Instruction Bulletin - 01.4IB.67000
Power/Vac® Metal-Clad Switchgear

5kV & 15kV
20kA, 25kA, 31.5kA, 40kA, 50kA, & 63kA
1200A, 2000A, 3000A, 3500A, & 4000A FC
Contact Information

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Signal Words

As stated in ANSI Z535.4-2007, the signal word is a word that calls attention to the safety sign and designates a degree or level of hazard seriousness. The signal words for product safety signs are “Danger”, “Warning”, “Caution” and “Notice”. These words are defined as:

- **DANGER**
  
  DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

- **WARNING**
  
  WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

- **CAUTION**
  
  CAUTION, used with the safety alert symbol, indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

- **CAUTION**
  
  CAUTION, used without the safety alert symbol, is used to address practices not related to personal injury.

- **NOTICE**
  
  NOTICE is used to address practices not related to personal injury.

Qualified Person

For the purposes of this manual, a qualified person, as stated in NFPA 70E®, is one who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training to recognize and avoid the hazards involved. In addition to the above qualifications, one must also be:

1. trained and authorized to energize, deenergize, clear, ground, and tag circuits and equipment in accordance with established safety practices.
2. trained in the proper care and use of personal protective equipment (PPE) such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc., in accordance with established safety practices.
3. trained in rendering first aid if necessary.
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Ch 1 General Information

⚠️ WARNING

The equipment described in this document may contain high voltages and currents which can cause death or serious injury.

The equipment is designed for use, installation, and maintenance by knowledgeable users of such equipment having experience and training in the field of high voltage electricity. This document and all other documentation shall be fully read, understood, and all warnings and cautions shall be abided by. If there are any discrepancies or questions, the user shall contact Powell immediately at 1.800.480.7273.

⚠️ WARNING

Prior to adjustments, servicing, maintenance, or any act requiring the operator to make physical contact with the equipment, the power source must be disconnected and the equipment grounded. Failure to do so may result in death or serious injury.

⚠️ NOTICE

The information in this instruction bulletin is not intended to explain all details or variations of the Powell equipment, nor to provide for every possible contingency or hazard to be met in connection with installation, testing, operation, and maintenance of the equipment. For additional information and instructions for particular problems, which are not presented sufficiently for the user’s purposes, contact Powell at 1.800.480.7273.

⚠️ NOTICE

Powell reserves the right to discontinue and to change specifications at any time without incurring any obligation to incorporate new features in products previously sold.
A. Scope

The information in this instruction bulletin describes the following Power/Vac® metal-clad switchgear assemblies:

- 5kV & 15kV
- 20kA, 25kA, 31.5kA, 40kA, 50kA, & 63kA
- 1200A, 2000A, 3000A, 3500A, & 4000A FC

Standard construction details are provided in the appropriate sections. The circuit breaker element operation and maintenance instructions can be found in the circuit breaker operating instruction manual provided with each circuit breaker. Any special switchgear construction details are provided in supplementary documentation.

B. Purpose

The information in this instruction bulletin is intended to provide details required to properly operate and maintain the Power/Vac metal-clad switchgear described in Ch 1 General Information, A. Scope.

This instruction bulletin provides:

1. Safety guidelines
2. General descriptions of the operation and maintenance of the Power/Vac metal-clad switchgear
3. Instructions for installation and placing the switchgear into service
4. Instructions for part replacement
5. Information for ordering renewal parts
6. Illustrations, photographs, and description of the switchgear

The illustrations contained in this document may not represent the exact construction details of each particular type of metal-clad switchgear. The illustrations in this document are provided as general information to aid in showing component locations only.

WARNING

Follow the appropriate safety precautions while handling any of the equipment. Failure to do so may result in death or serious injury.

To the extent required, the products described herein meet the applicable ANSI, IEEE, and NEMA Standards; however, no such assurance is given with respect to local codes and ordinances which may vary greatly.

C. Instruction Bulletins Available Electronically

Changes to the instruction bulletin may be implemented at any time and without notice. Go to powellind.com to ensure use of the current instruction bulletin for Powell equipment.

NOTICE

For more information visit powellind.com. To contact the Powell Service Division call 1.800.480.7273 or 713.944.6900, or email info@powellservice.com.

For specific questions or comments pertaining to this instruction bulletin email documents@powellind.com.
Ch 2  Safety

A. Safe Work Condition

The information in Section A is quoted from NFPA 70E 2012 - Article 120, 120.1 Establishing an Electrically Safe Work Condition.

120.1 Process of Achieving an Electrically Safe Work Condition

1. Determine all possible sources of electrical supply to the specific equipment. Check applicable up-to-date drawings, diagrams, and identification tags.

2. After properly interrupting the load current, OPEN the disconnecting device(s) for each source.

3. Wherever possible, visually verify that all blades of the disconnecting devices are fully OPEN or that drawout type circuit breakers are withdrawn to the fully disconnected position.

4. Apply lockout/tagout devices in accordance with a documented and established policy.

5. Use an adequately rated voltage detector to test each phase conductor or circuit part to verify they are deenergized. Test each phase conductor or circuit part both phase-to-phase, and phase-to-ground. Before and after each test, determine that the voltage detector is operating satisfactorily.

Informational Note: See ANSI/ISA-61010-1 (82.02.01)/UL 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements, for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 1000 V and below.

6. Where the possibility of induced voltages or stored electrical energy exists, ground the phase conductors or circuit parts before touching them. Where it could be reasonably anticipated that the conductors or circuit parts being deenergized could contact other exposed energized conductors or circuit parts, apply ground connecting devices rated for the available fault duty.

B. Safety Guidelines

Study this instruction bulletin and all other associated documentation before installing the switchgear.

Each user has the responsibility to instruct and supervise all personnel associated with usage, installation, operation, and maintenance of this equipment on all safety procedures. Furthermore, each user has the responsibility of establishing a safety program for each type of equipment encountered.

The circuit breakers used in the metal-enclosed switchgear described in this instruction bulletin are operated by a high-energy, high-speed mechanism that is interlocked to provide specific operating sequences. It is mandatory that the following rules be observed to ensure the safety of personnel associated with usage, installation, operation, and maintenance of these circuit breakers.

The safety rules in this instruction bulletin are not intended to be a complete safety program. The rules are intended to cover only some of the important aspects of personnel safety related to Power/Vac® metal-clad switchgear.
C. General

1. Only supervised and qualified personnel trained in the usage, installation, operation, and maintenance of the switchgear shall be allowed to work on this equipment. It is mandatory that this instruction bulletin, any supplements, and service advisories be studied, understood, and followed.

2. Maintenance programs must be consistent with both customer experience and manufacturer’s recommendations, including service advisories and instruction bulletin(s). A well planned and executed routine maintenance program is essential for circuit breaker’s reliability and safety.

3. Service conditions and circuit breaker applications shall also be considered in the development of safety programs. Variables include ambient temperature; humidity; actual continuous current; thermal cycling; number of operations; interrupting duty; and any adverse local conditions including excessive dust, ash, corrosive atmosphere, vermin and insect infestations.

D. Specific

1. **DO NOT WORK ON ENERGIZED SWITCHGEAR.** If work must be performed on the switchgear, remove it from service and place it in an electrically safe condition.

2. **DO NOT WORK ON THE SWITCHGEAR WITH THE CONTROL CIRCUIT ENERGIZED.**

3. **EXTREME CARE MUST BE EXERCISED TO KEEP ALL PERSONNEL, TOOLS, AND OTHER OBJECTS CLEAR OF MECHANISMS WHICH ARE TO BE OPERATED, DISCHARGED, OR RELEASED.** These circuit breakers utilize stored energy mechanisms. These mechanism must be serviced only by skilled and knowledgeable personnel capable of releasing each spring load in a controlled manner. Detailed information regarding these mechanisms is found in the circuit breaker instruction bulletin.

4. **DO NOT ATTEMPT TO CLOSE THE CIRCUIT BREAKER MANUALLY ON AN ENERGIZED CIRCUIT.**

5. **DO NOT USE AN OPEN CIRCUIT BREAKER AS THE SOLE MEANS OF ISOLATING A HIGH VOLTAGE CIRCUIT.** For complete isolation, the circuit breaker shall be in the disconnected position or shall be withdrawn completely.

6. **ALL COMPONENTS SHALL BE DISCONNECTED BY MEANS OF A VISIBLE BREAK AND SECURELY GROUNDED FOR SAFETY OF PERSONNEL PERFORMING MAINTENANCE OPERATIONS ON THE SWITCHGEAR.**

E. Safety Labels

The equipment described in this document has DANGER, WARNING, CAUTION, and instruction labels attached to various locations. All equipment DANGER, WARNING, CAUTION, and instruction labels shall be observed when the circuit breaker is handled, operated, or maintained.

