**Eaton Guide Specification**

**Notes and instructions to specwriter**

The following guide specification is offered for your assistance in specifying this product as part of a CSI (Construction Specification Institute) compliant document.

This guide specification has been created in MS Word and uses Word features including **Styles** and **Review** to assist in editing and formatting. You may also find it helpful to view the document in **Outline** mode when editing or selecting sections to copy/paste into your base document.

**Styles**

Styles are provided for all paragraph types described in the CSI Masterformat. Applying a Style to text will provide the correct indentation, paragraph letter/number, font, capitalization, etc…. Styles are shown on the right-hand side of the Word “Home” ribbon.



**Review**

“Notes to Specwriter” (when available) are provided using the Reviews feature in Word. To view “Notes to Specwriter” select “All Markup” in the Tracking dropdown menu on the Review ribbon. To hide notes, select “No Markup”. You can advance from one note to the next using the Previous and Next buttons on the same ribbon. In earlier versions of MSWord hide notes by un-checking ‘Comments’ under Review>SH



**Outline view**

The Outline view within Word is often helpful when editing or copying sections from this Guide Specification. Also, when pasting sections from this document into a base document the specwriter may want to consider using right-click and “Merge Formatting’ or ‘Keep Text Only” features.

Section 26 13 13.23

Switchgear – Mv metal enclosed breaker, fixed mounted (msb)

# General

## Scope

### The Contractor shall furnish and install the medium voltage metal enclosed switchgear equipment as specified herein and as shown on the contract drawings.

## Related Sections

## References

### The medium voltage metal-enclosed switchgear and all components shall be designed, manufactured and tested in accordance with the latest applicable standards as follows:

#### ANSI/IEEE C37.20.3

#### ANSI/IEEE C37.20.4

#### ANSI C37.22

#### ANSI C37.57, C37.58

#### NEMA SG5

#### NEMA SG6

#### CSA 22.2 No. 31-M189

#### EEMAC G8-3.3

## Submittals – for Review/Approval

### The following information shall be submitted to the Engineer:

#### Master drawing index

#### Front view elevation

#### Floor plan

#### Top view

#### Single line

#### Schematic diagram

#### Nameplate schedule

#### Component list

#### Conduit entry/exit locations

#### Assembly ratings including:

##### Short-circuit rating

##### Voltage

##### Continuous current

##### Basic Impulse Level

#### Major component ratings including:

##### Voltage

##### Continuous current

##### Interrupting ratings

#### Cable terminal sizes

#### Product data sheets

### Where applicable, the following additional information shall be submitted to the Engineer:

#### Busway connection

#### Connection details between close-coupled assemblies

#### Composite floor plan of close-coupled assemblies

#### Key interlock scheme drawing and sequence of operations

## Submittals – for CONSTRUCTION

### The following information shall be submitted for record purposes:

#### Final as-built drawings and information for items listed in Paragraph 1.04, and shall incorporate all changes made during the manufacturing process

#### Wiring diagrams

#### Certified production test reports

#### Installation information including equipment anchorage provisions

#### Seismic certification as specified

## Qualifications

## Regulatory Requirements

## Delivery, storage and handling

### Equipment shall be handled and stored in accordance with manufacturer’s instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

### Each switchgear assembly shall be split into shipping groups for handling as indicated on the drawings or per the manufacturer’s recommendations. Shipping groups shall be designed to be shipped by truck, rail or ship. Shipping groups shall be bolted to skids. Accessories shall be packaged and shipped separately. Each switchgear shipping group shall be equipped with lifting eyes for handling solely by crane.

