

SECTION 40 99 90

PACKAGE CONTROL SYSTEMS

10/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (2008) Enclosures for Electrical Equipment
(1000 Volts Maximum)

NEMA AB 1 (2002) Molded-Case Circuit Breakers,
Molded Case Switches, and Circuit-Breaker
Enclosures

NEMA ICS 2 (2000; Errata 2002; R 2005; Errata 2006)
Standard for Industrial Control and
Systems: Controllers, Contractors, and
Overload Relays Rated Not More than 2000
Volts AC or 750 Volts DC: Part 8 -
Disconnect Devices for Use in Industrial
Control Equipment

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2007; AMD 1 2008) National Electrical
Code - 2008 Edition

UNDERWRITERS LABORATORIES (UL)

UL 508A (2007) Standard for Industrial Control
Panels

1.2 SYSTEM DESCRIPTION

Assemble panels and install instruments, plumbing, and wiring in equipment manufacturer's factories.

Test panels and panel assemblies for proper operation prior to shipment from equipment manufacturer's factory.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Control Panel; G construction Drawings

Control Panel Electrical; G wiring diagrams

SD-03 Product Data

Control Panel; G enclosure

Control Panel Electrical; G

Components and bill of material.

Programmable Controllers; G

Complete system data and input/output listing.

SD-05 Design Data

Control Panel; G

Seismic anchorage and bracing data sheets and drawings as required by 26 05 48.00 10, SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT;

Programmable Controllers; G

Fully documented application program listing and complete database listing for SCADA integration.

SD-07 Certificates

Control Panel; G

Manufacturer's Certificate of Proper Installation

SD-10 Operation and Maintenance Data

Control Panel; G

Final drawings and component listing with complete Operation and Maintenance data.

1.4 DELIVERY STORAGE, AND HANDLING

Prior to shipment, include corrosive-inhibitive vapor capsules in shipping containers and related equipment as recommended by capsule manufacturer.

1.5 EXTRA MATERIALS

1.5.1 Spares, Expendables, and Test Equipment

1. Selector Switch, Pushbutton, and Indicating Light: 20 percent, one minimum, of each type used.
2. Light Bulb: 100 percent, 2 minimum, of each type used.
3. Fuse: 100 percent, 5 minimum, of each type used.
4. Surge Suppressors: 20 percent, one minimum, of each type used.

PART 2 PRODUCTS

2.1 SIGNAL CHARACTERISTICS

2.1.1 Analog Signals

1. 4 to 20 mA dc, in accordance with compatibility requirements of ISA S50.1.
2. Unless otherwise specified or shown, use Type 2, two-wire circuits.
3. Transmitters: Load resistance capability conforming to Class L.
4. Fully isolate input and output signals of transmitters and receivers.

2.1.2 Pulse Frequency Signals

dc pulses whose repetition rate is linearly proportional to process variable over 10:1 range. Generate pulses by contact closures or solid-state switches.

1. Power source: Less than 30V dc.

2.1.3 Discrete Signals

1. Two-state logic signals.
2. Utilize 120V ac sources for control and alarm signals.
3. Alarm signals shall be normally open, close to alarm isolated contacts rated for 5 ampere at 120V ac and 2 ampere at 30V dc.

2.2 CORROSION PROTECTION

a. Corrosion-Inhibiting Vapor Capsule Manufacturers:

1. Northern Instruments; Model Zerust VC.
2. Hoffmann Engineering; Model A HCI.

2.3 CONTROL PANEL

a. Panel Construction and Interior Wiring: In accordance with the National Electrical Code (NEC), UL 508, state and local codes, and applicable sections of NEMA, ANSI, and ICECA.

b. Conform to NEMA ratings as specified in individual equipment sections.

c. Minimum Metal Thickness: 14 gauge.

d. NEMA 250, Type 4X Panels: Type 316 stainless steel construction unless otherwise specified.

e. Doors:

1. Three-point latching mechanisms in accordance with NEMA 250 Type 1 and 12 panels with doors higher than 18 inches.
2. For other doors, stainless steel quick release clamps.

