

## CSI SPECIFICATION: *SQ-Elite-8T*

### SECTION: 230913 Instrumentation and Control devices for HVAC

#### PART 1 GENERAL

##### 1.1 Summary

###### A. Section Includes:

1. Multi-Stage hydronic sequencing control for heating (or cooling) applications

###### B. Related Sections:

1. Conforms to applicable building and local code requirements of all authorities having jurisdiction.

##### 1.2 References

###### A. International Organization for Standardization (ISO)

1. Manufacturer shall be ISO 9001:2000 Quality Management Systems Certified.

###### B. National Electrical Manufacturers Association (NEMA)

1. Enclosure follows NEMA Standard 250. (NEMA-1)

###### C. Underwriters Laboratories, Inc. (UL):

1. The control shall be tested and certified per standard 916 "Energy Management Equipment".

###### D. The City of New York, Department of Environmental Protection (DEP).

1. The control shall be approved for installation in New York City by DEP under "Engineering Criteria for Fuel Oil Burning Equipment".

##### 1.3 Quality Assurance

###### A. Manufacturer's Quality System:

1. Registered to ISO 9001:2000 Quality Standard, including in-house engineering for product design activities.
2. The control must be UL tested and certified per standard 916 "Energy Management Equipment".

##### 1.4 Control Operation

**A. Description:** The control shall operate on 120VAC, with a maximum power of 12 VA. The control shall be pre-engineered and programmed exclusively for the sequencing and lead rotation of multiple hydronic heating (or cooling units) based on PID logic. It shall be capable of controlling eight stages without any additional modules. However, it shall be capable of controlling a total of 24 total stages using a maximum of two external compatible extension controls.

**B. Stages:** The control shall have eight normally open relay contacts that can be used to start and stop each stage. The control shall have the capability to operate multiple single-stage, two-stage, three-stage, or four-stage units. In addition to operating the stages, the control shall be configurable to control the unit pumps or valves using one of the stage outputs.

### C. Sequence of Operation:

1. **When heat (or cool) is required**, the control PID shall activate the system pump and combustion air damper outputs. If the prove input was activated, then the control shall energize the lead unit lowest stage and its pump or valve relays to start its purge delay.
2. **Adding Stages**: After the purge elapses, the control shall use a number of adjustable settings to customize the sequencing to the specific application and equipment being controlled. These settings shall include reaction time, minimum runtime, last stage hold, and standby delay. If additional output is required, the control shall wait a full, field adjustable, reaction time before energizing any additional stages.
3. **Subtracting Stages**: If the control PID requires output reduction, the control shall turn-off a stage after making sure that the stage has run for a full, field adjustable, minimum runtime before de-energizing it. In addition, it shall not turn-off any additional stages until a full minimum runtime has elapsed since the last boiler stage has been turned-off.
4. **Last Stage On**: The control shall have the ability to hold the last stage on for an additional number of degrees to prevent the lead stage from short cycling during light load conditions.

### D. Features:

1. **Heating (or Cooling)**: The control PID shall be capable of operating either multi-stage heating boilers (or multi-stage cooling units).
2. **Outdoor Reset or Set Point**: The control shall provide an integral sensor set point adjustment for heating (or cooling). The set point shall be adjustable either through the control menu or remotely using an optional 4-20mA input signal interface (an optional accessory). In addition, in heating when equipped with an outdoor sensor, the control shall be capable of varying the set point based on an either a preset or custom outdoor reset curve. All outdoor reset curve parameters shall be field customizable.
3. **Reaction Time and Minimum Runtime**: The control shall have the capability of field adjusting the PID delays required to turn on or off a stage.
4. **Last Stage Hold**: The last stage hold feature shall keep the last boiler's (cooling unit's) lowest stage on for an additional, field adjustable, number of degrees before de-energizing it to reduce short cycling of the lead boiler (cooling units).
5. **Standby Boiler**: The control shall offer the capability of changing the operating mode of any boiler (or cooling unit) to standby. That setting shall allow that boiler stages (cooling unit stages) to turn on only in extreme load conditions and only after all the stages have been on for a full programmable standby period.
6. **Purge Time**: The control shall have an adjustable purge delay. This setting shall determine the delay time required for a boiler (or cooling unit) to start to produce output.
7. **Rotation**: The control shall be capable of rotating the boilers (or cooling units) either based on an adjustable time period (between 1 hour and 999 hours), First-On/First-Off, or Manually.
8. **Parallel or Normal Sequencing**: The control shall have an option for parallel sequencing where the control shall start the lower firing stages on all boilers (or cooling units) before energizing the higher firing stages. Also, it shall have a normal sequencing mode where it shall bring on the lowest stage of a unit followed by the next higher stage on the same unit. Then when all stages on that unit are energized, it shall do the same to the next unit inline.
9. **Multiple Output or Single Output Staging**: The control shall be capable of controlling the unit output either by energizing multiple stages on the same unit to achieve a higher output rate as with most multi-stage boilers. Or by energizing the higher output stage while de-energizing the lower output ones on the same unit to achieve the higher output required as with some cooling units.
10. **Boiler Pump or Boiler Valve control**: The control shall have the capability of controlling boiler (or cooling unit) pumps or valves using one of the control's available stages.
11. **Memory**: The control shall store all configuration and settings on an EE-Prom. In case of power failure the control shall retrieve all of its latest settings.