## operation and Maintenance Manuals

### Equipment operation and maintenance manuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.

# Products

## Manufacturers

### Eaton

### \_\_\_\_\_\_\_\_\_\_

### \_\_\_\_\_\_\_\_\_\_

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

## Ratings – Switchgear, Switch and Circuit breaker cubicles

Note to Spec. Writer:

Select appropriate paragraph below based upon system voltage

### The 5 kV switchgear assembly ratings shall be as follows:Maximum Design Voltage 4.76 kVBasic Impulse Level 60 kVNominal System Voltage \_\_\_\_ kV three-phase [three-] [four-] wireSystem Grounding [solid] [low-resistance] [high resistance] [ungrounded]Short-Time (2-Second) Current 25 kA Symmetrical RMSMain Cross Bus Continuous CurrentRating [none] [600 Amperes] [1200 Amperes]  [2000 Amperes]

### The 5 kV Breaker/Switch ratings shall be as follows:

### 3-Phase MVA 206 MVA at 4.76 kV Continuous Current Rating 1200 AmperesCircuit Breaker Rated Short-Circuit Current at Rated Maximum kV 25 kA Symmetrical RMSVoltage Range Factor K= 1Short-Time (2-Second) Current 25 kA Sym RMSCircuit Breaker Closing and Latching Capability (and assembly momentary) 40 kA Asym RMS/65 kA Peak

### Switch continuous/load break 1200 Amperes

### Switch Fault Close 40 kA Asymmetrical RMS/65 kA Peak

OR

### The 15 kV switchgear assembly ratings shall be as follows:Maximum Design Voltage 15.0 kVBasic Impulse Level 95 kVNominal System Voltage \_\_\_\_ kV three-phase [three-] [four-] wireSystem Grounding [solid] [low-resistance] [high- resistance] [ungrounded]Short-Time (2-Second) Current 25 kA Symmetrical RMSMain Cross Bus Continuous Current Rating [none] [600 Amperes] [1200 Amperes]

### The 15 kV Breaker/Switch ratings shall be as follows:

### 3-Phase MVA Class 650 MVA at 15 kVContinuous Current Rating 1200 AmperesCircuit Breaker Rated Short-Circuit Current at Rated Maximum kV 25 kA Symmetrical RMSVoltage Range Factor K= 1Short-Time (2-Second) Current 25 kA Sym RMSCircuit Breaker Closing and Latching Capability (and assembly momentary) 40 kA Asym RMS/65 kA Peak Switch continuous/load break 1200 Amperes

### Switch Fault Close 40 kA Asymmetrical RMS/65 kA Peak

### Load Interrupter Switches

|  |
| --- |
| NON-FUSED SWITCH RATING |
| Maximum Continuous and Momentary Fault Close 2-SecondVoltage Load Break kA RMS kA RMS Current Current Asymmetrical Asymmetrical kA Symmetrical  |
| 4.76 or 15 600 or 1200 40 40 25 61 61 38 |
|  |