**NOTICE**

Warning and Caution labels are located in various places. Do NOT remove or deface any of these warning/caution labels.
Ch 3 Equipment Description

A. General

**NOTICE**

Powell is committed to continuous product improvement. It is possible that improvements occurred between revisions to this document and therefore, may not be described in these instructions. If the equipment does not resemble the photographs and descriptions contained herein, do not attempt to perform the actions. Contact the Powell Service Division.

Power/Vac® Metal-Clad Switchgear equipped with vacuum circuit breakers is designed to comply with ANSI Standard C37.20.2.

Metal-Clad switchgear is characterized by removable interrupting devices, isolation of major circuit elements, grounded metal compartments, and insulated primary bus conductors. The metal-clad switchgear is a line-up of one or more switchgear vertical sections known as units, which are enclosed on all sides except for the ventilation openings and lower unit cable penetrations.

The metal-clad switchgear is used to protect and control medium voltage alternating current power distribution systems. Each unit consists of a number of circuit breaker compartments, plus auxiliary compartments containing accessory apparatus. The circuit breakers are used to control various types of circuits, such as incoming lines, bus ties, feeders, and motor starters. Also, special functions are provided in great variety and may be required for particular applications. Figure 1 illustrates a typical Power/Vac metal-clad switchgear line-up.

This instruction bulletin should be used in conjunction with the appropriate instructions for Vacuum Circuit Breakers, including any applicable supplement(s), separate instructions covering other components of the metal-clad switchgear, and applicable drawings because each metal-clad switchgear line-up is custom designed for a particular use and application. Separate instructions covering other components are not included in this publication, but are available upon request.

B. Primary Compartment

The primary compartment contains the high voltage equipment and connections. It consists of the breaker compartments, bus compartment, cable termination compartment, and auxiliary compartments for voltage and control power transformers. Each of these compartments is separated from the others by metal barriers for reliability and safety.

Interference interlocks are provided on the metal-clad switchgear to permit only the circuit breaker with the correct voltage, continuous current, MVA and momentary rating to be inserted.
Figure 1  Typical Indoor Power/Vac® Metal-Clad Switchgear Lineup
Figure 2  Typical Outdoor Power/Vac® Metal-Clad Switchgear Lineup
Table A Standard Dimensions

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Continuous Current Rating (Amperes)</th>
<th>Short-Circuit Rating (kA)</th>
<th>Height (inches)</th>
<th>Depth (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>One-High</td>
<td>1200, 2000, 3000</td>
<td>20, 25, 31.5, 40, 50 &amp; 63</td>
<td>95</td>
<td>94</td>
</tr>
<tr>
<td>Two-High</td>
<td>1200, 2000</td>
<td>20, 25, 31.5 40,, 50 &amp; 63</td>
<td>95</td>
<td>94</td>
</tr>
<tr>
<td>One-High</td>
<td>3500</td>
<td>20, 25, 31.5 40,, 50 &amp; 63</td>
<td>95</td>
<td>106</td>
</tr>
<tr>
<td>One-High</td>
<td>4000 Force Cooled</td>
<td>20, 25, 31.5 40,, 50 &amp; 63</td>
<td>106</td>
<td>106</td>
</tr>
</tbody>
</table>

Figure 3  Interior Metal-Clad Switchgear (Lower Compartment)
### Table B Ratings of Medium Voltage Power/Vac Metal-Clad Switchgear

#### 5kV

<table>
<thead>
<tr>
<th>Maximum Voltage</th>
<th>Nominal Voltage</th>
<th>Power Frequency Withstand (kV)</th>
<th>BIL Crest (kV)</th>
<th>Main Bus Continuous Current (A rms)</th>
<th>Symmetrical short-circuit Rating (kA rms)</th>
<th>Short Time Current 2 sec. (kA)</th>
<th>Momentary withstand Rating (kA Crest)</th>
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<td>4.76</td>
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<td>1200, 2000, 3000, 3500, 4000 FC</td>
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<td>40</td>
<td>97</td>
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#### 7.2kV - 15kV

<table>
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<th>Maximum Voltage</th>
<th>Nominal Voltage</th>
<th>Power Frequency Withstand (kV)</th>
<th>BIL Crest (kV)</th>
<th>Main Bus Continuous Current (A rms)</th>
<th>Symmetrical short-circuit Rating (kA rms)</th>
<th>Short Time Current 2 sec. (kA)</th>
<th>Momentary withstand Rating (kA Crest)</th>
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</thead>
<tbody>
<tr>
<td>15.0</td>
<td>13.8</td>
<td>36</td>
<td>95</td>
<td>1200, 2000, 3000, 3500, 4000 FC</td>
<td>20</td>
<td>20</td>
<td>52</td>
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### C. Secondary Compartment

The secondary compartment is located in the front of the equipment where the circuit breaker is withdrawn. The compartment is provided with a hinged panel upon which are mounted the necessary instruments, control and protective devices. The terminal blocks, fuse blocks, and some control devices are mounted inside the compartment on the side sheets and on the internal device panel. A wiring space is provided across the top of the switchgear to run wires between vertical sections.

### D. Breaker Removable Element

The Power/Vac® circuit breaker is a vacuum type circuit breaker. It is designed to meet all the requirements for use in metal-clad switchgear and as such it has all the necessary interlocks and grounding to interface with the switchgear. It is a removable device, designed with wheels that make insertion and removal from the compartment a simple operation. All circuit breakers with equal ratings are interchangeable.

For a detailed description of the circuit breaker and its operation refer to the appropriate instruction bulletin for Power/Vac vacuum circuit breakers.
E. **Breaker Lift Truck**

For ease of breaker handling during installation and removal, a breaker lift truck is furnished as a standard accessory with each Power/Vac switchgear order. This accessory device is used to elevate the breaker from the floor or working platform to the level of the tracks in the switchgear compartment. Docking of the lifting device rails to the switchgear tracks is provided for maximum safety. Refer to Ch 5 Operation, B. Inserting the Removable Element into the Compartment, or the latest version of Instruction Bulletin 01.4IB.66000.

F. **Ratings**

Ratings of Power/Vac switchgear and circuit breakers are based on factors supplied in the following:

- ANSI C37.04 Circuit Breaker Rating Structure
- ANSI C37.06 Circuit Breaker Ratings
- ANSI C37.20.2 Switchgear Assemblies

See Table B, Ratings of Medium Voltage Power/Vac® Metal-Clad Switchgear for complete ratings.

**Note:** Certain non-standard ratings are available for special applications. Consult the manufacturer for details. Refer to the specific job drawings for detailed voltage ratings applicable to particular switchgear line-up.

G. **Lighting Impulse Withstand (BIL)**

The basic impulse level is 60kV for the 4.16kV class switchgear and 95kV for the 8.25kV and 13.8kV class switchgear. The basic impulse level testing excludes control transformers, starting reactors, and autotransformers.

**Note:** If required, AC Field Dielectric Tests should be limited to 75% of Factory Dielectric Test values. Direct current dielectric testing is not recommended. If DC testing is required, see Ch 4 Installation, U. Testing and Inspection for values to be used.

H. **Circuit Breaker Racking Mechanism**

The circuit breaker may be placed in three distinct positions within the circuit breaker compartment of the switchgear:

- Disconnected Position
- Test Position
- Connected Position

In the “disconnected position” the movable primary disconnects of the circuit breaker are disengaged and separated at a safe distance from the stationary primary disconnecting devices located in the compartment. A metal shutter covers the openings of the stationary primary disconnecting devices which prevents contact. In this position, the secondary disconnect devices and control contacts are disengaged.

In the “test position”, the primary disconnecting devices are disengaged and the shutters are closed. The secondary circuits are completed by inserting the secondary disconnect plug (breaker) into the secondary disconnect receptacle of the switchgear compartment via the breaker mounted handle. Now the circuit breaker may be electrically operated without affecting the primary circuit.
Note: At this time the circuit breaker is in the same physical location as the “disconnected position”.

In the “connected position”, the movable primary disconnecting circuits and stationary primary disconnecting circuits are engaged. The shutters are open and the secondary circuits and control contacts are completed.

Interlocks deter the movement of a circuit breaker from one position to another unless the circuit breaker is tripped open. The interlocks also deter closing the breaker between positions.

For complete instructions on inserting and withdrawing the circuit breaker in and out of the switchgear, see Ch 5 Operation of this bulletin and also refer to the applicable Power/Vac® circuit breaker instruction bulletin.

CAUTION

If the circuit breaker main closing spring is charged, withdrawing the secondary disconnect plug will cause this main closing spring to discharge.

I. Remote Racking

The optional electrically operated racking device provides a convenient means for racking a breaker between the connected and test positions from a remote location. It is easily mounted to the breaker compartment front door and is designed for quick transfer between units.

