**Eaton Guide Specification**

**Notes and instructions to specwriter**

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Section 26 13 16.15

MEDIUM VOLTAGE ARC RESISTANT Load interrupter switchgear

# General

## Scope

### The Contractor shall furnish and install the medium voltage load interrupter switchgear as specified herein and as shown on the contract drawings.

## Related Sections

## References

### The medium voltage load interrupter 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

#### IEEE Testing Guide C37.20.7

#### ANSI C37.22

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

#### NEMA SG5

#### NEMA SG6

#### CSA 22.2 No.31-M89 (5/15 kV ratings only)

#### CSA 22.2 No. 193

#### CSA 22.2 No. 58

### Listing by Underwriters Laboratories (UL) or Canadian Standards Association (CSA) shall be provided for 5 kV or 15 kV class medium voltage arc resistant load interrupter switchgear.

## 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

#### Nameplate schedule

#### Component list

#### Conduit entry/exit locations

#### Assembly ratings including:

#### Main cross bus momentary and short time short-circuit withstand ratings

##### Voltage

##### Continuous current

##### Basic Impulse Level

##### Enclosure internal arc short circuit rating and duration

#### Major component ratings including:

##### Voltage

##### Continuous current

##### Interrupting ratings

#### Cable terminal sizes

### Where applicable or required by the Engineer the following additional information shall be submitted to the Engineer:

#### Bus duct connection

#### Connection details between close-coupled assemblies

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

#### Electrical schematic diagram

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

#### Descriptive bulletins

#### Product data sheets

## 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

### The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

### For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

### The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

### Provide Seismic tested equipment as follows:

#### The equipment and major components shall be suitable for and certified ***by actual seismic testing*** to meet all applicable seismic requirements of the 2006 International Building Code (IBC). Guidelines for the installation consistent with these requirements shall be provided by the equipment manufacturer and based upon testing of representative equipment. Equipment certification acceptance criteria shall be based upon the ability for the equipment to be returned to service immediately after a seismic event within the above requirements without the need for repairs.

#### The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.

##### The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil engineer in the state. Mounting recommendations shall be provided by the manufacturer based upon the above criteriato verify the seismic design of the equipment.

##### The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.

##### The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

## 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 Corporation

###

###

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 assembly ratings shall be as follows:

#### Nominal System Voltage \_\_\_\_ kV three-phase [three] [four] wire

#### System Grounding [solid] [low-resistance]  [high-resistance] [ungrounded]

#### Rated Maximum Voltage [4.76 kV][15 kV]

#### Rated Lightning Impulse Withstand Voltage (BIL) [60 kV for 4.76 kV assemblies][95

 kV for 15 kV assemblies]