- f. Cutouts shall be cut, punched, or drilled and finished smoothly with rounded edges.
- g. Access: Front, suitable for installation with back and sides adjacent to or in contact with other surfaces, unless otherwise specified.
- h. Temperature Control:
 - 1. Size panels to adequately dissipate heat generated by equipment mounted on or in the panel.
 - 2. Furnish cooling fans with air filters if required to dissipate heat.
 - 3. For panels outdoors or in unheated areas, furnish thermostatically controlled heaters to maintain temperature above 40 degrees F.
- i. Push-to-Test Circuitry: For each push-to-test indicating light, provide a fused push-to-test circuit.
- j. Lighting: Minimum of one hand switch controlled internal 100 watt incandescent light for panels 12 cubic feet and larger.
- k. Minimum of one 120 volt GFCI duplex receptacle for panels 12 cubic feet and larger.
- l. Finish:
 - 1. Metallic External Surfaces (Excluding Aluminum and Stainless Steel): Manufacturer's standard gray unless otherwise specified.
 - 2. Internal Surfaces: White enamel.
- m. Panel Manufacturers:
 - 1. Hoffman.
 - 2. H.F. Cox.
 - 3. Or approved equal.
- n. Breather and Drains: Furnish with NEMA 250, Type 4 and 4X panels.
 - 1. Manufacturer and Product: Cooper Crouse-Hinds; ECD Type 4X Drain and Breather; Drain Model ECD1 N4D, Breather Model ECD1 N4B.

2.4 CONTROL PANEL ELECTRICAL

- A. UL Listing Mark for Enclosures: Mark stating "Listed Enclosed Industrial Control Panel" per UL 508A.
- B. I&C and electrical components, terminals, wires, and enclosures UL recognized or UL listed.
- C. Control Panels without Motor Starters:

1. Furnish main circuit breaker and a circuit breaker on each individual branch circuit distributed from power panel.
2. Locate to provide clear view of and access to breakers when door is open. Group on single subpanel. Provide typed directory.
3. Circuit Breakers:
 - a. Coordinate for fault in branch circuit trips, branch breaker, and not main breaker.
 - b. Branch Circuit Breakers: 15 amps at 250V ac.
 - c. Breaker Manufacturers and Products:
 - 1) Heineman Electric Co.; Series AM.
 - 2) Airpax/North American Philips Controls Corp.; Series 205.
 - 3) Or approved equal.

D. Control Panels with Three-Phase Power Supplies and Motor Starters:

1. Interlock main circuit breaker with panel door.
 - a. Mount logic controls, branch circuit breakers, overload reset switches, and other control circuit devices.
 - b. Mount operator controls and indications on front access door.
2. Circuit Breakers:
 - a. In accordance with **NEMA AB 1**.
 - b. Breakers, except Motor Branch Breakers: Molded case thermal magnetic.
 - c. 42,000 ampere RMS symmetrical rating, minimum at 480 volts, unless otherwise specified in package system equipment specification sections.
 - d. Tripping: Indicate with operator handle position.
3. Magnetic Motor Starters:
 - a. Full voltage, **NEMA ICS 2**, Class A, Size 0 minimum.
 - b. Include three-pole bimetallic or eutectic alloy thermal overload relays sized for each motor.
 - c. Manual reset type with reset button mounted on panel door.
4. Motor Control: 120V ac (except intrinsically safe circuits where applicable).
 - a. Power Control Transformer:
 - 1) Sufficient capacity to serve connected load, including

200VA for duplex outlet plus 100VA (minimum).