The remote racking device is furnished in two operating voltage versions. The 115VAC, 50/60Hz model has a four foot electrical cord with standard three prong plug to fit a grounded receptacle or extension cord. The 230VAC, 50/60Hz model has a three wire four foot cord to which the purchaser applies his standard plug.

The remote racking device is provided with a two position directional switch, an “On-Off” circuit breaker and a push button control box attached with a 30 foot extension cord.

Refer to the specific instruction bulletin for remote racking instructions.

J. Primary Disconnect Devices

The 1200A and 2000A primary disconnects consist of two rows of silver-plated copper fingers mounted on either side of the circuit breaker studs. These fingers are held in place with a spider which positions the fingers and fastens them to the breaker. Wipe pressure is obtained by tension springs between the rows of fingers which pull them together. When the circuit breaker is connected to the metal-clad studs, the spring force on the fingers is divided between the breaker stud and metal-clad studs (Figure 4).
K. **Bus Compartment**

The main buses are enclosed in a metal compartment with removable front covers to provide accessibility. The bus is supported and insulated by molded glass-reinforced polyester barriers which are flame retardant and track resistant. Polyester supports with porcelain sleeves may be furnished as an option in 5kV and 15kV equipment.

Bus bars are insulated with an extruded thermoplastic insulation sleeving or an applied epoxy insulation using the fluidized bed process. All bolted joints have silver-to-silver connections for low contact resistance. Most joints are insulated with a molded polyvinyl chloride boot.

L. **Current Transformer Compartment**

Current transformers are mounted over the primary bushings in the rear of the breaker compartment and are isolated from the breaker by the shutter barrier. They are front accessible by removal of the shutter barrier.

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CAUTION

The equipment must be deenergized before any component is touched or serious injury could result.

M. **Primary Termination Space**

The primary termination space of each breaker unit is isolated from the other equipment by metal barriers. Space is provided in this compartment for connecting the customer’s primary cable by means of potheads or clamp type terminals. Two-hole NEMA drilling for two cables per phase is provided at all cable connection points.
In double breaker vertical sections, a steel duct serves as a pull-box and barrier to separate the two outgoing cable circuits.

The primary termination space of a unit is accessible by removal of the bolted rear cover.

N. Voltage Transformers

The voltage transformers are mounted on a rollout carriage equipped with primary and secondary disconnecting devices. When the voltage transformers are disconnected, they are at a safe striking distance from all live parts of the metal-clad switchgear. In addition, a grounding device is provided which contacts the fuses when the voltage transformers are disconnected, effectively discharging the transformers. In this position, the transformer fuses may be safely removed and replaced. When the voltage transformer rollout tray is in the disconnected position, the rear barrier of the tray effectively deters access to the stationary primary disconnects mounted in the compartment behind the rollout tray. However, these stationary primary disconnects may remain energized.

O. Current-Limiting Fuses and Control Power Transformer

Current limiting fuses with high interrupting rating are sometimes used in metal-clad switchgear to protect small transformers or circuits where circuit breakers cannot be economically or functionally justified.

The fuses are mounted on a moveable carriage equipped with primary and secondary disconnecting devices. Single phase control power transformers of 15kV and smaller and their secondary breaker are mounted on the carriage with the fuses. Larger control power transformers, up to 37.5kV single-phase or 75kV three-phase, are located in the cable compartment behind their associated fuse carriage and their secondary breaker is located behind a hinged cover on the upper cable compartment.

WARNING

Do not remove the rollout tray from its rails without first deenergizing the primary circuit to which the roll-out connects. Removing the tray makes the stationary primary disconnect devices accessible.

When fuses are disconnected, they are at a safe striking distance from all live parts of the switchgear. In addition, a grounding device is provided which contacts the fuses after they are disconnected, effectively removing any static charge from the fuses. In this position, the fuses may be safely removed and replaced. The primary disconnecting devices are capable of interrupting transformer magnetizing current, but should not be used to interrupt load current. Mechanical or key interlocks are applied to prevent operating the disconnecting device while the load is connected. This is generally accomplished by interlocking so that the transformer secondary breaker must be locked in the open position before the disconnecting device can be connected or disconnected.

Current-limiting fuse and control power transformer rollouts are located in auxiliary units.

P. Dummy Removable Element (Type PVD)

Dummy removable elements are used as a means of isolating circuits or bus sections where operation is infrequent and a circuit breaker cannot be economically justified. The device consists of a circuit breaker mechanism frame and primary insulator supports with six primary studs including disconnecting
devices. Copper rods are bolted in the location normally occupied by vacuum interrupters. The stationary structure is the same as for a circuit breaker. When the device is fully racked in, it connects the top set of metal-clad primary disconnects to the bottom set.

An interlock system, consisting of a side extension identical to the positive interlock extension of a standard circuit breaker when the breaker is closed, ensures that the dummy element cannot be racked in or out unless all sources to which it may connect are deenergized.

A key lock is provided on the dummy element. It takes a key which becomes available only when all sources to which the dummy might connect are deenergized. When the key is available, the key interlock can be operated to withdraw the positive interlock extension. The dummy element now looks like an open breaker and it can be racked in or out. As long as the positive interlock extension is withdrawn, the key is captured and it cannot be released unless the dummy element is in the CONNECTED or TEST position or completely withdrawn. Hence, the sources to which the dummy element may connect cannot be re-energized until the dummy element is in one of these three positions.

The key for the dummy element interlock will usually be obtained from a transfer block at which all the source keys are accumulated and captured before the dummy element key can be obtained.

Q. **Ground and Test Device**

This device is designed to make either the upper or lower primary conductors in the breaker unit readily accessible. The type PVV manual ground and test device provides a convenient means of grounding the cables or the bus in order to safeguard personnel who may be working on the cables or the equipment. The device can be used for applying power for high-potential tests or for fault location. It can be used to measure insulation resistance (megger). By using voltage transformers, it can also be used for phasing out cables. Refer to the instruction bulletin provided for this device. If “hotsticks” are used, they should be insulated.

**NOTICE**

*Note that the main switchgear bus is connected to the lower studs when the device is installed in an upper compartment and to the upper studs when the device is installed in a lower compartment.*

In addition to the device described in this section, there is a deluxe power-operated type GMV device available which has a self-contained bus or line selector switch and a separately controlled, power operated, three-phase grounding switch. The GMV device is a dead-front design with mechanical and electrical interlocks, provisions for remote control and plug-type cable testing and phasing. The primary conductors required for grounding are self-contained, with no external cable connections required.

The GMV device is designed for maximum safety to personnel while accomplishing all the basic required grounding and testing functions. Refer to the specific ground and test device instruction bulletin for more details.
Once the assembly of the metal-clad switchgear is completed on site, all joints and hardware, including bus connections, should be checked for tightness and proper torque values. See Table C, Bolt Torque Values for Power/Vac® Metal-Clad Switchgear.

B. Receiving

Power/Vac Metal-Clad Switchgear is fabricated in rigid, floor mounted, steel vertical sections. The switchgear vertical sections are shipped in an upright position and when received should be kept upright.

When the switchgear is received, check for signs of damage. If damage is found or suspected, file claims as soon as possible with the transportation company and notify the nearest Powell representative.

Refer to the instruction bulletin furnished with the circuit breaker for receiving, handling, and storage instructions on the circuit breaker.

Some components such as top-mounted resistors or potential transformers, may be shipped separately. These components are identified by a number coinciding with that of the switchgear vertical section on which they are to be mounted.

C. Handling

Powell recommends the switchgear be handled or moved by means of an overhead crane. If an overhead crane is not available the switchgear may be moved on an even surface by the use of rollers or heavy duty pipes placed under the switchgear. The use of a forklift is not recommended, since the forks may damage the compartments or interior parts of the switchgear vertical sections. If no other method of handling is available, the forks must be completely under the switchgear base to avoid damage to the switchgear.
For outdoor enclosures, lifting angles are provided attached to the base of the equipment, and spreaders should be used in the slings above the enclosure to prevent damage to the top edges. Do not attempt to lift the equipment by using the angles installed on the sides, as these angles are provided only to tie the equipment down during shipment to ensure that it will not tip if top heavy, and are not intended to be used for lifting purposes. Slings should be tied to referenced angles to prevent tipping.

All indoor switchgear equipment not furnished in a Powell Power Control Room (PCR®) is furnished with channel bases installed at the factory. The equipment may be moved on an even surface by the use of rollers or heavy duty pipe under the base. Any force to move or jack the equipment must be applied to the channel base and not the equipment.

D. Storage

Shipping and storage of electrical equipment requires measures to prevent the deterioration of the apparatus over a long unused period. The mechanical and dielectric integrity must be protected. Electrical equipment is designed for use in a variety of environments. When the equipment is in transit and storage, these design considerations are not fully functional. In general, the following measures must be considered.

