5 psig] [3 to 10 psig] [8 to 11 psig] [as indicated].

Valves shall spring return to normal position as indicated on freeze, fire, or temperature protection.

4. Hydronic Systems:

Rated for service pressure of 125 [] psig at 250 degrees F.

Replaceable plugs and seats of [stainless steel] [brass].

Sized for [3] [] psig maximum pressure drop at design flow rate.

Two way valves shall have equal percentage characteristics and three way valves shall have linear characteristics. Two way valve operators shall be sized to close valves against pump shut-off head.

2.6 DAMPERS

- A. Dampers shall comply with the following:

1. Performance: tested in accordance with AMCA 500.

2. Frames: [galvanized steel] [extruded aluminum] [rolled corner steel] [stainless steel], welded or riveted with corner reinforcement.

3. Blades: [galvanized steel] [extruded aluminum] [rolled carbon steel] [stainless steel], maximum blade size [] inches wide, [] inches long, attached to minimum 1/2 inch shafts with set screws.

4. Blade Seals: [synthetic elastomeric] [neoprene] [inflatable] mechanically attached, field replaceable.

5. Jamb Seals: stainless steel.
6. Shaft Bearings: [oil impregnated sintered bronze or graphite impregnated nylon sleeve, with thrust washers at bearings;] [lubricant free, stainless steel, single row, unground, flanged, radial, antifriction type with extended inner race.]
7. Linkage Bearings: oil impregnated sintered bronze or graphite impregnated nylon.
8. Leakage: less than [one] [1/2] percent based on approach velocity of 2000 ft/min and 4 inches wg.
9. Maximum Pressure Differential: [] [6] inches wg.
10. Temperature Limits: -40 to 200 degrees F.

2.7 TIME CLOCKS

A. Time clocks shall be:

- [1. Seven day programming switch timer with synchronous timing motor and seven day dial, continuously charged Ni-cad battery driven power failure 8 hour carry over and multiple switch trippers to control systems for minimum of two and maximum of eight signals per day with two normally open and two normally closed output switches.]
- [1. Solid state programmable time control with [] separate programs, 24 hour battery carry over[,] [.] [duty cycling] [individual on/off/auto switches for each program] [7 day programming] [365 day calendar with 20 programmable holidays] [choice of fail safe operation for each program] [system fault alarm].]

2.8 WATER TEMPERATURE CONTROLLERS

- ### A. Controllers shall operate by adjustable differential over adjustable temperature range and shall be suitable for operating control valve indicated.

2.9 DAMPER OPERATIONS

A. Damper operators shall comply with the following:

1. General: smooth proportional control with sufficient power for air velocities 20 percent greater than maximum design velocity and constructed to provide tight seal against maximum system pressures; with spring return for two position control and for fail safe operation.
2. Pneumatic Operators: rolling diaphragm piston type[.] [with adjustable stops.]
3. Pilot Positioners: starting point adjustable from [] [2] to [] [12] psig and operating span adjustable from [] [5] to [] [13] psig.
4. Electric Operators: split phase type with oil immersed gear train.

5. Number: sufficient to achieve unrestricted movement throughout damper range; [and one damper operator for maximum 36 sq ft damper section.]
6. Inlet Vane Operators: high pressure with pilot positioners and sufficient force to move vanes when fan is started with vanes in closed position; and designed to return to closed position on fan shutdown.

2.10 TRANSMITTERS

A. Transmitters shall comply with the following:

1. Building Static Pressure Transmitter: one pipe, [direct acting, double bell,] differential type with temperature compensation, scale range [] [0.01] to [] [6.0] inch wg positive or negative, and sensitivity of 0.0005 inch wg and designed to transmit [electronic] [pneumatic] output.
2. Pressure Transmitters: one pipe direct acting [indicating type] for gas, liquid, range suitable for system, proportional [electronic] [pneumatic] output.
3. Temperature Transmitters: one pipe, directly proportional output signal to measure variable linearity within plus or minus 1/2 percent of range for [] [200] degree F span and plus or minus one percent for [] [50] degree F span, with [] [50,] [100,] or [200] degree F temperature range, compensated bulb, averaging capillary, or rod and tube operating on [] [20] psig input pressure and [] [3] to [] [15] psig output.