- 2) Limit voltage variation to 15 percent during contact pickup.
 - 3) Fuse one side of secondary winding and ground the other.
 - 4) Furnish primary winding fuses in ungrounded conductors.
5. Power Monitoring Relay:
- a. Protect three-phase equipment from single phasing, phase imbalance, or phase reversal.
 - b. Separate, isolated contact outputs to stop motors and activate alarm light during abnormal conditions.
 - c. Transient Voltage Protection: 10,000 volts.
 - d. Manufacturer and Product: Furnas; Class 47.
6. Power Distribution Blocks: Furnish to parallel feed tap on branch circuit protective devices. Do not "leap frog" power conductors.
7. Terminations for Power Conductors: Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.

E. Wiring:

1. ac Circuits:
 - a. Type: 600 volt, Type MTW stranded copper.
 - b. Size: For current to be carried, but not less than 14 AWG.
2. Analog Signal Circuits:
 - a. Type: 300 volt, Type 2 stranded copper, twisted shielded pairs.
 - b. Size: 18 AWG, minimum.
3. Other dc Circuits.
 - a. Type: 600 volt, Type MTW stranded copper.
 - b. Size: 18 AWG, minimum.
4. Separate analog and other dc circuits at least 2 inches from any ac power and control wiring.
5. Enclose wiring in sheet metal raceways or plastic wiring ducts.
6. Wire Identification: Numbered and tagged at each termination.
 - a. Wire Tags: Machine printed, heat shrink.
 - b. Manufacturers:

- 1) Brady PermaSleeve.
- 2) Tyco Electronics.
- 3) Or approved equal.

F. Wiring Interface:

1. For analog and discrete signal, terminate at numbered terminal blocks.
2. For special signals, terminate power (240 volts or greater) at manufacturer's standard connectors.
3. For panel, terminate at equipment on/with which it is mounted.

G. Terminal Blocks:

1. Quantity:
 - a. For external connections.
 - b. Wire spare or unused panel mounted elements to their panels' terminal blocks.
 - c. Spare Terminals: 20 percent of connected terminals, but not less than 10.
2. General: Group to keep 120V ac circuits separate from 24V dc circuits.
 - a. Connection Type: Screw connection clamp.
 - b. Compression Clamp:
 - 1) Hardened steel clamp with transversal grooves penetrating wire strands providing a vibration-proof connection.
 - 2) Guides strands of wire into terminal.
 - c. Screws: Hardened steel, captive, and self-locking.
 - d. Current Bar: Copper or treated brass.
 - e. Insulation:
 - 1) Thermoplastic rated for minus 55 to plus 110 degrees C.
 - 2) Two funnel shaped inputs to facilitate wire entry.
 - f. Mounting:
 - 1) Rail.
 - 2) Terminal block can be extracted from an assembly without displacing adjacent blocks.
 - 3) End Stops: One at each end of rail, minimum.

- g. Wire Preparation: Stripping only.
 - h. Jumpers: Allow jumper installation without loss of space on terminal or rail.
 - i. Marking System:
 - 1) Terminal number shown on both sides of terminal block.
 - 2) Allow use of preprinted and field marked tags.
 - 3) Terminal strip numbers shown on end stops.
 - 4) Mark terminal block and terminal strip numbers as shown.
3. Terminal Block, 120 Volt Power:
- a. Rated Voltage: 600V ac.
 - b. Rated Current: 30 amp.
 - c. Wire Size: 22 through 10 AWG.
 - d. Rated Wire Size: 10 AWG.
 - e. Color: Gray body.
 - f. Spacing: 0.25 inch, maximum.
 - g. Manufacturer and Product: Entrelec; Type M4/6.
4. Terminal Block, Ground:
- a. Wire Size: 22 through 12 AWG.
 - b. Rated Wire Size: 12 AWG.
 - c. Color: Green and yellow body.
 - d. Spacing: 0.25 inch, maximum.
 - e. Grounding: Ground terminal blocks electrically grounded to the mounting rail.
 - f. Manufacturer and Product: Entrelec; Type M4/6.P.
5. Terminal Block, Blade Disconnect Switch:
- a. Use: Provide one for each discrete input and output field interface wire.
 - b. Rated Voltage: 600V ac.
 - c. Rated Current: 10 amp.
 - d. Wire Size: 22 through 12 AWG.