#### Arc Resistant Accessibility Type Type 2B per IEEE C37.20.7

#### Main Cross Bus Continuous Current [None] [600 A] [1200 A] [2000 A for 4.76 kV Assemblies only]

Items 7, 8, & 9 below 🡺 fill in data from Table 16361C-1

Items 11, 12, & 13 below 🡺 fill in data from Table 16361C-2

Items 14, 15, 16, & 17 below 🡺 fill in data from Table 16361C-3

#### Main Cross Bus Momentary Current (10 Cycle) \_\_\_\_ kA rms Asym/\_\_\_\_\_ kA peak

#### Main Cross Bus 2-Second Short Circuit Current \_\_\_\_ kA rms Sym

#### Enclosure Internal Arc Short Circuit Rating \_\_\_\_ kA rms Sym/\_\_\_\_ kA peak

#### Enclosure Internal Arc Short Circuit Duration 0.5 second

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

#### Non-Fused Switch Fault Close and Momentary withstand kA rms Asym

#### Non-Fused Switch 2-Second Short-time short-circuit current kA rms Sym

#### Fuse Rating [ Ampere][As shown on drawings]

#### Type of Fuse

#### Fuse Interrupting Rating kA Sym RMS

#### Fused Switch Fault close & Momentary kA Asym RMS

|  |
| --- |
| **Table 16361C-1** |
| Switchgear Assembly Ratings per IEEE C37.20.3-2001 |  | Switchgear Assembly Internal Arc Withstand Ratings Per IEEE C37.20.7 |
| Rated Maximum Voltage | Power Frequency Withstand Voltage, 60 Hz,1 Minute | Lightning Impulse Withstand Voltage (LIWV) (BIL) | Rated Main bus Continuous Current | Rated Momentary Short-Circuit Current Withstand (10 cycle) (167 ms) | Rated Short-time Short-Circuit Current Withstand ( 2 second) | Accessib-ility Type | Rated Internal Arc Short-Circuit withstand Current | Rated Internal Arc Short-Circuit Duration |
| kV rms | kV rms | kV Peak | Amperes | kA rms Asym | kA Peak | kA rms sym | kA rms Sym | kA Peak | Sec |
| 4.76 | 19 | 60 | 600, 1200 | 40 | 65 | 25 | 2B | 25 | 65 | 0.5 |
| 4.76 | 19 | 60 | 600, 1200 | 61 | 99 | 38 | 2B | 40 | 104 | 0.5 |
| 4.76 | 19 | 60 | 2000 | 61 | 99 | 38 | 2B | 40 | 104 | 0.5 |
| 4.76 | 19 | 60 | 600, 1200 | 80 | 130 | 50 | 2B | 40 | 104 | 0.5 |
| 4.76 | 19 | 60 | 2000 | 80 | 130 | 50 | 2B | 40 | 104 | 0.5 |
| 4.76 | 19 | 60 | 2000 | 101 | 164 | 63 | 2B | 40 | 104 | 0.5 |
| 15 | 36 | 95 | 600, 1200 | 40 | 65 | 25 | 2B | 25 | 65 | 0.5 |
| 15 | 36 | 95 | 600, 1200 | 61 | 99 | 38 | 2B | 40 | 104 | 0.5 |
| 15 | 36 | 95 | 600, 1200 | 80 | 130 | 50 | 2B | 40 | 104 | 0.5 |
| 15 | 36 | 95 | 600, 1200 | 101 | 164 | 63 | 2B | 40 | 104 | 0.5 |

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| --- |
| **Table 16361C-2** |
| NON-FUSED SWITCH RATINGS |
| Maximum Continuous and Momentary & Fault Close 2-SecondVoltage (kV) Load Break kA RMS Short-time short-circuit Current (Amp) Asymmetrical kA rms Symmetrical  |
| 4.76 or 15 600 or 1200 40 25 61 38 |

|  |
| --- |
| Table 16361C-3 |
| Fuse Type | Switchgear Rated Maximum Voltage | Fuse Rated Continuous Current Range | Fuse Interrupting Rating  | Fused Switch Fault-Close Rating  |
|  | kV rms | Amperes | kA rms Sym | kA rms Asym |
| RBA-200 | 4.76 | 10-200 | 19 | 26.5 |
| RBA-400 | 4.76 | 10-200 | 25 | 40 |
| RBA-400 | 4.76 | 0.5-400 | 37.5 | 60 |
| RBA-800 | 4.76 | 0.5-400 | 25 | 40 |
| RBA-800 | 4.76 | 0.5-720 | 37.5 | 60 |
| BHLE | 4.76 | 10-450 | 63 | 101 (note-1) |
| CLE600/750 | 4.76 | 600-750 | 40 | 64 |
| RBA-200 | 15 | 10-200 | 14.4 | 23 |
| RBA-400 | 15 | 0.5-400 | 25 | 40 |
| RBA-400 | 15 | 0.5-400 | 29.4 | 47 |
| RBA-800 | 15 | 0.5-720 | 25 | 40 |
| RBA-800 | 15 | 0.5-720 | 29.4 | 47 |
| HRBA-400 | 14.4 | 0.5-400 | 34.8 | 55.7 |
| HRBA-800 | 14.4 | 0.5-720 | 34.8 | 55.7 |
| BHLE | 15 | 10-250 | 63 | 101 (note-1) |
| BHCL | 15 | 300 | 63 | 101 (note-1) |
| Note-1 = UL and CSA listed integrated rating with an Eaton BHLE or BHCL fuse. |

## 5 and 15 kV Construction

### The metal-enclosed load interrupter switchgear shall consist of deadfront, completely metal-enclosed vertical sections containing load interrupter switches and fuses (where shown) 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 5-inch x 18-inch high-impact viewing window that permits full view of the position of all three switch blades through the closed door. Open Switch Blades should provide adequate AIR (normal air) clearance to provide full dielectric insulation between Line and load per IEEE C37.30.4 without the use of insulators or insulating gasses. The window shall not be more than 58-inches above the switch pad level to allow ease of inspection

#### The fuse compartment door shall be interlocked with the switch so that:

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

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

#### Switch compartment door shall be interlocked such that it cannot be opened until the switch has been locked open and fuse compartment door has been unlocked and opened.