1. Equipment designed for indoor installation must be stored indoors in a climate controlled environment to prevent condensation of moisture. Exposure to rain and the elements, even for a short period, can permanently damage the equipment. Space heaters within the equipment should be energized, if so equipped. Humidity controlling desiccant materials should be utilized when space heaters are not provided or cannot be energized. The temperature should be kept above 33°F/1°C and below 140°F/60°C. The relative humidity should be kept below 60% or a dew point of 15°C/59°F. The equipment should be stored in such a manner as to leave all doors and panels accessible for inspection. The equipment must be inspected on a routine basis to assure operational integrity.

2. Equipment designed for outdoor exposure may be stored either in indoor or outdoor storage locations. The equipment must be protected from airborne external contaminates if stored outdoors. Outdoor storage will also require additional care to maintain temporary covers over the openings and shipping splits. The equipment must be provided with control power to facilitate the energization of space heaters, as well as other temperature and humidity controlling equipment. The temperature should be kept above freezing (>33°F/1°C) and below (<140°F/60°C). The relative humidity should be kept below 60% or a dew point of 15°C/59°F. The equipment should be stored in such a manner as to leave all doors and panels accessible for inspection. The equipment must be inspected on a routine basis to assure its integrity.

3. The auxiliary control devices, ship loose material and protective relays must also be protected. This includes items such as battery chargers, UPS systems, lighting, installation hardware and air conditioning. If prolonged storage is anticipated, humidity controlling desiccant materials should be utilized. Desiccant packets should be installed in all compartments and packing containers.
E. Positioning the Metal-Clad Switchgear

1) Drawings and Diagrams

Prior to installation, consult and study all drawings and Bill of Materials furnished by Powell. The drawings include arrangement drawings and wiring and schematic diagrams.

The recommended aisle space for the front and at the rear of the metal-clad switchgear is shown on the floor plan drawing furnished for the particular order. The space at the front must be sufficient to permit insertion, withdrawal, and transferring of the circuit breakers. The space at the rear must be sufficient for installation of cables, inspection and maintenance.

For installation on a pad or sill, the pad or sill shall not extend more than 3” beyond the front of the switchgear for proper interface and operation of the lift device.

When three or more sections are to be arranged in one continuous lineup, the center section should be the first to be located. The other sections should be installed in successive order in each direction from the center of the structure.

When installing a unit substation or power center, the power transformer and the adjacent metal-clad switchgear lineup should first be lined up and set in position in accordance with the dimensions on the base plan drawing for the installation. The additional sections should then be installed.

Establish a base line located a few inches in front of the sections and parallel with the desired front of the structure. Equalize the distances from the front of the sections to the base line to make the face of the group parallel to the base line.

NOTICE

Applicable national or local codes or regulations may require greater aisle space than is needed for operation of the metal-clad switchgear. It is the user’s responsibility to comply with these codes and regulations.

Additional shipping members may have been installed in the bus or primary area to ensure against shipping damage. All shipping members must be removed from the switchgear compartments. All joints must be properly tightened and insulated before energizing the bus.

Mats, railing, etc. that are external to metal-clad switchgear may be required to meet local code. These items must be provided by the purchaser.
Figure 6  Installation Details for Indoor Power/Vac® Metal-Clad Switchgear
**Figure 7   Installation Details for Indoor Power/Vac® Metal-Clad Switchgear (cont.)**

**NOTE#1:** THE FINISHED FLOOR PAD MUST PROJECT 66 INCHES BEYOND THE FRONT OF THE P/V EQUIPMENT DEVICE PANEL. THE ELEVATION MUST BE LEVEL WITH THE BOTTOM OF P/V FLOOR FRAME AND SWITCHGEAR PAD.

**NOTE#2:** ALL FLOOR CHANNELS ARE 4" CHANNEL. SWITCHGEAR FLOOR STEEL (SEE NOTE#2)

**NOTE#3** THE FOUNDATION MUST BE FLAT AND LEVEL IN ALL PLANES. PERPENDICULAR ON BOTH AXES TO WITHIN .25" OVER A 10' SPAN.
Figure 8  Installation Details for Outdoor Power/Vac® Metal-Clad Switchgear

SPREADER
LIFT-SLING

FRONT VIEW

SIDE VIEW

FOR MOVEMENT
IN THIS DIRECTION ONLY
USE ROLLERS

EACH ROLLER MUST SUPPORT THE FRONT, MIDDLE, & REAR FLOOR CHANNELS

LIFTING EYE
CABLE LOOP
LIFTING ANGLE

OPTIONAL METHOD -AB-

JACKING TIMBER
ROLLERS - IF USED

TYPICAL JACKING AREA

OPTIONAL METHOD -AA-

LIFT JACKET
CABLE LOOP
LIFTING ANGLE

LIFTING EYE

OPTIONAL METHOD -AA-

LIFT JACKING METHOD
Figure 9  Installation Details for Outdoor Power/Vac® Metal-Clad Switchgear (cont.)

NOTE
#1. THE FINISHED FLOOR PAD MUST PROJECT 66 INCHES BEYOND THE FRONT OF THE P/V EQUIPMENT DEVICE PANEL. THE ELEVATION MUST BE LEVEL WITH THE BOTTOM OF P/V FLOOR FRAME AND SWITCHGEAR PAD

#2. ALL FLOOR CHANNELS ARE FURNISHED BY THE CUSTOMER.

NOTE
#3 THE FOUNDATION MUST BE FLAT AND LEVEL IN ALL PLANES. PERPENDICULAR ON BOTH AXIS TO WITHIN .25" OVER A 10' SPAN.
**Figure 10** Installation Details for Outdoor Power/Vac® Metal-Clad Switchgear with Protected Aisle
F. Preparation of Floor Anchoring

1) Indoor Metal-Clad Switchgear

The station floor must be strong enough to remain rigid and not sag under the weight of the switchgear structure. The floor also must be able to withstand the impact stress caused by the opening of the circuit breakers under short circuit conditions. The impact load is approximately 1 1/2 times the static load weight of the switchgear.

The user must provide suitable means for anchoring the equipment to the floor. It is essential that the floor be level to avoid distortion of the switchgear structure and that the equipment be completely aligned prior to final anchoring. The recommended floor construction is shown in Figure 6. The floor channels must be level and straight with respect to each other. Steel shims should be used for final leveling of the switchgear, if necessary. Care should be taken to provide a smooth, hard, and level floor under and in front of the units to facilitate installation and removal of the breaker. If the floor is not level and flush with the floor channels, it will be difficult to handle the breaker because it will not be level with respect to the stationary element.

The switchgear structure can be secured by bolting it to the floor channels using at least 5/8” bolts at locations shown in Figure 6. Plug welding can also be used at the same locations if desired.

Provisions should be made in the floor for conduits for primary and secondary cables, located as shown on the floor plan drawing furnished for the particular requisition. If desired, the conduits may be installed before the switchgear. Consideration should be given to conduits which might be required for future connections. Conduits must extend no more than one inch above the furnished floor prior to the installation of the switchgear. If shipped in more than one section, shipping sections must be assembled in the proper sequence due to the location of conduits. The left hand section of a switchgear lineup must be positioned in its final location first. Then the section located immediately to the right must be positioned as close as the lifting members permit with the front in alignment with the first section. Remove the lifting members and then push or jack the unit to the left until it is flush with the first section.

![CAUTION]

Be sure to distribute the forces over the side frame using appropriate timbers so as not to deform or damage the surface of the structure.
Figure 11  Typical Assembly Details

ASSEMBLY OF DETAILS A & B

ASSEMBLY OF DETAILS C&D

ASSEMBLY OF DETAILS E&F

ASSEMBLY OF DETAILS G&H

ASSEMBLY OF DETAILS J & K

ASSEMBLY OF DETAILS L & M

ASSEMBLY OF DETAILS P & N

DETAILS EE-FF
Figure 12  Typical Assembly Details (cont.)