2.11 RECEIVER CONTROLLERS

A. Controllers shall comply with the following:

1. Controllers shall be single or dual input models [with control point adjustment] direct or reverse acting with mechanical set point adjustment [with locking device], and proportional band adjustment and with [proportional] [proportional plus integral] control mode.
2. Remote control point adjustment shall be plus or minus [20] [] percent of sensor span, input signal [3 to 13 psig] [1 to 20 psig].
3. Proportional band shall extend from 2-1/2 to 40 percent of primary sensor span.
4. Controllers shall be suitable for supply air pressure of [18 psig] [20 psig] with input signals of [3 to 15 psig] [1 to 20 psig] and output signal 0 to [15 psig] [20 psig].

2.12 PNEUMATIC SYSTEMS ACCESSORIES

A. Control systems shall include:

1. Pressure Gauges: manufacturer's standard [to FS-GG-G-76], black letters on white background, [3-1/2 inch] [2-1/2 inch] [2 inch] diameter, flush or surface mounted, with [front calibration screw,] suitable dial range calibrated to match sensor, in appropriate units.

2. Instrument Pressure Gauges: manufacturer's standard [to FS-GG-G-76], black letters on white background, [2 inch] [1-1/2 inch] diameter, stem mounted with suitable dial range.
3. Diaphragm Control and Instrument Valves: 1/4 and 3/8 inch forged brass body with reinforced teflon diaphragm, stainless steel spring, and color coded phenolic handle.
4. Gauge Cocks: tee or lever handle, bronze, rated for 125 psig.
5. Relays: for summing, reversing, amplifying, highest or lowest pressure selection, with fixed 1:1 [or adjustable] input/output ration.
6. Switches: with indicating plates, accessible adjustment, calibrated and marked.

2.13 CONTROL PANELS

A. Control panels shall comply with the following:

1. Type: unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, pushbuttons and switches flush on cabinet panel face.
2. Standards: ANSI/NEMA 250, general purpose utility enclosures with enamelled finished face panel.

2.14 ALARM SYSTEM

A. Alarm panels shall comply with the following:

1. Alarm panel shall include individual indication, horn, silenced acknowledge switch, and test switch.
2. At any alarm condition, indication light shall flash and alarm shall sound; horn shall be stopped by depressing acknowledge switch and shall indicate alarm conditions by a continuous light until trouble condition has cleared; alarm shall sound again should second alarm occur before first one has cleared.
3. Remote panels, where indicated, shall include indication horn, activated by any alarm and alarm silence/acknowledge switch such that alarm can be acknowledged from master and remote panel.
4. Panels shall be located as indicated to serve duplicate functions of primary panel and shall include alarm silence/acknowledge switch such that alarm can be acknowledged from any panel.
5. Dry contacts shall be included at main alarm panel for use by independent alarm monitoring company to indicate [each] alarm condition.

2.15 MANUFACTURERS

- A. Products shall be manufactured by one of the following (or equal):
1. General Controls
 2. Honeywell
 3. Johnson Controls Co.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. **General:** Controls and components shall be installed in accordance with the manufacturer's written installation instructions and as follows:
1. Compressor and tank shall be mounted on vibration isolation[.] [consisting of springs, with minimum [1 inch] [2 inches] static deflection and one inch clearance to floor.] Air supply shall be isolated with wire-braid reinforced rubber hose[.] [or polyethylene tubing.]
 2. Instrument air shall be supplied from compressors through filter, pressure reducing valve, pressure relief valve, with pressure gauges, and shutoff and bypass valves.
 3. Pressure reducing stations consisting of pressure reducing valve, particle filter, valved bypass, pressure gauge on inlet and outlet, and pressure relief valve shall be installed.
 4. Refrigerated air dryer shall be located in discharge air line from tank; dryer shall be mounted on wall on rubber in shear mounts; pressure regulator shall be installed downstream of dryer; and automatic drain shall be piped to nearest floor drain.
 5. Copper tubing shall be installed in mechanical rooms, where subject to damage or temperatures in excess of 200 degrees F, where adjacent to heating pipes passing through common sleeve and where not readily accessible; in mechanical rooms, bundled plastic tubing with suitable junction boxes or single plastic tubing with tray or raceway may be used.
 6. Tubing shall be concealed and exposed only in mechanical rooms, storage rooms and like, in neat manner and shall be properly supported.
 7. Tubing shall be attached to supporting surfaces; sleeve shall be provided through concrete surfaces in minimum one inch sleeves, extended 6 inches above floors and 1 inch below bottom surface of slabs.
 8. Tubing shall be purged with dry, oil-free compressed air before connecting control instruments.
 9. [Pressure gauges] [Test plugs] shall be installed on branch lines at each receiver controller and signal lines at each transmitter excepting individual room controllers.

