Metal-Clad Switchgear Specification—5 kV to 15 kV

Refining Department

API STANDARD 544
FIRST EDITION, SEPTEMBER 1980

OFFICIAL PUBLICATION

REG. U.S. PATENT OFFICE

API specifications (standards) are published as an aid to procurement of standardized equipment and materials. These specifications are not intended to inhibit purchasers and producers from purchasing or producing products made to specifications other than API.

Nothing contained in any API specification is to be construed as granting any right, by implication or otherwise, for the manufacture, sale, or use in connection with any method, apparatus, or product covered by letters patent, nor as insuring anyone against liability for infringement of letters patent.

API specifications may be used by anyone desiring to do so, and every effort has been made by the Institute to assure the accuracy and reliability of the data contained in them. However, the Institute makes no representation, warranty, or guarantee in connection with the publication of API specifications and hereby expressly disclaims any liability or responsibility for loss or damage resulting from their use; for any violation of any federal, state, or municipal regulation with which an API specification may conflict; or for the infringement of any patent resulting from the use of an API specification.

FOREWORD

The objective of this standard is to provide a purchase specification to facilitate the manufacture and procurement of metal-clad switchgear assemblies consisting of switching and interrupting devices and their combination with associated control, metering, protective, and regulating devices for petroleum and chemical industry service. This specification is limited to metal-clad switchgear rated 5 kilovolts to 15 kilovolts.

This specification requires the purchaser to specify certain details and features. It is recognized that the purchaser may desire to modify, delete, or simplify sections of the specification. It is strongly recommended that such modifications be made by supplementing this specification rather than by rewriting or by incorporating sections thereof into another complete specification.

Successful application and reliable operation of metal-clad switchgear requires that special attention be given to proper application and setting of switchgear.protective relays and devices. Designation of the responsible party—vendor, contractor, or owner—should be made early in a project, or at the latest, when switchgear proposals are requested.

Suggested revisions are invited and should be submitted to the Director, Refining Department, American Petroleum Institute, 2101 L Street, N.W., Washington, D.C. 20037.

CONTENTS

Metal-Clad Switchgear Specification
5 kV to 15 kV

SECTION 1—GENERAL

1.1 Scope

This specification, together with applicable data sheets and job specifications, covers the materials, design, fabrication, and testing of metal-clad switchgear assemblies with associated control, metering, protective, and regulating devices for petroleum and chemical industry service. This specification covers metal-clad switchgear rated 5 kilovolts to 15 kilovolts (kV).

Should conflicts exist, the job specifications will govern.

NOTE: A bullet (•) indicates that a decision may be required which may not be covered on the data sheets (Appendixes A and B). Refer to the Appendix C checklist.

• 1.2 Referenced Publications

1.2.1 Applicable sections of the latest editions of the following standards and codes are part of this specification unless amended herein or by the data sheets:

ANSI/IEEE[1]	
C37.010	*Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis*
ANSI[1]	
C37.04	*Rating Structure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis*
C37.06	*Ratings and Related Required Capabilities for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis*
C37.12	*AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis and a Total Current Basis*
C37.20	*Switchgear Assemblies, Including Metal-Enclosed Bus*
NEMA[2]	
SG5	*Powered Switchgear Assemblies*

1.2.2 The applicability of any federal, state, or local codes, regulations, ordinances, or rules shall be mutually agreed upon by the purchaser and the vendor and listed in Appendix A.

[1] American National Standards Institute/Institute of Electrical and Electronic Engineers, 1430 Broadway, New York, New York 10018.

[2] National Electrical Manufacturers Association, 2101 L Street, N.W. Washington, D.C. 20037.

1.3 Application

The purchaser shall supply the following information:

1. One-line diagram showing electrical arrangement and number and service of circuit breakers.
2. Completed data sheets (Appendix A) specifying electrical ratings; relay, instrument, and control requirements; bus duct and/or cable connections; type of enclosure; and special conditions.
3. Arrangement drawing, if appropriate.

• 1.4 Service Conditions

1.4.1 Metal-clad switchgear designated as suitable for indoor operation shall be furnished with enclosures designed for both continuous operation and long periods of inactivity in atmospheres that may be made corrosive by traces of chemicals that could be present in a petroleum or chemical processing plant and by environmental conditions existing at the plant site, such as high humidity, insects, and rodents. The purchaser shall specify the chemicals involved and the environmental conditions that prevail.