- e. Rated Wire Size: 12 AWG.
 - f. Color: Gray body, orange switch.
 - g. Spacing: 0.25 inch, maximum.
 - h. Manufacturer and Product: Entrelec; Type M4/6.SN.
6. Terminal Block, Fused, 24V dc:
- a. Rated Voltage: 600V dc.
 - b. Rated Current: 6.3 amp.
 - c. Wire Size: 22 through 12 AWG.
 - d. Rated Wire Size: 12 AWG.
 - e. Color: Gray body.
 - f. Fuse: 5 by 20 GMA fuses.
 - g. Fuse Marking: Fuse amperage rating shown on top of terminal block.
 - h. Indication: LED diode 24V dc.
 - i. Leakage Current: 5.2 mA, maximum.
 - j. Spacing: 0.32 inch, maximum.
 - k. Manufacturer and Product: Entrelec; Type M4/6.SFD.
7. Terminal Block, Fused, 120V ac:
- a. Rated Voltage: 600V ac.
 - b. Rated Current: 6.3 amp.
 - c. Wire Size: 22 through 12 AWG
 - d. Rated Wire Size: 12 AWG.
 - e. Color: Gray body.
 - f. Fuse: 5 by 20 GMA fuses.
 - g. Fuse Marking: Fuse amperage rating shown on top of terminal block.
 - h. Indication: Neon lamp 110V ac.
 - i. Leakage Current: 1.8 mA, maximum.
 - j. Spacing: 0.32 inch, maximum
 - k. Manufacturer and Product: Entrelec; Type M4/6.SFL, or approved equal.

H. Grounding: Internal copper grounding bus for ground connections on panels, consoles, racks, and cabinets.

I. Relays:

1. General:

- a. Relay Mounting: Plug-in type socket.
- b. Relay Enclosure: Provide dust cover.
- c. Socket Type: Screw terminal interface with wiring.
- d. Socket Mounting: Rail.
- e. Furnish holddown clips.

2. Control Circuit Switching Relay, Nonlatching:

- a. Type: Compact general purpose plug-in.
- b. Contact Arrangement: 3 Form C contacts.
- c. Contact Rating: 10A at 28V dc or 240V ac.
- d. Contact Material: Silver cadmium oxide alloy.
- e. Coil Voltage: As noted or shown.
- f. Coil Power: 1.8 watts (dc), 2.7VA (ac).
- g. Expected Mechanical Life: 10,000,000 operations.
- h. Expected Electrical Life at Rated Load: 100,000 operations.
- i. Indication Type: Neon or LED indicator lamp.
- j. Push-to-test button.
- k. Manufacturer and Product: Potter and Brumfield; Series KUP, or approved equal.

3. Control Circuit Switching Relay, Latching:

- a. Type: Dual coil mechanical latching relay.
- b. Contact Arrangement: 2 Form C contacts.
- c. Contact Rating: 10A at 28V dc or 120V ac.
- d. Contact Material: Silver cadmium oxide alloy.
- e. Coil Voltage: As noted or shown.
- f. Coil Power: 2.7 watts (dc), 5.3VA (ac).
- g. Expected Mechanical Life: 500,000 operations.
- h. Expected Electrical Life at Rated Load: 50,000 operations.