- **METAL CLAD EQUIPMENT**
- **AISLE END WALL**
- **AISLE END EXTENSION**
- **ASSEMBLY OF DETAILS AA & BB**
- **SHIPPING ASSEMBLY OF DETAILS CC & DD**
- **SHIPPING ASSEMBLY OF DETAILS S & T**
- **SHIPPING ASSEMBLY OF DETAILS W & X**
- **SHIPPING ASSEMBLY OF DETAILS Y & Z**

- **1/4-20 BOLT WASHER LOCK WASHER**
- **3/8-16 BOLT X 1 LG WASHER LOCK WASHER NUT**
- **1/4-20 TAPTITE**

- **REUSE HARDWARE TO BOLT AISLE ROOF IN PLACE**
- **LIFTING MEMBER (DISCARD)**
- **SHIPPING COVER (DISCARD)**
- **ASSEMBLY OF DETAILS U & V**

- **METAL CLAD EQUIPMENT**
- **AISLE SIDE PANEL**
- **3/8-16 BOLT X 1 LG WASHER LOCK WASHER NUT**

- **1/4-20 BOLT WASHER LOCK WASHER**
- **3/8-16 BOLT X 1 LG WASHER LOCK WASHER NUT**
- **1/4-20 TAPTITE**

- **METAL CLAD EQUIPMENT**
- **AISLE END EXTENSION**
- **SHIPPING COVER (DISCARD)**

- **REUSE HARDWARE TO BOLT SHIPPING SPLITS**
2) **Outdoor Metal-Clad Switchgear**

Switchgear support should be concrete or reinforced concrete with depth, fill, drainage, etc., according to recommended foundation design for the loading, type of construction, and local conditions involved. The base furnished with the switchgear should be supported on a level surface over the full area of the switchgear. Steel supporting members should be furnished if required for leveling the foundation and supporting the switchgear. Refer to *Figure 9* for recommended foundation and anchoring.

Primary and secondary conduits should be installed in accordance with the requisition drawings, before the equipment is put into place. Conduits must extend no more than one inch above the finished floor prior to the installation of the switchgear.

When outdoor pieces of equipment are shipped in more than one section, the roof joint between the sections must be assembled as shown in *Figure 9*. Shipping sections must be assembled in the proper sequence due to the location of conduits. The left hand section of a switchgear lineup must be positioned in its final location first. Then the section located immediately to the right must be positioned as close as the lifting members permit with the front in alignment with the first section. Remove the lifting members and then push or jack the unit to the left until it is flush with the first section.

---

**CAUTION**

*Be sure to distribute the forces over the side frame using appropriate timbers so as not to deform or damage the surface of the structure.*

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3) **Outdoor Switchgear with Protected Aisle**

a. Remove aisle front wall from the front of the metal-clad switchgear, discard all yellow shipping covers on aisle wall and front of metal-clad switchgear except lifting members. Reuse $\frac{3}{8}$ - 16 hardware. Since the relay and instrument cases are not weatherproof, the control panels should be protected from inclement weather until the installation of the aisle enclosure is complete.

b. Lay down aisle floor in front of each metal-clad unit (*Figure 13*). Secure at each unit line with tie plate and floor cap per *Figure 11, detail A & B*. Secure to metal-clad per *Figure 11, detail E & F*.

c. For aisle end wall design, disassemble channel cap, cap bushing, roof cap, end trim, and corner cap. Reassemble at end of aisle that has the aisle end wall. Reuse $\frac{1}{4}$ - 20 hardware and plug buttons. *Figure 10* and *Figure 12, detail EE & FF*.

d. Disassemble aisle end extensions or aisle end extension and aisle end wall (*Figure 12, detail AA & BB*). Do not remove shipping support from aisle end wall.

e. Position aisle end extension(s) and/or aisle end wall(s) at ends of the line-up. Secure aisle extension to aisle floor and metal-clad switchgear (*Figure 11, details A & B, G & H*). Secure aisle end wall per *Figure 12, detail AA-BB*.

f. Set up aisle wall and secure to aisle floor, aisle end extension(s), aisle end wall(s) and shipping split. *Figure 11, details J-K, C-D*, and *Figure 12, detail AA-BB*.

g. Apply prestige gasketing material to the top of aisle wall, metal-clad roof, and aisle end wall. Punch holes in gasket with drift pin.
h. Remove roof angle (reuse 1/4 - 20 hardware) and set aisle roofs in place, taking care to align the lap joint between the aisle and switchgear roof assemblies before contacting prestite gasket. Secure roof sections to each other, to aisle wall and metal-clad switchgear per Figure 11, details R, L & M, and P & N.

i. Apply RTV clear seal and assemble roof caps, cap bushings, and channel end caps. Figure 11, details L & M, P & N.

j. After steel erection is complete, check to certify that all bolted, butt, or overlapped joints are resistant to water leaks. A source of outside light in a darkened aisle is an indication that RTV108 clear seal should be applied to the exterior surfaces.

k. Assemble grommets in the aisle roof sections.

l. Assemble and wire the light switches, receptacles, lamp sockets, etc. in accordance with the wiring diagrams furnished with the equipment.

m. Anchor the base of the protected aisle assembly to the concrete pad using the anchor clips provided. Install anchor bolts in accordance with the requisition drawing.

4) Outdoor Switchgear with Common Aisle

a. Remove and discard the yellow shipping covers on front of metal-clad switchgear. Since the relay and instrument panels are not weatherproof, the control panel should be protected from inclement weather until the installation of the aisle enclosure is completed.

b. Lay down aisle floor in front of each metal-clad unit of first switchgear line-up. Secure to metal-clad per Figure 11, detail E & F.

c. Move second switchgear line-up into position and secure to aisle floor per Figure 11, E & F. After the switchgear is secured to the aisle floor, it should be anchored to the concrete pad using the anchor clips provided. Install anchor bolts in accordance with the requisition drawing.

d. For aisle end wall design, disassemble channel cap, cap bushing, roof cap, end trim, and corner cap. Reassemble at end of aisle that has the aisle end wall. Reuse 1/4 - 20 hardware and plug buttons.

e. Disassemble aisle end extensions (Figure 12,detail Y & Z) or aisle end extension and aisle end wall. Figure 11, AA & BB. Do not remove shipping support from aisle end wall.

f. Position aisle end extension(s) and/or aisle end wall(s) at ends of the lineup. Secure aisle extension to aisle floor and metal-clad switchgear (Figure 11, details A & B, G & H). Secure aisle end wall per Figure 12, detail AA & BB.

g. Apply prestite gasketing material to top of metal-clad roof and aisle end wall. Punch holes in gasket with drift pin.

h. Remove roof angle (reuse 1/4 - 20 hardware) and set aisle roofs in place taking care to align the lap joint between the aisle and switchgear roof assemblies before contacting prestite gasket. Secure roof sections to each other and to metal-clad switchgear per Figure 11, details R, L & M, P & N.

i. Apply RTV clear seal and assemble roof caps, cap bushing, and channel end caps.

j. After steel erection is complete, check to certify that all bolted, butt or overlapped joints are resistant to water leaks. A source of outside light in a darkened aisle is an indication that RTV108 clear seal should be applied to the exterior surfaces.
k. Assemble grommets in the aisle roof sections.
l. Assemble and wire the light switches, receptacles, lamp sockets, etc. in accordance with the wiring diagrams furnished for the switchgear.

Figure 13  Assembly of Outdoor Switchgear with Protected Aisle
Figure 14  Assembly of Outdoor Switchgear with Protected Aisle - (cont.)
G. BREAKER REMOVABLE ELEMENT

CAUTION

Before inserting a removable element into the compartment, the racking mechanism must be in the “TEST/DISCONNECT” position or damage may occur to the removable element or the switchgear.

Refer to the instruction bulletin shipped with the removable element for installation and operating instructions.

H. TEST CABINET

The test cabinet is used to operate a breaker that has been removed from the metal-clad switchgear. It should be installed on the wall at a location where maintenance and testing of the breaker can be conveniently done. Conduits must be installed for cables to supply control power for testing. Make certain that the green ground conductor is connected to the electrical ground.

I. ADDITION OF UNITS TO EXISTING EQUIPMENT

Before adding units to existing equipment, consult and study all drawings furnished with the equipment. In addition to the usual drawings furnished with new equipment, special drawings may be furnished covering complicated or special assembly work. Also, check to make sure all necessary parts are on hand.

CAUTION

Before any covers are removed or any doors opened which permit access to the primary circuits, it is essential that the circuit or circuits be deenergized and breakers be withdrawn to the test position and tagged.

The information below indicates that special procedures are required to add new metal-clad units to outdoor equipment without a protected aisle and with a protected aisle. For indoor equipment, it is usually necessary only to remove the end trim sheets and to reassemble them on the new units after these are located and bolted to the existing units.

When the units are in place and bolted together, assemble the main bus and other primary connections following the procedure below.

Secondary wiring and control bus connections should be made in accordance with the wiring diagrams furnished with the equipment.