1.4.2 Enclosures designated as suitable for outdoor operation shall not require additional protective shelters or coatings and shall afford adequate protection against rain, snow, dust, and salt-laden air in addition to the requirements for indoor operation in 1.4.1. The purchaser shall specify the enclosure type required (that is, indoor ventilated, minimum outdoor ventilated, protected aisle outdoor ventilated, or common aisle outdoor ventilated) for the environmental conditions anticipated.

1.5 Operating Experience

When a new design or material that has not been proven in service for at least 2 years is offered, proposals shall indicate which parts of the metal-clad switchgear equipment are affected, such as new insulating materials, contact design change, and so forth, and the extent of field experience with such parts.

1.6 Guarantee

The metal-clad switchgear shall be guaranteed by the vendor against defective material, poor workmanship, design deficiencies, and failure from normal usage for a minimum of 1 year after being placed in the specified

service or 18 months after the date of shipment. The vendor shall repair, as required, any equipment damage resulting from poor workmanship or faulty design found within this time without expense to the purchaser.

• 1.7 Drawings and Data

1.7.1 The bidder shall furnish the information specified in 1.7.1.1 and 1.7.1.2 with his quotation.

1.7.1.1 Data Sheets

The specified number of copies of each of the purchaser's data sheets completed with the information requested by the purchaser shall be included.

1.7.1.2 Outline Drawings

The specified number of copies of complete outline dimensional drawings that include weights for each cubicle or line-up shall be supplied. The drawings shall show the principal dimensions of the switchgear line-up, the voltage, and interrupting, momentary, and continuous ratings, where applicable.

1.7.2 In addition to the information furnished with the quotation, the successful bidder shall furnish the specified number of copies of the information in 1.7.2.1 through 1.7.2.3 for design, installation, maintenance, and record purposes. All drawings and data shall be identified with the job number, the purchaser's name, the purchaser's complete requisition number, and the item number.

1.7.2.1 Preliminary

If not furnished with the bid, within an agreed specified period after issuance of a purchase order and before the start of preparation of approval drawings, the manufacturer shall submit the specified number of copies of preliminary drawings showing major outline dimensions of the equipment; openings for conduit, bus duct, and so forth; clearances required for withdrawal of equipment; and clearances for door opening and removal of panels.

1.7.2.2 Approval

Within an agreed period after receipt of a purchase order and prior to starting the fabrication, the manufacturer shall submit for approval the specified number of copies of drawings covering dimensions and including all clearances required for door swings and equipment removal; the individual and total assembly weights; the mounting arrangements; a bill of materials; and the applicable one-line, ac three-line, and ac/dc schematic diagrams. Copies of the manufacturer's drawings and other data shall be marked to facilitate the coordination of all drawings into a cohesive package. One copy bearing the purchaser's approval stamp and notations of any required corrections will be returned to the manufacturer.

1.7.2.3 Final

After approval of the above-mentioned drawings and data, the manufacturer shall supply the following final as-built items:

1. The specified number of copies or one reproducible copy of fully dimensioned drawings including total weights; mounting arrangements; and one-line, three-line, schematic, and connection diagrams.
2. The specified number of copies of operating and maintenance instruction booklets.
3. The specified number of copies of the recommended spare parts list.
4. The specified number of copies or one reproducible copy of the bill of materials of electrical components.

NOTE: The requirements of 1.7.2.3 shall apply to all components and purchased items incorporated into the switchgear assembly.

SECTION 2—CONSTRUCTION

2.1 General

• **2.1.1** The information required for the selection of the metal-clad switchgear and its components shall be supplied by the purchaser on the data sheets (Appendix A).

• **2.1.2** The required interrupting capacity and continuous current rating for the metal-clad switchgear shall be stated by the purchaser if other than standard.

Standard ratings are:

Interrupting Capacity

At 13,800 volts (15 kV class)
19.5, 30.5 and 40.0 kA symmetrical or 500, 750, 1,000 mVA (nominal mVA)

At 4,160 volts (5 kV class)
33.0, 47.0 kA symmetrical or 250, 350 mVA (nominal mVA)

At 2,400 volts (5 kV class)
36.0, 49.0 kA symmetrical or 150, 200 mVA (nominal mVA)

Continuous Current
1200, 2000 and 3000 amps

• **2.1.3** The type of breaker and enclosure shall be specified by the purchaser. The circuit breakers shall be of the drawout type and may be air-break or vacuum-break.

Metal-clad switchgear may be installed in a building or in an outdoor weatherproof enclosure supplied with the switchgear.