10. Location of thermostats and other exposed control sensors shall be verified with plans and room details before installation; room thermostats shall be located [60 inches] [48 inches] [42 inches] above floor; lighting switches shall be aligned.
11. Freeze protection thermostats shall be mounted using flanges and element holders.
12. Outdoor reset thermostats shall be mounted with sensing elements outdoors[.] [with sun shield.]
13. Separable sockets shall be installed for liquids and flanges for air bulb elements.
14. Guards shall be located on thermostats in entrance hallways [and other public areas.] [and where indicated.]
15. Control panels shall be mounted adjacent to associated equipment on vibration free walls or free standing angle iron supports. One cabinet may accommodate more than one system in same equipment room but shall include engraved plastic nameplates for instruments and controls inside cabinet and engraved lamicoid nameplates on cabinet face.
16. "Hand/off/auto" selector switches shall be installed to over-ride automatic interlock controls when switch is in "hand" position.
17. Conduit and electrical wiring shall be installed where required.
18. After completion of installation, control equipment shall be tested and adjusted.
19. Pneumatic systems shall be tested to system pressure maximum of [] [30] psig and calibration of instruments shall be checked.

3.2 SEQUENCE OF OPERATIONS

- A. Control systems shall be installed to provide for the Sequence of Operations indicated.
- B. Fan Coil Units:

- [1. [Single] [Dual] temperature thermostat set at [75] [] degrees F shall maintain constant space temperature [during the day and [15] [] degrees F cooler at night] by [modulating] [opening and closing] two-way control heating valve [with spring range of 3 to 7 psig] [and two-way cooling control valve] [with spring range of 8 to 13 psig] in sequence.]
- [2. [Single] [Dual] temperature thermostat set at [75] [] degrees F shall maintain constant space temperature [during the day and [15] [] degrees F cooler at night] by modulating four-way control valve; during heating cycle, thermostat shall modulate hot water supply to coil and divert return water to heating return pipe; during cooling cycle, thermostat shall modulate chilled water supply to coil and divert return water to cooling return pipe; when space temperature is at thermostat setting, flow shall be prevented from occurring in either circuit and in coil.]

3. Change over from heating to cooling shall be by indexing thermostat from thermostat on supply piping; when supply is above room temperature, thermostat shall operate in direct acting manner, opening valve when temperature falls below thermostat setting; when supply is below room temperature, thermostat shall operate in reverse acting manner, opening valve when space temperature rises above thermostat setting.
4. For heating and cooling fan coil units with fan speed control during heating cycle, fan speed shall increase as space temperature falls below thermostat setting when hot water is available; during cooling cycle, fan speed shall increase as space temperature rises above thermostat setting when chilled water is available.
5. Thermostat with adjustable knob and speed switch shall be mounted on common plate with "Heating Control and Fan Control" on top, with "Warmer and Cooler".

C. Electrical Rooms and Telephone Rooms:

1. On room temperatures above [95] [] degrees F [intake dampers shall open and] exhaust fans shall start.

D. Elevator Machine Rooms:

- [1. On room temperatures above [85] [] degrees F, intake dampers shall open and exhaust fan shall start.
- [2. On room temperatures above [90] [] degrees F, audible alarm shall signal].

E. Emergency Generator:

1. Air Cooled Generator

When generator is "off", outside and exhaust dampers shall be closed and recirculation damper shall be open.