#### 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 switch shall be removable from the structure as a complete operational 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 with thickness equal to or greater than that 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, padlockable hinged rear covers held closed by bolts shall be provided.

### Each vertical section containing a switch shall have hinged, bolted upper and lower front doors for access to load interrupter switch and fuse compartments. Switch operating mechanism shall be easily accessible from the front without requiring opening of main front doors. Removable handle shall be provided for manual operation of the switch. Provide storage provision for the removable handle within the switch operating mechanism box.

### Each load interrupter switch shall have the following features:

#### Three-pole gang-operated mechanism

#### 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 energy

#### 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 under normal operation

#### Separate main and break contacts to provide maximum endurance for fault close and load interrupting duty

#### Insulating barriers between each phase and between the outer phases and the enclosure

#### A maintenance provision for slow closing the switch to check switch blade engagement and slow opening the switch to check operation of the arc interrupting contacts

## Bus

### All phase bus conductors shall be [tin-plated copper] [silver-plated copper].

### Ground bus shall be silver-plated copper and be directly fastened to an unplated 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 only 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 Insulation SYSTEM

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

### All standoff insulators on 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 owner’s connections to other apparatus.

## fuses

### Fault protection shall be provided by fuses with continuous ratings as shown in the contract documents. Any fuse/switch integrated momentary and fault close ratings specified shall have been verified by test and UL and CSA certified.

## Utility metering

## 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 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 ring-type current transformers for each meter. 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.

### Web-Enabled Communications

#### Where indicated on the drawings, provide a separate compartment with a front facing hinged door as a central point of connection for all internally located communicating devices to an external Ethernet network and allow monitoring of the power infrastructure with real-time, web-enabled data.

#### The compartment shall have a lockable, hinged door with a functional through-the-door RJ45 network access port. Power for the components in the compartment shall be supplied by a pre-wired, bus-connected control transformer in the compartment that is fused and has a disconnecting means.

#### The included communications components shall be a [Power Xpert Ethernet Switch(es)] [Power Xpert Gateway(s)], which [is] [are] specified in Section 16911. Communication equipment, where indicated on the drawings, shall have the following features:

##### The communication system network shall be Cutler-Hammer type PowerXpert Architecture

##### Each load interrupter switch position (open and closed), where shown, shall be communicated via the network using an addressable relay. Each relay shall have a unique network address.

##### A blown high voltage fuse condition on each set of three (3) fuses shall be monitored by an addressable relay. Any blown fuse operation shall be communicated immediately over the network via the monitoring addressable relay.

##### The manufacturer shall wire between all communication capable devices within the switchgear, including electronic meters with the same protocol and wire to a set of easily accessible terminal blocks

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

## aCcessories

### Supply key interlocks as shown on the drawings.

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

## Miscellaneous Devices

### Motor operators, where indicated on the drawings, shall have the following features:

#### All motor-operated switches shall consist of a standard manually-operated switch in combination with an electric motor driven linear actuator, which charges the spring. Connection between the linear actuator and switch mechanism shall be by reliable rigid metal-to-metal linkages; not chains or cables. The linear actuator and all associated low voltage wiring shall be located in a low voltage compartment or barriered to separate it from the high voltage.

#### Operating voltage shall be 120 volts, 60 Hz available [from a fused control transformer] [from an external source as shown on the drawings]. The switch shall be capable of manual operation should a loss of control power be encountered.

#### The linear actuator shall be a highly repetitively manufactured item, completely sealed and weather protected, and designed for rugged industrial application. No lubrication or adjustments shall be necessary for its normal operating life. The motor shall be equipped with an automatically reset thermal overload protector.

#### Motor operator shall be easily removable for maintenance purposes.

## Encl osures

### Enclosures shall be constructed per IEEE/ANSI C37.20.3. It shall be designed such that it can be installed indoor or outdoor.