- i. Manufacturer and Product: Potter and Brumfield; Series KB/KBP, or approved equal.
4. Control Circuit Switching Relay, Time Delay:
 - a. Type: Adjustable time delay relay.
 - b. Contact Arrangement: 2 Form C contacts.
 - c. Contact Rating: 10A at 240V ac.
 - d. Contact Material: Silver cadmium oxide alloy.
 - e. Coil Voltage: As specified or shown.
 - f. Operating Temperature: Minus 10 to 55 degrees C.
 - g. Repeatability: Plus or minus 2 percent.
 - h. Delay Time Range: Select range such that time delay setpoint fall between 20 to 80 percent or range.
 - i. Time Delay Setpoint: As specified or shown.
 - j. Mode of Operation: As specified or shown.
 - k. Adjustment Type: Integral potentiometer with knob external to dust cover.
 - l. Manufacturer and Products: Potter and Brumfield or approved equal.
 - 1) Series CB for 0.1 second to 100 minute delay time ranges.
 - 2) Series CK for 0.1 to 120 second delay time ranges.
- J. Intrinsic Safety Barriers:
 1. Intrinsically Safe Relays: Monitor discrete signals that originate in hazardous area and are used in a safe area.
 - a. Manufacturer and Product: MTL, Inc.; Series MTL 5000, or approved equal.
 2. Intrinsically Safe Barriers: Interface analog signals as they pass from hazardous area to safe area.
 - a. Manufacturer and Product: MTL, Inc.; Series MTL 5000, or approved equal.
- K. Programmable Controllers:
 1. Solid state units capable of performing same function as conventional relays, timers, counters, drum sequencers, arithmetic, and other special functions necessary to perform

required control functions.

2. Meeting applicable requirements of Section 40 95 00, PROCESS CONTROL.
 3. Minimum of 25 percent excess capacity for inputs, outputs, internal coils, registers, and other necessary functions.
 4. Capable of operating in a hostile industrial environment (for example, heat, electrical transients, RFI, and vibration) without fans, air conditioning, or electrical filtering. Units operate from 0 to 60 degrees C and up to 95 percent humidity, noncondensing.
 5. Manufacturers and Product:
 - a. Allen-Bradley; Control Logix for interface with plant control system.
 - b. Or approved equal.
- L. Front-of-Panel Devices in Conjunction with NEMA 250, Type 1 and 12 Panels:
1. Potentiometer Units:
 - a. Three-terminal, oiltight construction, resolution of 1 percent and linearity of plus or minus 5 percent.
 - b. Single-hole, panel mounting accommodating panel thicknesses between 1/8 and 1/4 inch.
 - c. Include legend plates with service markings.
 - d. Manufacturers and Products:
 - 1) Allen-Bradley; Model 800T.
 - 2) Eaton/Cutler-Hammer; Model 10250T.
 - 3) Or approved equal.
 2. Indicating Lights:
 - a. Heavy-duty, push-to-test type, oiltight, industrial type with integral transformer for 120V ac applications.
 - b. Screwed on prismatic glass lenses in colors noted and factory engraved legend plates for service legend.
 - c. Manufacturers and Products:
 - 1) Eaton/Cutler-Hammer; Type 10250T.
 - 2) General Electric; CR2940U.
 - 3) Or approved equal.
 3. Pushbutton, Momentary:

- a. Heavy-duty, oiltight, industrial type with full guard and momentary contacts rated for 10 amperes continuous at 120V ac.
 - b. Standard size legend plates with black field and white markings for service legend.
 - c. Manufacturers and Products:
 - 1) Square D; Class 9001, Type K.
 - 2) Eaton/Cutler-Hammer; Type T.
 - 3) General Electric; Type CR 2940.
 - 4) Or approved equal.
4. Selector Switch:
- a. Heavy-duty, oiltight, industrial type with contacts rated for 120V ac service at 10 amperes continuous.
 - b. Standard size, black field, legend plates with white markings, for service legend.
 - c. Operators: Black knob type.
 - d. Single-hole mounting, accommodating panel thicknesses from 1/16 inch to 1/4 inch.
 - e. Manufacturers and Products for Units with up to Four Selection Positions:
 - 1) Eaton/Cutler-Hammer; Type T.
 - 2) Square D; Type K.
 - 3) Or approved equal.
 - f. Manufacturers and Products for Units with up to 12 Selection Positions:
 - 1) Rundel-Idec; Standard Cam Switch.
 - 2) Electros witch; 31.
 - 3) Or approved equal.
- M. Front-of-Panel Devices Used in Conjunction with NEMA 250, Type 4X Panels:
1. Potentiometer, Watertight:
 - a. Three-terminal, heavy-duty NEMA 250, Type 4X watertight construction, resolution of 1 percent and linearity of plus or minus 5 percent.
 - b. Single-hole, panel mounting accommodating panel thicknesses between 1/8 and 1/4 inch.