• **2.1.4** Enclosures shall be rigid free-standing structures. Steel panels and doors shall be either 12-gage (2.7 millimeter) minimum thickness or National Electrical Manufacturers Association standard thickness with appropriate forming to provide strength and rigidity. Enclosures shall be suitable for indoor or outdoor installations as specified. Enclosures shall be either for complete line-ups of equipment or for individual units as specified. Enclosures shall be constructed to allow mounting pad level variations of ±⅛ inch (±3 millimeters).

• **2.1.5** Unless otherwise specified on the data sheets, circuit breaker and other switchgear component cubicles shall be bussed together. Where single units are required, they shall be equipped with power bus bars, and the wireway shall extend the full cubicle width. All power and grounding buses and control wiring facilities shall be arranged to facilitate future switchgear additions. The entire length of the power bus shall be insulated for rated voltage. The power buses shall be individually insulated to minimize corrosion and to prevent contact by rodents and snakes.

2.1.6 Adequate space shall be provided for entrance and termination of power cables, control wiring, and raceways. The type, size, number, and location of these wires and conduits, as well as any special fittings will be specified on the data forms.

Breaker cubicle cable compartment sizes shall be mutually determined by the purchaser and vendor when the incoming cable exceeds one 500 kCM (250 square millimeters) cable per phase or where incoming line cables are terminated with potheads or preformed stress cones. A separate cable entrance compartment may be required.

2.1.7 All cubicles shall be grounded to a common ground bus, preferably at the bottom, running the full length of the assembly.

2.1.8 A corrosion-resistant coating over a suitably prepared surface shall be applied to the inside and outside of every cubicle.

2.1.9 Suitable wireways shall be provided in each compartment for control and meter wiring. These troughs shall run the entire length of the complete equipment assembly. Wireways shall be provided between facing line-ups of gear in the walk-in type of enclosure. Low voltage wiring shall be installed in grounded metallic wireways, rigid conduit, or electrical metallic tubing. Control and meter wires shall have a permanent wire marker attached to each wire at each termination.

• **2.1.10** Power bus shall be either copper or aluminum. All bolted power bus connections shall be silver-plated or tin-plated. Material and instructions necessary for insulation of connections or terminations of main power bus shall be supplied with the equipment. Fifteen kilovolt switchgear bus supports shall be porcelain, nontracking epoxy, or glass-filled polyester.

• **2.1.11** Identification nameplates shall be provided for each protective relay, for all control devices, and for meters at each cubicle, as well as for the cubicle service. Nameplates shall be of the engraved type and of appropriate size (minimum ½ × 2 inches). They shall be attached with stainless steel screws.

2.2 Mechanical Design Features

• 2.2.1 INDOOR INSTALLATIONS

Switchgear shall be metal-clad type with draw-out circuit breakers. Breaker and cubicle assemblies shall have permanent, full-travel alignment guides to position the breaker in the cubicle for insertion/withdrawal or lowering/raising.

The cubicle enclosure shall be an indoor-ventilated design. This assumes an environmentally controlled installation location. Ventilation openings shall be suitably filtered or screened with stainless steel hardware cloth arranged to prevent the entrance of snakes and rodents. Control devices shall be selected for proper operation in the designated atmosphere without further protection. Thermostatically controlled space heaters, as specified by purchaser, shall be provided to prevent condensation within the enclosure.

• 2.2.2 OUTDOOR INSTALLATIONS

Switchgear for outdoor installations shall comply with the requirements for indoor installations, in addition to the requirements in 2.2.2.1 through 2.2.2.6.

2.2.2.1 The enclosure shall be weatherproof, minimum ventilated (without operating aisle); weatherproof, protected aisle, ventilated (ventilated with protected aisle); or weatherproof, common aisle, ventilated (ventilated with common aisle between facing line-ups), as specified.

2.2.2.2 The entire enclosure shall be provided with structural shapes that raise the enclosure a minimum of 3 inches (75 millimeters) above the foundation or shall be suitable for direct mounting supported on structural shapes in the foundation, as specified. The underside of the enclosure shall be coated with mastic or other equally effective coating material to prevent rust.

• **2.2.2.3** Joints in the roof and outer steel housing shall be seal welded, bolted, and gasketed or otherwise designed and fabricated to preclude the entry of rain and dust. The roof shall be sloped to provide drainage. Anticondensation material shall be applied to the inside of roof panels, when specified.

2.2.2.4 All removable panels shall be secured with suitable slotted or shaped-head fasteners; or machine bolts engaging captive nuts or tapped holes in structural members. Self-tapping sheet metal screws are not acceptable.