1) Adding Units to Outdoor Equipment without a Protected Aisle

a. Remove the following items from the existing metal-clad section and move to the end of the new addition (except as noted):
   i. Channel End Caps
   ii. Roof Caps
   iii. Metal-Clad End and Corner Cap
   iv. Metal-Clad Front Trim Sheet - discard
   v. Metal-Clad Rear Trim Sheet - discard
   vi. Bus Opening Cover - discard

b. To install new metal-clad units:
   i. Set new units in place and bolt together
   ii. Assemble bus opening cover, front and rear trim sheets
   iii. Assemble new roof caps and rear channel end cap
   iv. Assemble ground bus splice between existing and new ground bus
   v. Assemble bus bars and insulating boots
   vi. Reassemble items i-iii from section a.
2) Adding Units to Outdoor Equipment with a Protected/Common Aisle

a. Remove the following items from the existing protected/common aisle and metal-clad section and move to the end of the new addition (except as noted):
   i. Channel End Caps
   ii. Roof Caps
   iii. Metal-Clad End Cap(s)
   iv. Floor Tie Plate
   v. Aisle End Bubble Enclosure
   vi. Metal-Clad Front Trim Sheet - discard
   vii. Metal-Clad Rear Trim Sheet - discard
   viii. Bus Opening Cover - discard

b. To install new metal-clad units:
   i. Set new units in place and bolt together
   ii. Assemble bus opening cover, front and rear trim sheets
   iii. Assemble new roof caps and rear channel end cap
   iv. Assemble ground bus splice between existing and new ground bus
   v. Assemble bus bars and insulating boots

c. To install new protected aisle units:
   i. Apply precast sealer to metal-clad roof
   ii. Install new aisle assembly and bolt in place
   iii. Assemble new roof cap and channel end cap
   iv. Assemble new floor tie plate
   v. Reassemble items i-v from section a.

J. Instructions for Making Bus Connections Across Shipping Split Sections

1) Introduction

Power/Vac® switchgear is shipped in splits of one, two, three, or four stacks. When connecting shipping splits together it may be required to make the connections across the main bus or the tie bus. The main bus can be accessed from the front of the gear through the breaker compartment and the tie bus can be accessed from the rear. Breakers and rollouts should be removed from the switchgear before the bus connections can be made across the shipping split.

Ground bus connections across shipping splits shall be made as specified in Ch 4 Installation, R. Ground Bus.

**WARNING**

All primary and secondary circuit devices must be deenergized and the primary grounded before undertaking any work on the switchgear.

2) Main Bus Connections Across the Shipping Split

Follow these steps to connect the main bus across the shipping splits.

a. Remove the horizontal barrier located between the front upper and lower compartments (Figure 15, d). If heaters are provided they will need to be removed.

b. Do not remove the pan on which the breaker ground shoe is located. In most cases, the pan will have a cover over it and is not required to be removed.
For stacks that have a two-high PT/CPT tray in the front upper compartment, the procedure for removing the horizontal barrier is different from that shown above. For such stacks, remove the three Taptites (self threading bolts) shown in Figure 17 in the front upper compartment. When these taptites are removed, the barrier underneath (Figure 16, a) can be removed.

Remove the vertical mid barrier located in the upper part of the lower front of the stack. See Figure 18 for identification of barrier in the breaker compartment and Figure 19 for identification of barrier in a PT/CPT rollout compartment.
c. Remove the vertical mid barrier located in the lower part of the front upper compartment. This barrier is located approximately 49 inches from the front of the stack (Figure 15, b).

d. Do not remove the secondary disconnect block (Figure 15, c) or the chain (Figure 15, a). This barrier can be removed by sliding it down. This will expose the main bus compartment as shown in Figure 20.

e. Unbolt and remove the glastic shipping supports taking care to ensure that splice plates and spacers provided in the bus joint do not fall off. Loosely refasten bus hardware to hold the splice plates and spacers in place.

f. Discard the shipping supports. The red insulating boots will have to be removed to access the bolts for the shipping supports. The boots are held together using plastic reusable pull apart fasteners.

g. Remove inter-unit bus supports. (Go to step ii if polyester glass bus supports are provided).

i. Apply a strong adhesive tape to keep the two glastic supports together temporarily. The tape may be applied in four places - above, below, and between the porcelain bus supports (Figure 21).

ii. Remove the 1/4 - 20 fasteners used to mount the bus support to the side sheet. There should be 4 (2 for poly glass) on the top and 4 (2 for poly glass) at the bottom. The hex nuts should be towards the outside on the left hand side of the side sheet.

iii. Gently remove the bus support assembly away from the side sheet and into the bus compartment. Let it rest temporarily in a vertical position inside the bus compartment.

Figure 19 View of Typical Front Lower PT/CPT Rollout Compartment

Figure 20 View of Main Bus Compartment from Front

Figure 21 Location of Tape
h. Align the switchgear stacks:
i. Gently align the next stack on the left with this stack taking care not to damage the porcelain bus supports.

ii. When the eight (8) bus support holes (four holes for polyester bus supports) are aligned, replace the bus support assembly against the side sheet and use the 1/4 - 20 hardware to fasten the bus supports and the two side sheets together as shown in Figure 23.

iii. A black rubber gasket is provided to cover the edge of the side sheets around the perimeter of the bus pass-through cutout for 15kV gear. It should be ensured that this gasket is in place.

i. Make bus connections (for polyester glass bus supports go to Step iii).

i. Position the rubber cushion so that it is approximately in the center of the porcelain support. Apply RTV sealant around the rubber cushion to hold it in place.

ii. Gently insert the main bus through the bus support taking care not to break or chip the porcelain. The main bus should pass through a rubber bus cushion locate inside the porcelain bus support. If the rubber bus cushion falls off, reinsert the cushion on the busbar as shown in Figures 24 & 25 and pass the busbar through the porcelain support.

iii. For polyester glass inter-unit bus supports insert the bus through the corresponding slots in the orange polyester glass material.

iv. Make main bus connections at the bus joint. The main bus should be inserted into its vacant slot between the splice plates. The bus should lineup with the main bus coming into the joint from the other side.

v. Tighten bus connections to between 30-35 ft-lbs.
j. Finishing up:
   i. Reassemble the boots that were removed in Step e.
   ii. Remove tape applied in Step g, i (for porcelain only).
   iii. Ensure that no tools or other material is left behind in the bus compartment.
   iv. Reassemble the vertical mid barriers and the horizontal pan that were removed in Steps a-c.
   v. Before energizing the switchgear conduct insulation resistance (Megger) and HV Hipot test (optional) as described in the instruction bulletins.

3) Tie Bus Connections Across the Shipping Split

   Steps d thru h are the same for making the tie bus connections. The tie bus compartment can be accessed from the rear of the switchgear by removing the rear bus barrier of the tie bus compartment. Figure 26 shows a typical bottom tie bus compartment with the rear bus barrier removed.

   If the tie bus compartment has a 2” x 1/4” aux bus running between stacks, inter-unit bus supports are not required and will not be provided.
K. **Instructions for Bolting Stacks Together Across Shipping Split Sections**

1) **Introduction**

Power/Vac® switchgear is shipped in splits of one, two, three, or four stacks. This instruction provides details on bolting the stacks together across the shipping splits. This instruction is applicable to indoor, indoor drip proof, and outdoor switchgear. However, for indoor drip proof and outdoor construction additional assembly instructions for connecting the roof and aisle sections are provided in *Ch 4 Installation* of this instruction bulletin.

![WARNING]

*All primary and secondary circuit devices must be deenergized and the primary grounded before undertaking any work on the switchgear.*

All breakers have to be racked out and PT/CPT rollouts have to be drawn out of the shipping split stacks before proceeding with the inter-unit bolting.

1. Make inter-unit bus connections as specified in *Ch 4 Installation, J. Instructions for Making Bus Connections Across Shipping Split Sections.*
2. Use the two sets of 0.38 x 3” hardware and two sets of 0.38 x 3.25” hardware that are provided to bolt the center post (*Figures 27 & 28*). The center post bolting has to be done at two places in the front upper compartment and at two places in the front bottom compartment. The 3.25 inch long bolts may be used where it is required to bolt through the red glastic sheet.
Figure 27  Sectional View of Inter-Unit Bolting

Figure 28  Typical Center Post Bolting

a. Center-Post Bolting
3. Sixteen sets of 0.38 x 1” hardware is provided for perimeter bolting. The following guidelines shall be followed:
   a. Minimum of 3 bolts on each vertical post.
   b. For 82” deep and 94” deep stacks, a minimum of two bolts on each depth post with at least one bolt in the front compartment and one bolt in the rear compartment.
   c. For 106” deep stacks, a minimum of three bolts on each depth post with at least one bolt in the front compartment and one location in the rear compartment.

Where there are no accessibility issues it is generally recommended that perimeter bolting be done at all 16 locations.

Note: If the units have to be moved or lifted after installation, they should be lifted only at the shipping splits.

L. Connections

1) Main Bus Bars

The main bus bars and other connection bars are either copper or aluminum. The connection surfaces are silver surfaced or equivalent. The silver plating used on bolted contact surfaces is approximately 0.0001” thick; plating on sliding contact surfaces is thicker. All field assembled joints in primary conductors should be made as follows:

1. Wipe the surface clean with a lint-free cloth. Do not use sandpaper or any other abrasive material on the plated surface. Avoid handling of cleaned surfaces as much as possible. If the surface is tarnished, clean it with silver polish and then wash it with denatured alcohol.