### Switchgear enclosure shall provide protection against internal arcing faults at the front, sides, and rear as defined by accessibility Type 2B under ANSI test guide C37.20.2.

### In the event of an internal arcing fault, the resulting arc pressure and the exhaust shall be directed upward and into the plenum fitted above each section.

### Provide a barrier between load-break switch compartment and fuse compartment to maintain arc resistant protection when accessing the fuse compartment after the switch has been locked open.

### The switchgear shall be installed inside an electrical room. An enclosed arc exhaust plenum shall be furnished for installation above the switchgear. Arc exhaust shall be vented from the arc-plenum to the exit location via arc-duct as shown on the drawings. Arc duct shall be supplied by [the switchgear manufacturer][Purchaser]. When supplied by Purchaser, it must be made and installed in accordance with basic minimum design requirements provided by the switchgear manufacturer. Field assembly of the arc-plenum and arc-duct shall be by installing contractor. 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].

-- OR --

### The switchgear shall be installed outdoor. An enclosed arc exhaust plenum shall be furnished for installation above the switchgear. Arc exhaust shall be vented from the arc-plenum to the exit location via arc-duct as shown on the drawings. Arc duct shall be supplied by [the switchgear manufacturer][Purchaser]. When supplied by Purchaser, it must be made and installed in accordance with basic minimum design requirements provided by the switchgear manufacturer. Field assembly of the arc-plenum and arc-duct shall be by installing contractor. 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].

-- OR --

### The switchgear shall be installed inside an outdoor Integrated Power Assembly (IPA). Auxiliary power required for the IPA auxiliary loads [is to be supplied from a suitably sized control power transformer supplied within the switchgear] [will be supplied from an external power source]. Refer to specification \_\_\_\_\_\_\_\_\_ for outdoor IPA requirements. The switchgear shall include an arc exhaust plenum with arc duct exit as needed for the application. An end piece with suitable louver assembly shall be provided at the end of the arc duct exit outside the IPA wall to prevent ingress of snow/rain into the duct under normal operation. The switchgear supplier and IPA supplier shall be responsible for all mechanical and electrical coordination between the switchgear and the IPA. A minimum of one (1) 250-watt, 120-volt space heater shall be provided in each vertical section of the switchgear. Power for the space heater(s) shall be furnished [as indicated on the drawings] [by a control power transformer mounted in the switchgear].

## 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

## Special switchgear configurations

### Duplex Switchgear Assembly

#### Furnish, where shown on the drawings, a duplex switchgear assembly configuration consisting of two (2) load interrupter switches with common load side bus to feed one load circuit, which shall be fused or unfused as indicated on the drawings. Key interlocks shall be supplied to prevent paralleling the incoming sources, and to prevent opening the front door of each vertical section containing one of the two switches unless both switches are locked open

## Automatic Transfer Control – Two-Switch 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 switches with a common load bus. The system shall consist of the two (2) switches 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 switch closed and standby main switch open.

#### Upon detection of an undervoltage to the line side of the preferred main switch and after a field adjustable time delay, that main switch shall open and after an additional field adjustable time delay, the standby switch shall close restoring power to the facility.

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

### The logic of the transfer shall function via a microprocessor controller equal to Eaton type ATC-600 with the following features.

#### 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-programmable 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.

#### The controller shall be equipped with a communications card which will allow it to communicate over the Eaton Power Xpert Architecture. All values and historical data that are displayed locally shall be available via communications.

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

##### 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 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

##### Complete interlocking to prevent both switches from closing when the system is in either the manual or automatic mode.

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

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

# execution

## Factory Testing

### Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.

### 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

#### The manufacturer shall include the cost of transportation and lodging for up to three (3) owner’s representatives. The cost of meals and incidental expenses shall be the owner’s responsibility

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

## Field Quality Control

### Provide the services of a qualified factory-trained manufacturer’s representative to assist the Contractor in installation and startup of the equipment specified under this section for a period of \_ working days. The manufacturer’s representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.

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

## Manufacturer’s Certification

### The Contractor shall provide a qualified factory-trained manufacturer’s representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer’s recommendations.

### The Contractor shall provide three (3) copies of the manufacturer’s representative’s certification.

## Training

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

### The training session shall be conducted by a manufacturer’s qualified representative and consist of instruction on the assembly, switches and major components.

## Installation

### The Contractors 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

## Field Testing