2.2.2.5 An outer door shall be provided at each end of (walk-in) protected aisle or common aisle enclosures. Minimum outdoor (aisle-less) enclosures shall have individual outer doors for each section. Outer doors shall have formed or gasketed weatherproof joints to prevent entrance of dust and moisture. Gaskets shall be held in metal retainers (channels). Door stops shall be provided to lock doors in the open position and shall have a stop release no higher than 6 feet above the floor. Door latches shall engage the steel frame to latch the doors closed. Doors at each end of protected aisle and common aisle enclosures shall have quick-release latch mechanisms. Doors on conventional outdoor enclosures shall have provisions for padlocking.

2.2.2.6 All exposed handles, screws, and hinges shall be stainless steel or equivalent rust-resistant material.

2.3 Electrical Design Features

• **2.3.1** Power circuit breakers, of either the stored energy or solenoid type, shall be electrically controlled, shall be electrically and mechanically trip free, and shall be interchangeable with other breakers of the same voltage, current, and interrupting rating within the same line-up. Circuit breakers shall be so interlocked that they cannot be drawn out or reinserted in the cubicle in the closed position.

2.3.2 Secondary disconnecting devices shall be provided in the auxiliary switch and control leads to the operating mechanisms on removable circuit breakers.

2.3.3 Circuit breaker design shall prevent generation of excessive transient overvoltages caused by breaker operation that may damage the insulation of equipment supplied by the circuit breaker. This applies particularly to circuit breakers used for switching motor no-load or part-load currents and transformer magnetizing currents. Proposals shall specify the maximum overvoltage value that the breaker design produces for the stated low current switching operation. Proposals shall also specify whether voltage limiting devices must be used and the recommended location of these devices, or the breaker shall be applied in accordance with a specific manufacturer's guide to prevent imposing excessive transient voltage on the equipment supplied by the breaker.

2.3.4 Circuit breakers specified for use as motor controllers shall have provisions at the switchgear for opening and closing the breaker when in the test position and provisions only for opening the breaker (not closing) when the breaker is in the operating position. These breakers shall have provisions that automatically render the remote control circuit inoperable when the breaker is in the test or withdrawn position.

2.3.5 Breaker control switches shall have red (closed), white (relay action), and green (open) indicating lights. The lamps in these indicating lights shall be removable from the front of the panels. The white indicating light shall be connected to indicate when the breaker has been opened by any action other than normal use of the control switch. The red indicating light shall be connected to monitor the trip coil and trip circuit of the breaker.

2.3.6 Operating handles for circuit breaker trip-close, metering, synchronizing, and so forth shall have physically different shapes. This is done to avoid operating error.

SECTION 3—PROTECTION

Metal-clad switchgear shall include the protective equipment as specified in items 1 through 8:

• 1. Metal-clad switchgear shall include protective relaying, either electro-mechanical or solid state, as specified by the purchaser or as specified by the manufacturer at the purchaser's request, for the protection of equipment being supplied by the switchgear.

2. Switchboard drawout-type protective relays shall be installed. These relays shall be flush or semiflush mounted at locations convenient for maintenance, inspection, target reset, and testing.

3. Protective relays shall be provided with targets to indicate operation, where applicable.

4. Contacts for relays shall be self-aligning and visible to permit ready inspection.

5. Auxiliary relays associated with protective relays may be surface mounted inside the switchgear, except look-out relays, which shall be flush or semiflush mounted as with protective relays.

6. Protective relays shall have provisions for testing and calibrating, using an external power supply without disconnecting the permanent wiring.

• 7. Required relaying will be shown on the diagrams included with the data sheets.

• 8. When specified by the purchaser, the vendor shall include a protective relay coordination study in his proposal that requires the vendor to engineer the protective relay protection system. This study shall include the necessary calculations, the selection of relays and settings, and the preparation of the coordination curves showing selectivity between devices and the relay settings tabulations. The tabulation shall include relay type, characteristics, suggested settings for tap and time dial, and calibration points.

SECTION 4—METERING

Metering shall be as specified in items 1 through 4:

• 1. Required metering will be shown on the diagrams included with the data sheets.

2. Indicating meters shall be of the switchboard circular scale type for flush or semiflush mounting.

3. Kilowatt-hour meters shall be of the switchboard flush or semiflush drawout type. These meters shall have provisions for testing and calibrating using an external power supply without disconnecting permanent wiring.