2. Join the clean contact surfaces by using the hardware provided.

The correct length of bolt must be used in each joint to ensure that electrical clearances at bolt locations are maintained. As a general rule, when using ½ inch diameter bolts, the bolts should be 1 inch longer than the combined thickness of the copper bars being bolted together.

For example, if three ¼ inch thick copper bars are to be connected, the bolt should be 1⅜ inch long. In addition to proper length bolts, the bolt assembly must include flat washers, split ring lock washers, and nuts. All bus joint hardware is zinc-plated, dichromate treated, high strength steel. Cap screws are ½ - 13 SAE Grade 5. See Figure 29 for proper hardware assembly.

3. In some cases, external connections are made to metal-clad switchgear bus by bars. The metal-clad switchgear bars are normally silver plated. Unplated bars, either copper or aluminum, should not be used to connect to plated bars.

4. All field assembled primary conductor joints and terminations must be
insulated before the operating voltage is applied.

**Note:** All hardware must be tightened to the torque values listed in Table C, Bolt Torque Values for Power/Vac® Medium Voltage Metal-Clad Switchgear.

2) **Sliding Connections**
   
a. **Stationary Primary Disconnect Devices - Breakers and Rollouts**

Wipe contact surfaces with a clean, soft, dry, lint-free cloth to remove dirt and grease from silvered areas. Do not use any abrasives such as sand paper, emery cloth or steel wool for this purpose. Avoid handling of the contact surfaces after cleaning. Apply a thin coat of Mobil grease (Red) to the front two inches of all breaker and rollout primary disconnect devices. Cover all surfaces, front, sides, top and bottom evenly.

b. **Stationary Ground Contact Cluster**

Prepare the contact surfaces as described in the previous section *a. Stationary Primary Disconnect Devices, Breakers and Rollouts* giving special attention to the facing curved surfaces to be sure no sharp edges or burrs exist at the narrowest dimension. Apply a thin coat of Mobil grease (Red) to the facing curved surfaces for a distance of no less than 3/4 inch centered around the point of narrowest dimensions.

c. **Movable Primary Disconnect Devices - Rollouts**

Before assembling the contact fingers, prepare the contact surfaces (double thickness segment) of the primary tangs and apply a thin coat of Mobil grease (Red) as described in section *a. Stationary Primary Disconnect Devices - Breakers and Rollouts*. Assemble and pin the contact fingers in place. Apply a thin coat of Mobil grease (Red) to the facing curved surfaces of the contact fingers as described in section *b. Stationary Contact Cluster*.

### M. **Main Bus Assembly**

#### Table C Bolt Torque Values for Power/Vac® Medium Voltage Metal-Clad Switchgear

<table>
<thead>
<tr>
<th>Bolt Dimensions (inches)</th>
<th>Bolt Head</th>
<th>Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Ft-Lbs</td>
</tr>
<tr>
<td>5/8</td>
<td><a href="#">Hexagon</a></td>
<td>55-70</td>
</tr>
<tr>
<td>1/2</td>
<td><a href="#">Hexagon</a></td>
<td>35-50</td>
</tr>
<tr>
<td>3/8</td>
<td><a href="#">Hexagon</a></td>
<td>20-30</td>
</tr>
<tr>
<td>1/4</td>
<td><a href="#">Hexagon</a></td>
<td>5-7</td>
</tr>
</tbody>
</table>
Wrapping of joints with insulating tape is an acceptable alternative to booting the bus conductor joints. For some complex or unusual joints, the formed bus boots may not be available. Bus conductor joints to be tape wrapped must use the following procedure to maintain proper insulation characteristics within the switchgear (Figure 30).

### Table D Bus Wrapping Components

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0282A3529 P004</td>
<td>2” wide tape</td>
</tr>
<tr>
<td>0282A3529 P005</td>
<td>4” wide tape</td>
</tr>
<tr>
<td>0282A3529 P008</td>
<td>Electrical grade rubber based (RB) putty</td>
</tr>
</tbody>
</table>

**Note:** Electrical grade RB putty will be used only when required to grade voids and smooth out sharp edges of joints and pothead, terminator or entrance bushing connections.

### Figure 30 Insulation of Bus Bar

![Diagram of Insulation of Bus Bar](image)

### Table E Insulation of Bus Bar

<table>
<thead>
<tr>
<th>Insulation Range (kV)</th>
<th>Number of Layers</th>
<th>Tape Width (inches)</th>
<th>Approx. Footage of Tape Required to Insulate (1) Linear Foot of Bus Bar (2” &amp; 4” Wide Rolls are 30’ Long)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.6 To 5</td>
<td>1 Layer • ½ Lap *</td>
<td>2</td>
<td>2 x 4 6 8 10 12</td>
</tr>
<tr>
<td>5 To 15</td>
<td>2 Layers • ½ Lap *</td>
<td>2</td>
<td>2 x 9 11 12 18 20 24</td>
</tr>
</tbody>
</table>

**Note:** Apply tape at medium tension to produce a void-free uniform build-up of tape. A medium tension stretches a 0.030”x2” tape down to 0.024”x13/4” and 0.030”x4” down to 0.024”x31/2”. Apply with mastic side down.

* Apply 3 layers - ½ lap for conductors passing through CT’s.
**Figure 31 Single Bus Bar Connection Joint**

- Epoxy Insulation
- Thermoplastic Sleeving or Tape Insulation
- “B” - 1/2 LAP
- “A”
- “C”
- RB Putty *

**Table F Insulation of Single Bus Bar Connection Joint**

<table>
<thead>
<tr>
<th>Insulation Level (kV)</th>
<th>Inner Filler “A”</th>
<th>Outer Wrap “B”</th>
<th>“C” (inches)</th>
<th>Approx. Number of Rolls per Joint of HV Tape Δ</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 or 15</td>
<td>3 Layers HV Tape Δ</td>
<td>2 Layers HV Tape Δ</td>
<td>3</td>
<td>1 Roll HV Tape Δ</td>
</tr>
</tbody>
</table>

**Note:** Electrical grade rubber base putty 0282A3529 P008 in roll form will be used to grade voids and smooth out sharp edges of joints. This putty has no insulation value.

1 roll is ½” x 1½” x 5’ long.

Δ High voltage insulating tape 0282A3529 P004 - Roll is .030 x 2” x 30’ long. Apply with mastic side down.

**Figure 32 Double Bus Bar Connection Joint**

- 4” (101.6) Wide PAD HV Tape #
- “A”
- “B”
- “C”
- RB Putty * Framework

**Table G Insulation of Double Bus Bar Connection Joint**

<table>
<thead>
<tr>
<th>Insulation Level (kV)</th>
<th>Inner Filler “A”</th>
<th>Outer Wrap “B”</th>
<th>“C” (inches)</th>
<th>Approx. Number of Rolls per Joint of HV Tape Δ</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 or 15</td>
<td>RB Putty* &amp; 3 Layers HV Tape Δ</td>
<td>2 Layers HV Tape Δ</td>
<td>3</td>
<td>½ Roll RB Putty * 1 Roll HV Tape Δ 1 Roll HV Tape Δ</td>
</tr>
</tbody>
</table>

**Note:** Electrical grade rubber based putty 0282A3529 P008 in roll form will be used to grade voids and smooth out sharp edges of joints

# HV Tape 0282A3529 P005 roll is .030” x 4” x 30’ long.

Δ HV Tape 0282A3529 P004 roll is .030” x 2” x 30’ long. Apply with mastic side down.
**Figure 33  Tee Connection Joint**

- Epoxy Insulation Thermoplastic Sleeving or Tape Insulation
- Pre-Insulation Epoxy Insulation Thermoplastic Sleeving or Tape Insulation
- Apply RB Putty Sparingly to Grade-Out and Round Off Pre-Insulation
- Crisscross Tape in a Figure Eight Pattern to Fully Cover End
- 1) Cut and Apply 1-Strip of Tape to Form a Boot Over End
- 2) Apply RB Putty Sparingly to Round Off End of Bar
- 3) Continue with “A” Layer of HV Tape.