12. **Display:** The control shall have a graphical display capable of displaying a minimum of five lines by twenty-one character. The display shall be visible with no ambient light. All control operation information shall be available for display. During times of inactivity, or 5 minutes after the last user entry, the display shall enter default mode. In this mode the control shall display the outdoor temperature, system temperature, and each stage status.
13. **Boiler Minimum Return:** Using a return temperature sensor, shall use a mathematical logic that can predict low returns before they occur.
14. **Setback Schedule or Remote Setback:** The control shall have a setback setting where it will reduce the temperature in heating (increase the temperature in cooling) of the system either based on the programmed schedule or using an external setback signal.
15. **Domestic Hot Water:** The control shall offer several domestic hot water priority options. It shall be capable of accepting either a dry-contact DHW call or a DHW thermistor type temperature input. In addition, it shall be capable of controlling a DHW pump operation.

#### E. Inputs:

1. **Outdoor Temperature:** The control shall be capable of accepting a 5K-thermistor type sensor to be used to read the current outdoor temperature. It shall be placed on the north side of the building at least 10 Ft. above the ground.
2. **System Temperature:** The control shall be capable of accepting a 5K-thermistor type sensor to be used to read the current system temperature. It shall be placed on the system water pipe to measure the circulating water temperature.
3. **Return Temperature:** The control shall be capable of accepting a 5K-thermistor type sensor to be used to read the current boiler return temperature. It shall be placed on the return pipe after the last connection but before reaching the boilers. It can be used to help in protecting the boilers from low return temperatures.
4. **Domestic Hot Water Temperature:** The control shall be capable of accepting a 5K-thermistor type sensor to be used to read the domestic hot water temperature. It shall be placed in the domestic hot water tank.
5. **Domestic Hot Water dry-contact Call:** The control shall be capable of accepting a dry-contact input type to be used as a domestic hot water call. This shall be the input from a domestic hot water tank aquastat connection. It shall be used when a domestic hot water sensor installation is not applicable.
6. **External Shutdown (Opened for normal operation):** The control shall be capable of accepting a dry-contact shutdown input. This shall prevent any stage from being activated when the contact is closed/shorted.
7. **Thermostat Input (Closed for normal operation):** The control shall be capable of accepting a dry-contact Thermostat input. This shall prevent any stage from being activated when the contact is opened.
8. **Setback Input:** The control shall be capable of accepting a dry-contact Setback input that could be used to lower (to increase) the set point by a specified number of degrees to save energy.
9. **Prove Input:** The control shall be capable of accepting a dry-contact prove input to check on system components before energizing the stages. This shall prevent any stage from being activated until the contact is closed/shorted.
10. **Remote Set Point Module:** This shall allow the control to accept a remote 4-20mA set point signal from a remote energy or building management systems using an (optional) external interface.

#### F. Outputs:

1. Eight Stage, unit pump, or unit valve relay outputs
2. System relay output
3. Combustion Air Damper relay output
4. Domestic Hot Water Pump relay output
5. Connection to compatible extension controls.

## G. Sensor History:

1. **System Sensor History:** This shall be the history of the system sensor readings at 12-minute intervals for the past 24 hours.
2. **Outdoor Sensor History:** This shall be the history of the outdoor sensor readings at 12-minute intervals for the past 24 hours.
3. **Return Sensor History (optional):** This shall be the history of the return sensor readings at 12-minute intervals for the past 24 hours.
4. **Domestic Hot Water Sensor History (optional):** This shall be the history of the domestic hot waters sensor readings at 12-minute intervals for the past 24 hours.

## 1.5 Regulatory Approvals

### A. Underwriters Laboratories, Inc. (UL):

1. The control shall be tested and certified per standard 916 "Energy Management Equipment".

### B. The City of New York, Department of Environmental Protection (DEP).

1. The control shall be approved for installation in New York City by DEP under "Engineering Criteria for Fuel Oil Burning Equipment".

## 1.6 Items Included

- A. **Outdoor Temperature Sensor** shall be of the Thermistor type capable of measuring temperatures between  $-30^{\circ}\text{F}$  to  $250^{\circ}\text{F}$ . It shall have a weather shield.
- B. **System Temperature Sensor** shall be of the Thermistor type capable of measuring from  $-30^{\circ}\text{F}$  to  $250^{\circ}\text{F}$ . It shall fit in a 3/8" well.

## 1.7 Optional Items

- A. **Domestic Hot Water Temperature Sensor** shall be of the Thermistor type capable of measuring temperatures between  $-30^{\circ}\text{F}$  to  $250^{\circ}\text{F}$ . It shall fit in a 3/8" well on the domestic hot water piping/tank.
- B. **4-20mA Set Point Interface:** The Interface shall be capable of accepting a remote 4-20mA signal to remotely change the sequencing control's target set point. The target range is field selectable.

## 1.8 Security

### A. Control Security:

1. No changes to control settings shall take place except after the program switch has been toggled to allow for changes. The switch shall be located in a secure location on the control where it can be locked from unauthorized users.