- c. Include engraved legend plates with service markings.
 - d. Manufacturer and Product: Allen-Bradley; Bulletin 800H, or approved equal.
2. Indicating Lights, Watertight:
- a. Heavy-duty, push-to-test type, NEMA 250, Type 4X watertight, industrial type with integral transformer for 120V ac applications and corrosion-resistant service.
 - b. Screwed on prismatic lenses and factory engraved legend plates for service legend.
 - c. Manufacturers and Products:
 - 1) Square D; Type SK.
 - 2) Allen-Bradley; Type 800H.
 - 3) Or approved equal.
3. Pushbutton, Momentary, Watertight:
- a. Heavy-duty, NEMA 250, Type 4X watertight, industrial type with momentary contacts rated for 120V ac service at 10 amperes continuous and corrosion-resistant service.
 - b. Standard size, black field, legend plates with white markings for service legend.
 - c. Manufacturers and Products:
 - 1) Square D; Type SK.
 - 2) Allen-Bradley; Type 800H.
 - 3) Or approved equal.
4. Selector Switch, Watertight:
- a. Heavy-duty, NEMA 250, Type 4X watertight, industrial type with contacts rated for 120V ac service at 10 amperes continuous and corrosion-resistant service.
 - b. Standard size, black field, legend plates with white markings, for service legend.
 - c. Operators: Black knob type.
 - d. Single-hole mounting, accommodating panel thicknesses from 1/16 to 1/4 inch.
 - e. Manufacturer and Products:
 - 1) Square D; Class 9001, Type SK.
 - 2) Allen-Bradley; Type 800H.

- 3) Or approved equal.

2.5 PANEL COMPONENTS

- a. Digital Panel Indicator: As specified in Section 40 95 00, Supplement COMPONENT SPECIFICATIONS, component code S27.
- b. Signal Current Isolator: As specified in Section 40 95 00, Supplement COMPONENT SPECIFICATIONS, component code S24.
- c. Operator Interface Terminal (OIT): Panel-mounted color touch screen for operator interface with control system. Complete with programming and application development to provide specified functions and features. Available features include buttons and switches, status indicating lights, process variable meters and value displays, setpoint adjustments, screen navigation, alarm notification, and trend graphs. Ethernet communication with PLC.
- d. Ethernet Switch: As specified in Section 40 95 00, Supplement COMPONENT SPECIFICATIONS, component code Y82.
- e. Fiber Optic Patch Panel: Space for patch panel installation minimum 12 inches H, 12 inches W, and 8 inches D.

2.6 INSTRUMENT TAG NUMBERS

- A. A tag number notation is used. For example:

10-AIT-90310 [ORP]

<u>Notation</u>	<u>Explanation</u>
10	Facility number
AIT	ISA designator for Analysis Indicator
90	Unit process number
310	Loop number
[ORP]	Same notation shown at 2 o'clock position on ISA circle symbol on Process and Instrument Diagram

2.7 NAMEPLATES, NAMETAGS, AND SERVICE LEGENDS

2.7.1 Nametags

- A. Permanently mounted bearing entire ISA tag number.
- Panel Mounted: Plastic, mounted to instrument behind panel face.
 - Field Mounted: Engraved Type 316 stainless steel, 22 gauge minimum thickness, attached with stainless steel.