#### Non-Fused Switch (Continuous and Load Break) \_\_\_\_ Amperes

#### Non-Fused Momentary withstand \_\_\_\_ kA Asym RMS

#### Non-Fused Switch Fault close (3 times, minimum) \_\_\_\_ kA Asymmetrical RMS

#### Non-Fused Switch 2-Second short circuit current \_\_\_\_ kA Sym RMS

|  |
| --- |
| FUSED SWITCH RATING |
| Current Limiting Fuses |
| Maximum Voltage kV | Fuse Ampere RatingB | Fuse Type | Fuse Interrupting Rating, kA Sym RMS | Fused Switch Fault Close Rating, kA Asym RMS | Fused Switch 2-Sec Withstand |
| 4.76 | 250 | CLE | 63 | 101A | NA |
| 4.76 | 450 | CLE | 63 | 101A | NA |
| 4.76 | 750 | CLE | 40 | 64A | NA |
| 15 | 150 | CLE | 63 | 101A | NA |
| 15 | 300 | CLE | 63 | 101A | NA |
| A – UL and CSA listed integrated rating with a Cutler-Hammer CLE fuseB – Fuse ampere rating is maximum for the fuse “frame size.” 5 kV ranges: 10-450, and 600-750. 15 kV ranges: 10-300.  |
| Boric Acid Expulsion Fuses |
| Maximum Voltage kV | Fuse Ampere RatingC | Fuse Type | Fuse Interrupting Rating, kA Sym RMS | Fused Switch Fault Close Rating, kA Asym RMS | Fused Switch 2-Sec Withstand |
| 4.76 | 200 | RBA200 | 19 | 26.5 | NA |
| 4.76 | 400 | RBA400 | 25 | 40 | NA |
| 4.76 | 400 | RBA400 | 37.5 | 60 | NA |
| 4.76 | 720 | RBA800 | 25 | 40 | NA |
| 4.76 | 720 | RBA800 | 37.5 | 60 | NA |
| 15 | 200 | RBA200 | 14.4 | 23 | NA |
| 15 | 400 | RBA400 | 25 | 40 | NA |
| 15 | 400 | RBA400 | 29.4 | 47 | NA |
| 15 | 720 | RBA800 | 25 | 40 | NA |
| 15 | 720 | RBA800 | 29.4 | 47 | NA |
| 14.4 | 400 | HRBA400 | 34.8 | 55.7 | NA |
| 14.4 | 720 | HRBA800 | 34.8 | 55.7 | NA |
| C – Fuse ampere rating is maximum for the fuse “frame size.” RBA200 range: 10 to 200, RBA400 range: 0.5-400, RBA800 range: 0.5-720 amperes. |

#### Fuse Rating \_\_\_\_\_ Ampere

#### Type of Fuse \_\_\_\_\_

#### Fuse Interrupting Rating \_\_\_\_\_ kA Sym RMS

#### Fused Switch Fault Close Rating \_\_\_\_\_ kA Asym RMS

## Construction

### The metal-enclosed switchgear assembly shall consist of deadfront, completely metal-enclosed vertical sections each containing a non-fused load interrupter switch in series with a vacuum circuit breaker. Where shown, furnish additional vertical sections containing load interrupter switches and fuses or miscellaneous auxiliary apparatus of the number, rating and type noted on the drawings or specified herein.

### The following features shall be supplied on every vertical section containing a three-pole, two-position open-closed switch:

#### A minimum 8-inch x 16-inch high-impact viewing window that permits full view of the position of all three switch blades through the closed door. The window shall not be more than 58-inches above the switch pad level to allow ease of inspection

#### On vertical sections without a circuit breaker, the door shall be interlocked with the switch so that:

##### The switch must be opened before the door can be opened.

##### The door must be closed before the switch can be closed.

### High voltage parts within circuit breaker compartments shall be isolated with grounded metal barriers.

### A hinged grounded metal barrier bolted closed in front of every switch to prevent inadvertent contact with any live part, yet allow for a full-view inspection on the switch blade position

#### Provision for padlocking the switch in the open or closed position.

#### Green OPEN, Red CLOSED switch position indicators with the words Open and Closed in French, Spanish and English.

#### A hinged cover with rustproof quarter turn nylon latches over the switch operating mechanism to discourage casual tampering.

#### The primary switch shall be removable from the structure as a complete perational component.

### Vertical section construction shall be of the universal frame type using die-formed and bolted parts. All enclosing covers and doors shall be fabricated from steel whose thickness shall be equal to or greater than those specified in ANSI/IEEE C37.20.3. No owner removable hardware for covers or doors shall be thread-forming type. To facilitate installation and maintenance of cables and bus in each vertical section, a split removable top cover and [split removable rear covers with rustproof nylon handles] [hinged, bolted rear door with padlock provisions] shall be provided. A G90 grade galvanized base shall isolate equipment from contact with the concrete pad providing protection from rust. Heavy-duty hot dipped galvanized anchor clips shall be provided to anchor the switchgear to the concrete pad.

### Each vertical section containing a switch shall have a single, full-length, flanged front door and shall be equipped with two (2) rotary latch-type padlockable handles. Provision shall be made for operating the switch and storing the removable handle without opening the full-length door.