When generator is "on", dampers shall be controlled and operate with outside and exhaust dampers opening, and recirculating dampers closing, to maintain room temperature of [85] [] degrees F.

2. Water Cooled Generator

On room temperatures above [95] [] degrees F intake dampers shall open and exhaust fans shall start.

F. Unit Heaters:

1. Hot Water Coils

Single temperature electric room thermostat shall maintain constant space temperature of [68] [] degrees F by cycling unit fan motor.

Single temperature thermostat on return heating water line [from floor mounted cabinet heaters] shall de-energize unit on temperatures below [95] [] degrees F.

2. Electric Space Heaters

Single temperature room thermostat set at [68] [] degrees F shall maintain constant space temperature by cycling unit fan motor and energizing electric heating elements.

G. Terminal Air Units:

1. Constant Volume

[Single] [dual] temperature thermostat set at [75] [] degrees F shall maintain constant space temperature [during the day and [15] [] degrees F cooler at night] by [modulating] [opening and closing] two-way control heating valve [with spring range of] [3 to 7 psig] [3 to 13 psig.]

2. Variable Air Volume

[Single] [Dual] temperature thermostat set at [75] [] degrees F shall maintain constant space temperature by modulating variable volume damper operator.

H. Heating Water Zone Control:

1. Hot Water Pump

[Flow] [Pressure] switch in heating pump discharge shall indicate "on/off".

2. Indoor/Outdoor Controller

Heating water shall control supply temperature [set at [195] [] degrees F] [in accordance with outdoor reset schedule] by modulating heating water control valve.

3. Outdoor Reset

Heating water shall be controlled at maximum [195] [] degrees F at outdoor temperature of [] degrees F, and minimum [130] [] degrees F at outdoor temperature of [75] [] degrees F, with straight line relationship.

I. Heating and Cooling With 4-Way Control Valve:

1. [Single] [Dual] temperature thermostat set at [75] [] degrees F shall maintain constant space temperature [during the day and [15] [] degrees F cooler at night] by modulating four-way control valve; during heating cycle, hot water supply to coil shall be modulated and return water shall be diverted to heating return pipe; during cooling cycle, chilled water supply shall be modulated to coil and return water shall be diverted to cooling return pipe; when space temperature is at

thermostat setting, flow shall be prevented from occurring in either circuit and in coil.

2. Change over from heating to cooling shall be by indexing thermostat from aquastat on supply piping; when supply is above room temperature, thermostat shall operate in direct acting manner, opening valve when temperature falls below thermostat setting; when supply is below room temperature, thermostat shall operate in reverse acting manner, opening valve when space temperature rises above thermostat setting.
3. Single temperature room thermostat set at [75] [] degrees F shall maintain constant space temperature by [energizing] [staging] [modulating electric output through action at SCR power controller, to] electric heaters.

J. VENTILATION SYSTEMS IN CORROSIVE ENVIRONMENTS

1. Where corrosive environments (including process areas using chlorine, sulfur dioxide and hydrogen sulfide) are indicated, ventilation systems shall comply with the following:

Gas monitor shall activate audible alarms located both adjacent to process areas and in Administration Area.

Gas monitor shall signal light in control panel in Administration Building.

3.3 CONTROL DAMPER AND CONTROL VALVE SCHEDULES

- A. Control dampers shall comply with the requirements indicated on the attached Control Damper Schedule.
- B. Control valves shall comply with the requirements indicated on the attached Control Valve Schedule.

3.4 DEMONSTRATION

- A. The WORK of this Section includes demonstration to the OWNER and CONSTRUCTION MANAGER of complete operation of systems, including sequence of Operation after Date of Substantial Completion.

** END OF SECTION **

CONTROL DAMPER SCHEDULE

Equipment I.D. Number

[CD-1]

[CD-2]

Drawing Reference

Location

Height, inch

Width, inch

Air Flow, CFM

Air Pressure Drop, inch wg

Damper Operator

CONTROL VALVE SCHEDULE

Equipment I.D. Number

[CV-1]

[CV-2]

Drawing Reference

Location

Valve Size, inch

Valve CV

Operator Spring Range

Normal Position

Valve Operator