2.7.2 Service Legends

- A. Service Legends (Integrally Mounted with Instrument) and Nameplates:
- Engraved, rigid, laminated plastic type with adhesive back.

Furnish service legends and nameplates to adequately describe functions of panel face mounted instruments.

2. Color: White with black letters.
3. Letter Height: 3/16 inch.
4. For each panel, face mounted laminated nameplate inscribed with the panel name and tag number. Color shall be white with black letters 1/2 inch high.

2.7.3 Standard Light Colors and Inscriptions

Unless otherwise specified in individual equipment specifications, use the following color code and inscriptions:

<u>Tag</u>	<u>Inscription(s)</u>	<u>Color</u>
POWER ON	POWER ON	White
RUN (ON)	ON	Red
OPEN	OPEN	Red
CLOSED	CLOSED	Green
LOW	LOW	Amber
FAIL	FAIL	Amber
HIGH	HIGH	Amber
AUTO	AUTO	White

1. Lettering: Black on white and amber lenses; white on red and green lenses.
2. Standard Pushbutton Colors and Inscriptions:
 - a. Use following unless otherwise noted in individual Equipment Specifications:

<u>Tag</u>	<u>Inscription(s)</u>	<u>Color</u>
OC	OPEN	Red
	CLOSE	Green
SS	START	Black
	STOP	Red
RESET	RESET	Black
LOCK-OUT STOP	LOCK-OUT STOP	Red

- b. Lettering Color:
 - 1) Black on white and yellow buttons.
 - 2) White on black, red, and green buttons.

2.8 ELECTRICAL SURGE AND TRANSIENT PROTECTION

2.8.1 General

Equip control panels with surge-arresting devices to protect equipment from damage due to electrical transients induced in interconnecting lines from lightning discharges and nearby electrical devices.

2.8.2 Suppressor Locations

1. At point of connection between each equipment item, including ac powered transmitters and its power supply conductors (direct wired equipment).
2. On analog pairs at each end when the pair travels outside of building.
3. In other locations where equipment sensitivity to surges and transients requires additional protection beyond that inherent to design of equipment.

2.8.3 Power Supply Suppressor Assemblies

1. Suitable for connection to 120 volt, single-phase power supplies EDCO "HSP SERIES."
2. Suitable for connection to 480 volt, three-phase power supplies; Square D J9200 9A.

2.8.4 Analog Signal Cable Suppressor Assemblies

1. Epoxy encapsulated within a phenolic enclosure.
2. Flame retardant.
3. Four lead devices; include a threaded mounting/grounding stud.
4. Manufacturers and Products:
 - a. EDCO; SRA 64 Series.
 - b. Joslyn; Series 1800 and 1669.
 - c. Or approved equal.

2.8.6 Grounding

Coordinate surge suppressor grounding in field panels and field instrumentation with suppressor manufacturer's requirements. Furnish control panels with integral grounding terminations for connection of suppressors and other required instrumentation.

PART 3 EXECUTION

3.1 ELECTRICAL POWER AND SIGNAL WIRING

- A. Restrain control and signal wiring in control panels by plastic ties or ducts. Secure hinge wiring at each end so bending or twisting

will occur around the longitudinal axis of wire. Protect bend area with a sleeve.

B. Arrange wiring neatly, cut to proper length, and remove surplus wire. Install abrasion protection for wire bundles passing through holes or across edges of sheet metal.

C. Use manufacturer's recommended tool with sized anvil for crimp terminations. No more than one wire may be terminated in a single crimp lug. No more than two lugs may be installed on a single screw terminal.

D. Do not splice or tap wiring except at device terminals or terminal blocks.

3.2 PROTECTION

A. Protect enclosures and other equipment containing electrical, instrumentation and control devices, including spare parts, from corrosion through the use of corrosion-inhibiting vapor capsules.

B. During Work, periodically replace capsules in accordance with capsule manufacturer's recommendations. Replace capsules at Substantial Completion.

-- End of Section --