## Bus

### All buses shall be [tin-plated copper] [silver-plated copper].

### Ground bus shall be silver-plated copper and be directly fastened to a galvanized metal surface of each vertical section, and be of a size sufficient to carry the rated (2-second) current of the switchgear assembly.

### A neutral bus shall be provided when indicated on the drawings. It shall be insulated for 1000 Vac to ground. The current rating of the neutral bus shall be 600 amperes.

## BUS SUPPORTING SYSTEMS

### All bus shall be supported utilizing a high strength and high creep support providing 10.5-inch of creep between phases and ground. The molded fins shall be constructed of high track resistant [aramid nylon] [silicone rubber] [cycloaliphatic epoxy].

### All standoff insulators on the primary switches and fuse mountings shall be [glass polyester] [cycloaliphatic epoxy].

## Wiring/Terminations

### One (1) terminal pad per phase shall be provided for attaching contractor supplied cable terminal lugs for a maximum of two (2) conductors per phase of the sizes indicated on the drawings. Sufficient space shall be allowed for Contractor supplied electrical stress relief termination devices.

### Small wiring, fuse blocks and terminal blocks within the vertical section shall be furnished as indicated on the drawings. Each control wire shall be labeled with wire markers. Terminal blocks shall be provided for customer connections to other apparatus.

## Circuit Breaker

### Each circuit breaker shall be operated by a motor-charged spring stored energy mechanism. The spring may be charged manually in an emergency or during maintenance procedures.

### Each circuit breaker shall have three (3) vacuum interrupter assemblies. Each vacuum interrupter shall have a contact wear indicator which does not require any tools to indicate the contact wear. The current transfer from the vacuum interrupter moving stem to the breaker main conductor shall be a non-sliding design. The breaker front panel shall be removable when the compartment door is open for ease of inspection and maintenance of the mechanism.

### The breakers shall be electrically operated by:

#### [120-] [240-] Vac close and AC capacitor trip.

OR

#### [48-] [125-] Vdc close, and [48-] [125-] Vdc trip.

### Each breaker shall be complete with control switch and red and green indicating lights to indicate breaker contact position.

### The control voltage shall be [derived from a control power transformer mounted in the switchgear] [as indicated on the drawings].

## Protective relays

### The switchgear manufacturer shall furnish and install, in the metal-enclosed switchgear, the quantity, type and rating of protection relays as indicated on the drawings and described hereinafter in this specification.

### Microprocessor Three-Phase Protective Relay.

## Load interrupter switch cubicles

### Each load interrupter switch shall have a manual quick-make quick-break over-toggle type mechanism that does not require the use of a chain or a cable for operation, and utilizes a heavy-duty coil spring to provide opening and closing action.

### The speed of opening and closing the switch shall be independent of the operator, and it shall be impossible to tease the switch into any intermediate position.

### The interrupter switch shall have separate main and break contacts to provide maximum endurance for fault close and load interrupting duty.

### The interrupter switch shall have insulating barriers between each phase and between the outer phases and the enclosure.

### A maintenance provision shall be provided for slow closing the switch to check switchblade engagement and slow opening the switch to check operation of the arc interrupting contacts.

### For fused switch cubicles, fault protection shall be furnished by fuses as specified with continuous ratings as shown in the contract documents. Three (3) spare fuse refills shall be provided for each fused switch.

## Utility metering

### Where indicated on the drawings, each utility metering vertical section shall contain provisions for current transformers and voltage transformers as required by the utility. The construction shall conform to the utility company’s metering standards. It shall also conform to the general electrical and construction design of the switchgear specified above.

## OWNER metering

### Where indicated on the drawings, provide [a separate owner metering vertical structure with a front hinged door to provide safe isolated access to meters and all associated terminal and fuse blocks for maintenance, calibration or testing while the gear is energized] [owner metering in the switch or breaker structure on a hinged panel to provide safe isolated access to meters and all associated terminal and fuse blocks for maintenance, calibration or testing while the gear is energized].

