

SECTION 15940

SEQUENCE OF OPERATION FOR HVAC CONTROLS

PART 1 –GENERAL

1.1 SUMMARY

A. Section includes sequence of operation for:

1. Cabinet Heaters.
2. Central refrigeration systems.
3. Central fan systems.
4. Combustion air unit heaters.
5. Exhaust fans.
6. Wall louver dampers.
7. Excess pressure controls.
8. Fan coil units.
9. Heating Coils.
10. Heating water zone control.
11. Humidifiers.
12. Induction units.
13. Parking garage ventilation systems.
14. Radiant panels.
15. Radiation [and convectors].
16. Refrigeration systems.
17. Terminal air units.
18. Unit heaters.

1.2 SUBMITTALS

A. Section 01330 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate mechanical system controlled and control system components.

1. Label with settings, adjustable range of control and limits. Include written description of control sequence.
2. Include flow diagrams for each control system, graphically depicting control logic.
3. Include draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.

1.3 CLOSEOUT SUBMITTALS

- A. Section 01770 - Execution Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of components and set points of controls, including changes to sequences made after submission of shop drawings.

1.4 QUALIFICATIONS

- A. Installer: Company specializing in performing work of this section with minimum three years documented experience.

PART 2 –PRODUCTS

2.1 NOT USED

PART 3 –EXECUTION

3.1 CABINET HEATERS

- A. Single temperature electric or pneumatic thermostat mounted as noted on plan set at 68 degrees F maintains constant space temperature. Modulating 2 way valve. Fan speed switch tied to control valve to shut valves when fan is in off position.

3.2 CENTRAL REFRIGERATION SYSTEMS

- A. Time Schedule: Start and stop condensing water pump.
- B. Condensing Water Pump: Allow start on proof of water in cooling tower sump and on outdoor temperature above 50 degrees F. Start on demand from ventilation system.
- C. Energize chilled water pump to start and allow cooling tower fans to start when condensing water pump started
- D. When chilled water pump starts, open chiller control valve. Modulate chiller control valve to maintain constant flow through chiller.
- E. When flow switches prove chilled water flow and condensing water flow, allow refrigeration machine to start.
- F. Maintain minimum condenser water temperature of 75 degrees by modulating tower bypass valve and cycling cooling tower fans.

G. Display:

1. System graphic.
2. Condensing water pump on/off indication.
3. Chilled water pump on/off switch.
4. Chiller on/off indication.
5. Condensing-water temperature - supply and return.
6. Chilled-water temperature - supply and return.
7. Chiller condensing-water control point adjustment.
8. Common chilled-water control point adjustment.
9. Low level cooling tower sump alarm.
10. Expansion tank low-level alarm.
11. Cooling tower fan on/off indication.
12. Cooling tower sump heater on/off indication.
13. Cooling tower dump indication.
14. Chilled water control point adjustment.
15. Condensing water pump on/off auto switch.
16. Chilled water pump on/off/auto switch.
17. Chiller on/off auto switch.

3.3 CENTRAL FAN SYSTEMS

A. Time Schedule: Start and stop supply and return fans. Determine fan status by pressure differential switches. If fan fails to start as commanded, signal EMCS.

B. Safety Devices:

1. Freeze Protection: Stop fans and close outside air dampers if temperature downstream of preheat coil is below 37 degrees F signal EMCS.
2. Smoke Detector: Stop fans, close outside dampers, and close smoke dampers if smoke is detected; signal alarm.

C. Preheat Coil:

1. When fan is not running, close outside air dampers.
2. When fan is running, maintain constant supply air temperature of 55 degrees F by modulating preheat coil valve.

D. Outside, Return, and Relief Dampers:

1. When supply fan is not running, outside and relief dampers are closed and return damper is open.
2. When supply fan is running, dampers are controlled and operate with outside and relief dampers opening, and return damper closing.
3. For cooling and outside air temperatures below 55 degrees, modulate dampers to maintain mixed or supply air temperature of 55 degrees.
4. For cooling and outside air temperatures above 55 degrees F outside and relief dampers are open and return damper is closed.

5. For cooling and outside air temperatures above 55 degrees compare return and outside air enthalpies. If return air enthalpy is lower, drive outside damper to minimum, close relief damper, and open return damper.
6. For outside air temperatures above 79 degrees, drive outside damper to minimum, close relief damper, and open return damper.
7. For heating, drive outside damper to minimum, close relief damper, and open return damper.
8. Modulate mixed air dampers preheat coil valve and face and bypass dampers or cooling coil valve in sequence to maintain air temperature.

E. Multizone System:

1. Space sensor Single or Dual temperature room thermostat set at 75 degrees F summer and 68 degrees F winter maintains constant space temperature during the day and 15 degrees F cooler at night by modulating zone dampers.
2. Room with highest heating demand modulates heating coil valve. Room thermostat with highest cooling demand modulates cooling coil valve.

F. Dual Duct System:

1. Control hot deck by modulating heating coil valve in accordance with outdoor temperature reset schedule.
2. Control hot deck at maximum 135 degrees F at outdoor temperature of - 30 degrees F and minimum 75 degrees F at outdoor temperature of 75 degrees F, with straight line relationship between.
3. Maintain constant cold deck temperature of 55 degrees F by modulating cooling coil valve.
4. Reset hot and cold deck temperatures. Room thermostat with highest heating demand resets hot deck control temperature. Room thermostat with highest cooling demand resets cold deck control temperature.

G. Induction System:

1. Control hot deck by modulating heating coil valve in accordance with outdoor temperature reset schedule.
2. Control zone temperature at maximum 135 degrees F at outdoor temperature of 30 degrees F, and minimum 55 degrees F at outdoor [solar compensated] temperature of 75 degrees F. Use a straight-line relationship between the high and low temperatures.
3. Maintain constant supply static pressure of 1.5 inches wg by modulating V.F.D. on supply fans. Maintain constant building pressure of 0.05 by modulating V.F.D. on return fan.