4. Where public utility metering is specified, no other wiring shall enter the compartment housing such metering.

SECTION 5—SAFETY FEATURES

Safety features shall include those specified in items 1 through 4:

1. Control power and potential transformers shall have primary current-limiting fuses and be so arranged that withdrawal of the transformers or fuses will disconnect the transformers from the primary source. An interlock shall be furnished so that control power transformer primary fuses cannot be withdrawn until the transformer secondary breaker or switch is opened.

2. Suitable barriers or other protection shall be provided over primary wiring terminals. The terminals of relays, meters, switches, and other devices mounted on hinged panels or doors shall be protected to prevent accidental contact when the panel or door is opened for inspection.

3. The secondary circuits of current transformers shall be wired to accessible terminal strips of the type incorporating short-circuiting bars.

4. Suitable barriers or other protection shall be provided over all medium voltage terminals.

SECTION 6—CONTROL

6.1 Control Power

• **6.1.1** Where control power transformers are specified, the transformers and connections shall conform to the requirements of 6.1.1.1 through 6.1.1.4.

6.1.1.1 One control power transformer shall be connected to the line side of each incoming main feeder breaker and housed in an individual compartment. Where necessary because of size, control power transformers may be stationary.

• **6.1.1.2** Control power transformers shall be single phase, 3-wire grounded neutral with 120/240 volt secondary rating or three phase 4-wire grounded neutral with 120/208 secondary rating.

6.1.1.3 The kilovolts absolute rating shall be determined by the manufacturer. The rating shall be sufficient to supply all power requirements of the switchgear plus any additional requirements specified.

6.1.1.4 Where two control power transformers are required, the secondary of each transformer shall be connected to an automatic transfer switch and one transformer shall be designated as the normal supply. If the space heater circuits are sectionalized similarly to the main bus configuration, power for space heaters may be fed directly from their respective bus control power transformers. In this case the automatic transfer switch may be sized for control and lighting requirements exclusive of space heater requirements. The automatic transfer switch shall have two sets of single pole, double throw contacts for connection to a control power failure alarm.

• **6.1.2** Tripping power and closing power voltages for power circuit breakers shall be specified by the purchaser. Normal tripping voltages are 48, 125, and 250 volts dc.

Normal closing voltages are 48, 125, and 250 volts dc; 115 and 230 volts ac.

• **6.1.3** Control power circuits shall be protected by circuit breakers or a combination disconnecting device and suitable cartridge-type fuses. Individual protection for the control circuit in each cubicle shall be included; however, when specified, individual protection shall not be provided in the trip circuit.

• **6.1.4** The number of separate control power buses will normally be specified by the purchaser. When not specified, a separate control power bus shall be supplied for the feeder breakers of each bus section and for the incoming and any tie breakers.

6.2 Batteries and Battery Chargers

• **6.2.1** When batteries are housed within the switchgear, provisions shall be made for adequate ventilation of the battery enclosure. For standard outdoor enclosures, ventilating louvers shall be provided in the battery enclosure.

6.2.2 Batteries shall be sized to supply the loads described in items 1 and 2 and the situation specified in item 3 for a minimum of 8 hours at an ambient temperature of 5 C with the battery charger not energized:

1. Switchgear normal load (relays, indicating light, and so forth).
• 2. Specified emergency lighting load.
3. Close (or trip for tripping battery) all breakers in rapid succession or the 1-minute rating equal to the closing current requirements of circuit breakers which must be operated to return the system to normal.

• **6.2.3** Battery chargers shall be suitable for the type and voltage of batteries specified and shall be equipped with metering and control devices to allow ready maintenance. They shall be sized to have an output equal to battery continuous load plus 35 percent of the 8-hour discharge rate. Separate power failure alarm contacts shall be provided.

SECTION 7—ACCESSORIES

Where applicable, the accessories specified in items 1 through 5 for metal-clad switchgear shall be supplied:

1. A handle or equivalent device required for removing circuit breakers from cells.
2. A set of test plugs for meter and relay testing.
3. A portable motor or equivalent device for racking breakers into operating position. Two such devices shall be supplied when one lineup of switchgear is supplied. One device per lineup shall be provided if more than one lineup is supplied.
4. A jumper cable with appropriate end fittings to permit reconnection of secondary control circuits for operational test of the breakers outside the cubicle. One cable shall be provided for each lineup of switchgear. The cable shall be long enough to permit complete removal of the breaker from the cubicle.
5. Special tools, such as nonstandard wrenches or sockets, necessary to operate and service the equipment shall be provided with each assembly.