### Provide current transformers for metering as shown on drawings. Current transformers shall be wired to shorting-type terminal blocks.

### Provide voltage transformers including primary fuses and secondary protective devices for metering as shown on the drawings.

### Microprocessor-Based Metering System

## accessories

### Supply key interlocks as shown on the drawings

### Furnish [station] [distribution] class surge arresters with ratings in accordance with manufacture’s recommendations.

## Enclosures

### Enclosures shall be constructed per IEEE/ANSI C37.20.3 indoor specifications. (Meets or exceeds NEMA 1.)

### Each vertical section shall be ventilated at the top and bottom, both front and rear, to allow airflow to provide cooling and to help prevent buildup of moisture within the structure.

OR

### Enclosures shall be constructed per IEEE/ANSI C37.20.3 Outdoor specifications. (Exceeds NEMA 3R.)

### Each vertical section shall have a sloped weatherproof roof with labyrinth shaped joints. Use of gasket or caulking to make roof joints weatherproof shall not be permitted. All exterior openings shall be screened to prevent the entrance of small animals and barriered to inhibit the entrance of snow, sand, etc. A minimum of one (1) 250-watt, 120-volt space heater shall be provided in each vertical section. Power for the space heater(s) shall be furnished [as indicated on the drawings] [by a control power transformer mounted in the switchgear] [by a transformer mounted within the low voltage switchboard/switchgear]. The design shall be non-walk-in type.

### Each vertical section shall be ventilated at the top and bottom, both front and rear, to allow airflow to provide cooling and help prevent build-up of moisture within the structure. The ventilated covers shall be externally removable to allow safe maintenance of the filter media without providing access to live parts.

### Enclosure shall be Dust Resistant. All ventilated openings shall be filtered to inhibit the ingress of dust. The ventilated covers shall be externally removable to allow safe maintenance of the filter media without providing access to live parts. All external doors and covers shall be gasketed.

## Nameplates

### A nameplate shall be mounted on the front door of each switch vertical section in accordance with the drawings.

## Finish

### Prior to assembly, all enclosing steel shall be thoroughly cleaned and phosphatized. A powder coating shall be applied electrostatically, then fused on by baking in an oven. The coating is to have a thickness of not less than 1.5 mils. The finish shall have the following properties:Impact resistance (ASTM D-2794) 60 direct/60 indirectPencil hardness (ASTM D-3363) HFlexibility (ASTM D-522) Pass 1/8-inch mandrelSalt spray (ASTM B117-85 [20]) 600 hoursColor ANSI 61 gray

## Miscellaneous devices

### Communication equipment where indicated on the drawings, shall have the following features:

#### The communication system shall be Eaton PowerXpert Architecture

#### Each load interrupter switch position (open and closed) shall be communicated via an addressable relay. This relay shall communicate over a network. The relay shall monitor an auxiliary switch contact that monitors the primary switch position and shall be rated for the application. Each relay shall have a unique address so that it is possible to “call up” and “read” each load interrupter switch’s position from a host computer

### Each breaker position (open and closed), where shown, shall be communicated via an addressable relay. This relay shall communicate over a network. The relay shall monitor an auxiliary breaker contact that monitors the breaker position and shall be rated for the application. Each relay shall have a unique address so that it is possible to “call up” and “read” each breaker’s position from a host computer

#### A blown high-voltage fuse condition on each set of primary fuses shall be monitored by an addressable relay. Any blown fuse operation shall be communicated immediately over the network via the monitoring addressable relay. Each relay shall have a unique address so that it is possible to “call up” and “read” a fuse blown operation for a set of fuses with the communication system

#### The manufacturer shall wire a network to all communication capable devices within the switchgear and wire the network to a set of easily accessible terminal blocks