H. Display:

1. System graphic.
2. System on/off indication.
3. System day/night mode.

4. System fan on/off indication.
5. Return fan on/off indication.
6. Preheat coil pump on/off indication.
7. Spray pump on/off indication.
8. Outside air temperature indication.
9. Mixed air temperature indication.
10. Fan discharge air temperature indication.
11. Reheat zone air temperature indication
12. Return humidity indication.
13. Fan discharge temperature control point adjustment.
14. Return humidity control point adjustment.
15. Reheat zone control point adjustment.
16. Supply static pressure indication.
17. Supply static pressure control point adjustment.
18. Building static pressure indication.
19. Building static pressure control point adjustment.
20. System on/off auto switch.
21. System day/night/auto switch.
22. Supply fan on/off switch.
23. Return fan on/off/auto switch.
24. Preheat coil pump on/off switch.
25. Spray pump on/off auto switch.

3.4 COMBUSTION AIR UNIT HEATERS

- A. Single temperature room thermostat set at 68 degrees F maintains constant room temperature by modulating two-way heating control valve.
- B. Single temperature thermostat on return heating water line de-energizes unit fan on temperature below 95 degrees F.

3.5 EXHAUST FANS

- A. On room temperature above 85 degrees F, open intake dampers and start exhaust fans.

3.6 LOUVER DAMPERS AND EXHAUST FANS

- A. When the generator not running, outside and exhaust dampers are closed and return damper is open.
- B. When generator is running, dampers are controlled and operate with outside and exhaust dampers opening, and return dampers closing, to maintain room temperature of 85 degrees F.

3.7 FAN COIL UNITS

- A. Change over from heating to cooling by indexing thermostat from thermostat on supply piping. When supply is above room temperature, operate thermostat in direct acting manner, opening valve when temperature falls below thermostat setting. When supply is below room temperature, operate thermostat in reverse acting manner, opening valve when space temperature rises above thermostat setting.
- B. For heating and cooling fan coil units with fan speed control during heating cycle, increase fan speed as space temperature falls below thermostat setting, provided hot water is available. During cooling cycle, increase fan speed as space temperature rises above thermostat setting, provided chilled water is available.
- C. Mount thermostat with adjustable knob and speed switch on common plate engraved with "Heating Control and Fan Control" on top, with "Warmer and Cooler" and direction indicator around the thermostat knob.

3.8 HEATING COILS

- A. Single or Dual temperature thermostat set at 75 degrees F maintains constant space temperature during the day and 15 degrees F cooler at night. Thermostat modulates two-way control heating valve with spring range of 3 to 7 psig .
- B. Single temperature room thermostat set at 75 degrees F maintains constant space temperature by modulating electric output through action at SCR power controller, to electric heaters.

3.9 HEATING WATER ZONE CONTROL

- A. Pressure switch in heating pump discharge provides on/off indication.
- B. Control heating water supply temperature set at 180 degrees F in accordance with outdoor reset schedule by modulating steam control valve.
- C. Control heating water at maximum 180 degrees F at outdoor temperature of 30 degrees F.
- D. Control heating water at minimum 120 degrees F at outdoor temperature of 65 degrees Use a straight-line relationship between temperatures. System off at temp about 65 degrees F pump will run for 5 minutes after steam off to prevent over run temperature.
- E. Pressure switch in heating water circuit on no flow conditions closes valve and indicates EMCS alarm.

F. On outside temperatures above 65 degrees F de-energize heating pumps and suppress alarm.

G. Display:

1. System graphic.
2. System supply-temperature.
3. System supply control point adjustment.
4. System return-temperature.
5. Pump on/off indication

3.10 HUMIDIFIERS

A. Humidifier: Operate Humidification only when supply fan is running and there is water in humidifier sump. Humidistat located in return air, reset from outdoors modulates normally closed humidifier valve cycle spray pumps and modulates valve on spray header. Set outdoor reset to 50 percent relative humidity at 70 degrees and 15 percent relative humidity at -30 degrees.

3.11 PARKING GARAGE VENTILATION SYSTEMS

- A. Carbon Monoxide (CO) detector maintains maximum CO level of 50 ppm by cycling exhaust fan. When CO level exceeds 100 ppm, signal alarm.
- B. When exhaust fan starts, start make-up unit.

3.12 RADIATION AND CONVECTORS

- A. Single or Dual temperature thermostat set at 75 degrees F maintains constant space temperature during the day and 15 degrees cooler at night. Thermostat modulates two-way control heating valve with spring range of 3 to 7 psig 3 to 113 psig.
- B. Single temperature room thermostat set at 75 degrees F maintains constant space temperature by modulating electric output through action at SCR power controller, to electric heaters.

3.13 REFRIGERATION SYSTEMS

A. Maintain constant supply or return air duct temperature of 55 degrees F by cycling refrigeration system and signaling step capacity.

3.14 TERMINAL AIR UNITS

- A. Single or Dual temperature thermostat set at 75 degrees F maintains constant space temperature during the day and 15 degrees F cooler at night. Thermostat modulates two-way control heating valve with spring range of 3 to 7 psig, 3/to 13 psig.
- B. Single or Dual temperature thermostat set at 75 degrees F maintains constant space temperature by modulating variable volume damper operator.
- C. Where reheat coils or radiation is also provided, sequence two-way heating control valve with damper operator having spring range of 8 to 13 psig.

3.15 UNIT HEATERS

- A. Single temperature electric room thermostat maintains constant space temperature of 68 degrees F by modulating control valve. Fan will shut down on no demand condition.

END OF SECTION