SECTION 8—OPTIONS

The following additional features are listed for the purchaser's consideration:

• 1. When specified, power circuit breakers used for motor starting duty shall have provisions to deenergize the motor space heater circuit when the breaker is closed and to energize when the breaker is open. A disconnect switch or breaker with a suitable nameplate rating should be provided to permit deenergizing the motor space heater circuit when the breaker is open.
2. Where ground detectors are specified in switchgear designated for use in ungrounded delta-connected transformer substations, the installation shall be complete with three wye-connected potential transformers and current-limiting fuses for primary protection. Ground detectors shall have three individual lights with clear lenses or meters mounted on the cubicle front panel for indication. A single pole, double throw, individual contact shall be provided for remote alarm.
• 3. Individual cubicles shall have various metering, relaying, indication, and control as individually specified.
• 4. Test cabinet for complete electrical check of breakers at remote maintenance facilities, when specified.
• 5. One grounding and test device suitable for grounding either line or load side of each cubicle, when specified.

SECTION 9—PERFORMANCE AND TESTS

9.1 Performance

• **9.1.1** Equipment shall be completely assembled (including insertion of the breaker elements, unless specifically excepted), wired, and tested at the factory. Factory tests shall include, but not be limited to, all applicable production tests as outlined in the latest edition of NEMA, IEEE, and ANSI applicable publications (see 1.2 of this standard) and a complete functional test of all components.

9.1.2 The correctness of all control wiring, including interlocks, shall be verified by actual electrical operation of the component control devices under all modes of operation.

9.1.3 Where there is differential, directional, or other sophisticated relaying, the system shall be functionally checked by impressing test currents and/or voltages. The supplier shall submit detailed test procedures to the purchaser for approval.

9.1.4 The number of open-close operations attainable under normal operation shall be specified by the manufacturer.

9.1.5 The supplier shall furnish certified copies of all test reports.

9.2 Enclosure Tests

Assembled enclosure designs, whether for single or multiple circuit breakers and walk-in or nonwalk-in enclosures, shall have appropriate design tests.

SECTION 10—SHIPPING

The manufacturer shall ship switchgear according to the following procedures:

1. Equipment shall be shipped completely assembled whenever feasible.

2. When equipment must be disassembled for shipment, material and instructions for reassembling shipping sections, including making up main power bus connections at shipping splits, shall be provided. Terminal strips and detailed wiring diagrams shall be provided to facilitate reconnection of wiring at shipping splits with each wire and terminal identified with permanent markers.

• 3. Equipment shall be identified with the purchaser's or the vendor's order number and any designations requested on the purchaser's shipping instructions. The vendor shall comply with any special protective handling and packaging requirements for shipment or long-term storage prior to installation or energization and shall specify methods to be used to accomplish this purpose. The vendor shall also supply recommendations for storage at the purchaser's field site.

4. Foreign material to be removed prior to energization shall be clearly identified by distinctive colors, legends, and/or instructions. Temporary warning signs shall be posted on the exterior near the main power disconnect stating "Remove Temporary Materials Before Energizing."

5. All shipments shall contain a packing list which completely outlines the number of separate items that are ultimately to be shipped by the manufacturer in order to meet the requirements of these specifications. Any partial or sectional shipments shall be so indicated on the outline and individual packing lists included to fully describe the content of each shipment. Packing lists shall be in waterproof enclosure envelopes.

APPENDIX A

METAL-CLAD SWITCHGEAR DATA SHEET

RATING: 5 kV to 15 kV

Information to be Supplied by the Purchsaer

JOB NO. _____ ITEM NO. _____
REQUISITION NO. _____
INQUIRY NO. _____
PAGE _____ OF _____ BY _____
DATE _____ REVISION _____