#### Control power for the addressable relay shall be 120 volts, 60 Hz available [from a fused control transformer] [from an external source as shown on the drawings]

##  Special switchgear configurations

### Automatic Transfer Control – Two Breaker Automatic Transfer Control with Common Load Bus

#### Furnish, where shown on the drawings, a switchgear assembly with microprocessor-based automatic transfer control system for two (2) main breakers with a common load bus. The system shall consist of the two (2) breakers with motor operators as herein specified, and an integrated microprocessor-based automatic transfer control system containing sensing devices, low voltage logic control, and auxiliary equipment, as indicated on the drawings and specified here. The automatic transfer control system, when placed in the “automatic” mode, shall automatically transfer the load bus circuit to the alternate or standby power source upon failure of the preferred normal source

#### The basic sequence of operation based upon two normally energized sources shall be as follows. Normal operation shall be with the preferred source main breaker closed and standby main breaker open. Upon detection of an undervoltage to the line side of the preferred main breaker and after a field adjustable time delay, that main breaker shall open and after an additional field adjustable time delay, the standby breaker shall close restoring power to the facility.

#### The system shall return to the normal preferred source in an open transition manner as follows. Upon restoration of voltage to the line side of the preferred main breaker and after a field adjustable time delay the standby main breaker shall open and after a field adjustable time delay the preferred main breaker shall close

OR

#### The system shall return to normal power in a closed transition manner as follows. Upon restoration of voltage to the line side of the preferred main breaker and after a field adjustable time delay the preferred main breaker shall close and with no time delay, the standby breaker shall open. A synch check protective relay function shall enable the momentary paralleling.

#### The logic of the transfer shall function via a microprocessor controller equal to Eaton type IQ Transfer. The set points shall be field adjustable without the use of special tools. LED lights shall be included on the controller to show:

##### Normal Source Available

##### Standby Source Available

##### Normal Source Connected

##### Standby Source Connected

##### Load Energized.

#### A digital readout shall display each option as it is functioning. Readouts shall display actual line-to-line voltage, line frequency and timers. When timers are functioning, the microprocessor shall display the timer counting down. All set points shall be re-programmed from the front panel of the controller when it is in the program mode. In addition the controller shall display date, time and reason of last 16 transfers; Normal source and standby source runtime/available time/connect time; Load Energized time and set points of timers, voltage pickup and dropout set points. It shall be able to communicate onto a Cutler-Hammer PowerNet monitoring system all values and historical data that are displayed locally, and have the capability to change settings

#### The transfer system shall include the following:

##### A time delay transfer from the normal power source to the standby power source and from the standby power source to the normal source, forcing a neutral position (when open transition is selected) to ensure the load voltage has decayed before reconnecting to the source from which the load is to be fed (0 seconds to 30 minutes)

##### A time delay to override a momentary power outage or voltage fluctuation (0 seconds to 120 seconds)

##### A Form C relay contact that changes state when the power is available on the normal source

##### A Form C relay contact that changes state when the power is available on the standby source

##### Overcurrent phase and/or ground lockout of transfer.

##### A preferred source selection (Source 1 or Source 2, or none).

##### Two (2) sets of three-phase “line side” voltage transformers (open delta for 5 kV or 15 kV) with primary fuses and secondary supplementary protectors to provide both sensing and control power

##### One selector switch with automatic and manual positions

##### One selector switch for open or closed transition mode return to preferred normal source.

##### One (1) open-close control switch for manual electrical operation of each controlled breaker

##### One (1) pushbutton to initiate manual retransfer to preferred source when the IQ Transfer Controller is functioning automatically and programmed to “Hold” after transfer.

OR

### Automatic Transfer Control – Three Breaker Automatic Transfer Control with Two Mains and Normally Open Tie.

#### Furnish, where shown on the drawings, a switchgear assembly with automatic transfer control system for two (2) mains and normally open tie. The automatic transfer switchgear shall consist of a deadfront, metal-enclosed and integrated assembly including two (2) main breakers and one (1) tie breaker each being driven by a motor operator hereinafter specified, and an integrated automatic transfer control system containing sensing devices, low voltage logic control and auxiliary equipment, as indicated on the drawings. Operation shall be such that upon loss of voltage to the line side of a main, that main shall open and then the tie shall close

#### The basic sequence of operation based upon two normally energized sources shall be as follows. Normal operation shall be with the main breakers closed and the tie breaker open. Upon detection of an undervoltage to the line side of a main breaker and after a field adjustable time delay, that main breaker shall open and after an additional field adjustable time delay, the tie breaker shall close restoring power to the affected portion of the facility.

#### The system shall return to the normal source in an open transition manner as follows. Upon restoration of voltage to the line side of the preferred main breaker and after a field adjustable time delay the tie breaker shall open and after a field adjustable time delay the preferred main breaker shall close

#### OR

#### The system shall return to normal power in a closed transition manner as follows. Upon restoration of voltage to the line side of the preferred main breaker and after a field adjustable time delay the preferred main breaker shall close and with no time delay, the tie breaker shall open. A synch check protective relay function shall enable the momentary paralleling.

#### The transfer system shall include the following:

##### Time delays upon loss of voltage to either source. (0 seconds to 120 seconds)

##### Time delays on detection of return of normal voltage (0 seconds to 120 seconds)

##### Time delays forcing a neutral position (when open transition is selected) to ensure the load voltage has decayed before reconnecting to the source from which the load is to be fed (0 seconds to 30 minutes)

##### Overcurrent phase and/or ground lockout of transfer.

##### Complete interlocking of breakers to prevent all breakers from closing when the system is in the manual mode. If open transition return to normal is selected, interlocking shall also be provided in the automatic mode.

##### Two (2) sets of three-phase “line side” voltage transformers (open delta for 5 kV or 15 kV) with primary fuses and secondary supplementary protectors to provide both sensing and control power

##### Two sets of utility grade microprocessor based 27/47 voltage detection relays equal to Cutler Hammer type.

##### One selector switch with automatic and manual positions

##### One (1) open-close control switch for manual electrical operation of each controlled breaker

# execution

## Factory Testing

### The following standard factory tests shall be performed on the circuit breaker element provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.

#### Circuit breaker operated over the range of minimum to maximum control voltage

#### Factory setting of contact gap

#### One (1) minute dielectric test per ANSI standards

#### Final inspections and quality checks

### The following production test shall be performed on the circuit breaker housing:

#### One (1) minute dielectric test per ANSI standards on primary and secondary circuits

#### Operation of wiring, relays and other devices verified by an operational sequence test

#### Final inspection and quality check

### The manufacturer shall provide three (3) certified copies of factory test reports.

### Factory tests as outlined above shall be witnessed by the owner’s representative.

#### The manufacturer shall notify the owner two (2) weeks prior to the date the tests are to be performed

## Field Quality Control

### The Contractor shall provide the services of a qualified factory-trained manufacturer’s representative to provide startup of the equipment specified under this section for a period of \_\_\_\_ working days.

### The Contractor shall provide three (3) copies of the manufacturer’s field startup report.

## Training

### The Contractor shall provide a training session for up to five (5) owner’s representatives for \_\_\_\_ normal workdays at a jobsite location determined by the owner.

### The training session shall be conducted by a manufacturer’s qualified representative and consist of instruction on the assembly of switches, circuit breaker(s), protective devices, and other major components.

## Installation

### The Contractor shall install all equipment per the manufacturer’s recommendations and the contract drawings.

### All necessary hardware to secure the assembly in place shall be provided by the Contractor.

## Field Adjustments

### The relays shall be set in the field by:

#### The Contractor in accordance with settings designated by the Engineer.

#### OR

#### The Contractor in accordance with settings designated in a coordination study of the system as required elsewhere in the contract documents.

## FIELD TESTING