PURCHASER _____
DESTINATION _____
QUOTATION NUMBER _____
MANUFACTURER _____

REMARKS: _____

ARRANGEMENT DESIRED (ONE-LINE DIAGRAM AND LAYOUT ATTACHED): _____

VOLTAGE RATING (kV) _____
CONTINUOUS BUS RATING (amperes) _____
SYSTEM VOLTAGE (kV) _____
SYSTEM:
☐ GROUNDED ☐ UNGROUNDED
POWER BUSS:
☐ COPPER ☐ ALUMINUM
BREAKER TYPE:
☐ VACUUM ☐ AIR BREAK ☐ EITHER
OPERATING MECHANISM:
☐ STORED ENERGY ☐ SOLENOID OPERATED
NOMINAL 3 PHASE INTERRUPTING CAPACITY:
_____ mVA _____ kA
CONTROL:
CLOSING _____ volts dc _____ volts ac
TRIP _____ volts dc
VENTILATED ENCLOSURE:
INDOOR _____
OUTDOOR _____
☐ PROTECTED AISLE ☐ MINIMUM
☐ COMMON AISLE
SPECIAL ATMOSPHERE _____
RELAY COORDINATION RESPONSIBILITY:
☐ SUPPLIER ☐ PURCHASER ☐ CONTRACTOR
ENCLOSURE SPACE HEATER POWER SOURCE _____
RATING: _____ volts _____ watts
THERMOSTAT _____
MOTOR SPACE POWER SOURCE _____
RATING: _____ volts _____ watts

NOTE: ☑ CHECK BLOCK

GROUNDING:
WIRE SIZE AND TYPE _____
CONDUIT SIZE _____
LOCATION _____
BATTERY:
TYPE _____
VOLTAGE _____
BATTERY CHARGER:
AC SUPPLY VOLTAGE _____
OUTPUT VOLTAGE _____
DRAWINGS AND DATA (REQUIRED COPIES) _____
DATA SHEETS (APPENDIX B) _____
PRELIMINARY DRAWINGS _____
APPROVAL DRAWINGS _____
FINAL DRAWINGS _____
OPERATING AND MAINTENANCE BOOKS _____
SPARE PARTS BOOKS _____
BILL OF MATERIALS _____
ONE-LINE DRAWING _____
THREE-LINE DRAWING _____
APPLICABLE FEDERAL, STATE, AND LOCAL REGULATIONS AND CODES _____
OPTIONS AND ACCESSORIES (DESCRIBE) _____

METAL-CLAD SWITCHGEAR DATA SHEET

RATING: 5 kV to 15 kV

Information to be Supplied by the Purchaser

JOB NO. _____ ITEM NO. _____

REQUISITION NO. _____

INQUIRY NO. _____

PAGE _____ OF _____ BY _____

DATE _____ REVISION _____

SWITCHGEAR DATA:

ARRANGEMENT: SEE ATTACHED SKETCH NO. _____ *FOR UNIT DESIGNATION AND LOCATION.*

STRAIGHT LINE-UP _____ SINGLE UNITS _____

UNIT DESIGNATION			
CONT. RMS RATED AMPS			
CONTROL POWER BUS			
NO. OF RELAYS, ANSI			
DEVICE NO., ELECTROMECHANICAL			
(EM) OR SOLID STATE (SS)			
OVERCURRENT			
GROUND OVERCURRENT			
UNDERVOLTAGE (TD) (INST.)			
DIFFERENTIAL			
THERMAL			
LOCKOUT			
METERING			
AMMETER			
VOLTMETER			
kW			
kWH			
POWER FACTOR			
TRANSFORMERS			
CT's: NUMBER & RATIOS			
PT's: NUMBER & VOLTAGES			
CPT's: NUMBER, VOLTAGE, PHASE			
WIRING, POWER			
CONDUCTOR: NO. & SIZE			
CONDUCTOR INSULATION			
RATED AMPS			
RATED VOLTAGE			
POTHEAD: TYPE & NO.			
STRESS CONES: TYPE			
CONDUIT SIZE (INCHES)			
CONDUIT LOCATION			
WIRING, CONTROL			
CONDUCTOR: NO. & SIZE			
CONDUCTOR INSULATION			

METAL-CLAD SWITCHGEAR DATA SHEET
RATING: 5 kV to 15 kV
Information to be Supplied by the Purchaser

JOB NO. _____ ITEM NO. _____
REQUISITION NO. _____
INQUIRY NO. _____
PAGE _____ OF _____ BY _____
DATE _____ REVISION _____

SWITCHGEAR DATA (CONTINUED):

UNIT DESIGNATION			
WIRING, CONTROL (CONTINUED)			
CONDUIT SIZE (INCHES)			
CONDUIT LOCATION			
WIRING, ALARM, SIGNAL			
CONDUCTOR: NO. & SIZE			
CONDUCTOR INSULATION			
CONDUIT SIZE (INCHES)			
CONDUIT LOCATION			
SPECIAL CONTROL			
LOCAL			
REMOTE			
OTHER			
_____			
_____			

MOTOR DATA:

UNIT DESIGNATION			
TYPE OF MOTOR (SCIM) OR (SYN)			
TYPE ENCLOSURE			
RATED HORSEPOWER			
SPEED (RPM)			
VOLTAGE AT 60 HERTZ			
FULL LOAD AMPS			
LOCKED ROTOR AMPS			
SERVICE FACTOR			
TEMPERATURE RISE (° C) AT S.F.			
ALLOWABLE STALL TIME (secs)			
ACCELERATING TIME (secs)			

SPECIAL CONDITIONS: _____

ATTACHMENTS: PLEASE LIST ALL ATTACHMENTS HERE

APPENDIX B

METAL-CLAD SWITCHGEAR DATA SHEET

RATING: 5kV to 15kV

Information to be Supplied by the Manufacturer

JOB NO. _____ ITEM NO. _____

REQUISITION NO. _____

INQUIRY NO. _____

PAGE _____ OF _____ BY _____

DATE _____ REVISION _____

PURCHASER _____

DESTINATION _____

QUOTATION NO. _____

MANUFACTURER _____

MANUFACTURER'S CATALOG NUMBER _____

DELIVERY SCHEDULE: (WEEKS AFTER DATE OF PURCHASE):

- ASSEMBLY _____
- OUTLINE DRAWINGS _____
- PRELIMINARY DRAWINGS _____
- FINAL DRAWINGS _____
- DETAILED DRAWINGS _____
- OPERATION AND MAINTENANCE BOOKS _____
- *SPARE PARTS BOOKS* _____
- BILL OF MATERIALS _____

PRICE (COMPLETE) _____

TRANSPORTATION TO DESTINATION _____

FIELD SERVICE CHARGE _____

INVOICE TERMS _____

kV RATING _____

RELAY COORDINATION RESPONSIBILITY _____

EXCEPTIONS: _____

APPENDIX C
CHECKLIST

This checklist is to be used to indicate specific requirements of the purchaser where the specification provides a choice, requires that a decision be made, or requires that additional information be provided. These items are indicated by a bullet (•) in this specification.

The checklist should be used in conjuction with the Appendix A data sheet which covers information which should be supplied to the vendor for proposal or order purposes. Where needed for additional specification information, an addendum to the specification should be prepared.

Standard Paragraph Number	Items
1.2	Do any other standards apply? Regulations or codes?
1.4	Will any other ambient condition be present? What corrosive chemicals will be present?
1.7	Have number of copies of drawings, data books, and so forth been specified?
2.1.1	Has feeder/motor data been specified?
2.1.2	Have breaker ratings been specified?
2.1.3	Has breaker type been specified?
2.1.4	Has cubicle configuration been shown?
2.1.5	Will cubicles require separate busing?
2.1.6	Have all incoming and outgoing wires and conduits been described? Is an enlarged cable compartment required? Is a separate cable compartment required?
2.1.10	Is there a preference for the bus to be aluminum or copper? Is there a preference for bolted joint plating to be silver or tin?
2.1.11	Has a nameplate schedule been included in attachments?
2.2.1 and 2.2.2	Has enclosure type been specified? Has the type temperature control been specified? Has enclosure mounting (raised or direct) been specified for outdoor enclosures?
2.2.2.3	Is anticondensation material required in roof panels?
2.3.1	Has the type breaker control been specified?
3.1	Have the protective relays been specified? Are they electromechanical or solid state? Is the supplier to have responsibility for relay coordination?
3.7	Is relaying shown on the diagrams attached to the data sheets?
3.8	Is the supplier to have responsibility for relay coordination?
4.1	Is metering shown on the diagram?
6.1.1	Are control power tansformers required?
6.1.1.2	Are control power transformers 120/240 single phase? Or 120/208 three phase?
6.1.2	Has the voltage level for tripping and closing breakers been specified?
6.1.3	Is control power protection to be circuit breaker or combination disconnecting device and cartridge fuses? Is circuit protection not to be provided in the trip circuit?
6.1.4	Has the number of control power buses been specified?
6.2.1	Are batteries housed within switchgear? If so, specify type and preferred location.

6.2.2.2	Has emergency lighting load been specified?
6.2.3	Is a battery charger required? If so, specify ac source and ac and dc protective requirements. Specify if dc panelboard with protective devices for battery, battery charger, and control power buses is required.
8.1	Are motor space heater circuits required?
8.2	Is ground detection required?
8.3	Is any special metering, relaying, or indication required?
8.4	Is an external test cabinet required?
8.5	Are grounding and test provisions required at cubicle?
9.1.1	Are additional factory tests required?
10.3	Are there any special shipping or packaging instructions?
Appendix A	Have all attachments been listed?