**Table H  Insulation of Tee Connection Joint**

<table>
<thead>
<tr>
<th>Insulation Level (kV)</th>
<th>Inner Filler “A”</th>
<th>Outer Wrap “B”</th>
<th>“C” (inches)</th>
<th>Approx. Number of Rolls per Joint of HV Tape ∆</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 or 15</td>
<td>RB Putty* &amp; 3 Layers HV Tape ∆</td>
<td>2 Layers HV Tape ∆</td>
<td>.50 (12.7) Min</td>
<td>½ Roll RB Putty * 1 Roll HV Tape ∆</td>
</tr>
</tbody>
</table>

**Table I  Insulation of Dead End Bus Joint**

<table>
<thead>
<tr>
<th>Insulation Level (kV)</th>
<th>Inner Filler “A”</th>
<th>Outer Wrap “B”</th>
<th>“C” (inches)</th>
<th>Approx. Number of Rolls per Joint of HV Tape ∆</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 or 15</td>
<td>RB Putty* &amp; 3 Layers HV Tape ∆</td>
<td>3 Layers HV Tape ∆</td>
<td>.50 (12.7) Min</td>
<td>¼ Roll RB Putty * 1 Roll HV Tape ∆</td>
</tr>
</tbody>
</table>

**Note:** * Electrical grade rubber based putty 0282A3529 P008 in roll form will be used to grade voids and smooth out sharp edges of joints. This putty has no insulation value. 1 roll is ½” x 1½” x 5’ long.

Δ HV Tape 0282A3529 P004 roll is .030” x 2” x 30’ long. Apply with mastic side down.
2) **Cleaning Bus Insulation**

Main bus bars are insulated with a high temperature thermoset material having excellent dielectric and mechanical properties. When cleaning is necessary, use a lint-free cloth or industrial wiper, or a vacuum cleaner to remove accumulated dust and dirt. Do not clean the bus by blowing with compressed air. Dust and dirt removed in this manner may be blown into operating parts of the switchgear and damage bearings or other mechanisms.

If wiping or vacuuming does not clean the bus adequately, only distilled water, denatured alcohol or isopropyl alcohol should be used to remove any foreign materials from the insulation surface. The use of other solvents may result in severe damage to the insulation system or other parts of the equipment.

![Figure 35](attachment:Figure_35.png)

**Figure 35  Installation of Primary Cables**

**N. Primary Cables**

The primary cable connections in Power/Vac® switchgear are reached by accessing the rear cable compartment.

When circuit breakers are stacked two-high and primary cable terminations must be made in both upper and lower units, the following procedure should be followed:

1. Remove rear bolted covers.
2. Remove batten (*Figure 35, a*).
3. Remove cable trough cover and pull-box cover.
4. Remove cable trough (*Figure 35, b*).
5. If primary cables enter switchgear from below, terminate cables for lower unit first. If primary cables enter from above, terminate cables for upper unit first.
6. Replace cable trough.
7. Terminate primary cables in remaining unit (pulling cables through cable trough).
8. Replace pull-box cover, cable trough cover, batten, and rear bolted covers.
Before any primary cable connections are made, the cables should be identified to indicate their phase relationship with the switchgear connections. This is necessary to ensure that motors will rotate in the proper direction and that the phase rotation is the same when interconnecting two different sources of power.

There are two methods of making primary cable connections, two are discussed below:

1. Potheads are used when it is desired to hermetically seal the end of the cable to make a moisture-proof connection between the cable and switchgear bus. A pothead also prevents seeping of oil from the end of oil impregnated varnish cambric or paper insulated cable.

2. Prepackaged cable termination kits can be used if the sealing features of a pothead are not needed. These kits, which are available from several suppliers, usually include all the material necessary to terminate the cable and to provide stress relief at the termination.

No insulation materials are normally furnished for cable terminations. When potheads are supplied, insulation materials are furnished for the bar terminations to the pothead studs.

In all cases, carefully follow the cable manufacturer’s recommendations for installation and termination of the type of cable being used.

O. INSULATING PRIMARY CABLE TERMINATIONS

The factory does not furnish insulating materials for completing the termination of primary cables, nor does it furnish stress cone material. The cable manufacturer’s recommendations should be followed for the type of cable being used.

All field assembled joints for primary cable terminations must be insulated to maintain the dielectric ratings of the switchgear. These joints should be prepared as outlined in *Ch 4 Installation, L. Connections*. Upon completion of the cable termination, care must be exercised when taping the exposed termination.

1. All terminations must be prepared for insulation as outlined in *Ch 4 Installation, L. Connections*.

2. The instructions for application of the tape insulation are the same as outlined for wrapping of joints.

3. As an alternative to taping, heat-shrink or cold-shrink insulating systems rated for the system voltage may be used. Follow the instructions provided by the insulation system manufacturer when installing such material.
**Table J Cable Termination Joint**

<table>
<thead>
<tr>
<th>Insulation Level (kV)</th>
<th>Inner Filler “A”</th>
<th>Outer Wrap “B”</th>
<th>“C” (inches)</th>
<th>Approx. No. of Rolls per Joint of HV Tape Δ</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 or 15</td>
<td>RB Putty* &amp; 3 Layers HV Tape Δ</td>
<td>2 Layers HV Tape Δ</td>
<td>3</td>
<td>½ Roll RB Putty* &amp; 1 Roll HV Tape Δ</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 Roll RB Putty* &amp; 2 Rolls HV Tape Δ</td>
</tr>
</tbody>
</table>

*Electrical grade rubber base putty 0282A3529P008 in roll form will be used to grade voids and smooth out sharp edges of joints. This putty has no insulation value. 1 roll is ½” x 1½” x 5’ long.

Δ HV Tape 0282A3529 P004 roll is .030” x 2” x 30’ long. Apply with mastic side down.

**P. GROUND FAULT CURRENT TRANSFORMERS (THROUGH-TYPE)**

Through-type current transformers are furnished where specified for sensitive protection against ground faults. These transformers are normally installed in a horizontal position directly above or below the primary cable terminals so that the primary cable or cables can pass through them. One transformer is required for each three-phase circuit (Figure 37).

Where armored cable is used, the armor must be terminated and grounded before the cable passes through the transformer.

When lead or other conducting sheath cable, or cable with shielding tape or braid is used, it is recommended that the sheath or shield be grounded solidly to the switchgear ground bus. The ground lead should be bonded to the sheath or shield on the side of the current transformer away from the primary terminals. In cases where the ground cannot be applied before the cable passes through the transformer, bond the lead to the sheath or shield between the transformer and the primary terminals. The ground conductor must then be passed back along the cable path through the current transformer before being connected to the ground bus.

Where potheads are used in units provided with ground fault current transformers, the pothead mountings must be insulated from ground.
Figure 37  Rear View of Unit Showing Ground Fault Current Transformer

Figure 38  Bar-Type Current Transformer Joint Insulation

Table K  Bar-Type Current Transformer Joint Insulation

<table>
<thead>
<tr>
<th>Insulation Level (kV)</th>
<th>Inner Filler “A”</th>
<th>Outer Wrap “B”</th>
<th>“C” (inches)</th>
<th>“D” (inches)</th>
<th>Approx. No. of Rolls per Joint of HV Tape Δ</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 or 15</td>
<td>3 Layers HV Tape Δ</td>
<td>2 Layers HV Tape Δ</td>
<td>3</td>
<td>3</td>
<td>3/8 Roll HV Tape Δ</td>
</tr>
</tbody>
</table>

Note:  
* Electrical grade rubber base putty 0282A3529P008 in roll form will be used to grade voids and smooth out sharp edges of joints. This putty has no insulation value.  
1 roll is 1/8” x 1½” x 5’ long.

‡ Insulate as far as possible. Do not cover polarity marks.

Δ HV Tape 0282A3529P004 roll is .030” x 2” x 30’ long. Apply with mastic side down.
Q. **CONTROL CABLES**

Space is provided for control cables to enter the switchgear from either the top or the bottom of the units. See drawings furnished with the switchgear for detailed dimensions and location of the control cable entry space.

When control conduits enter the unit from below, entry space is located on each side of the unit near the front inside the secondary enclosure. The conduits should not extend more than 1” above the floor.

Connect the cables to the terminal blocks in accordance with the wiring diagrams furnished for the specific job.

If the control conduits enter from above, drill the top cover plate of the front enclosure to suit the conduits, being careful not to damage existing wire bundles. The top cover may be removed temporarily to facilitate drilling. Fasten the conduits to the cover with locknuts.

The cables from the control power source to the switchgear should be large enough to avoid excessive voltage drop when the circuit breakers are operated. See testing instructions.

Where units have been split for shipment, any control or other secondary leads which must connect across the split will be arranged with terminal blocks in a convenient location so that the wires can be reconnected. The wires will be cut to length and formed before being folded back so that a minimum of time will be required for reconnecting them.

R. **GROUND BUS**

Where the equipment is shipped in more than one section, the ground bus must be connected by using the splice plates furnished with the equipment. Assemble the ground bus joints as outlined in *Ch 4 Installation, L. Connections.*

The ground bus is bolted to the rear of the frame near the bottom. It is arranged so that connections to the station ground can be made in any vertical section. Optional ground bus pad can be provided in each section to provide a convenient place to ground cable armor, cable sheath, shields or ground wires. The switchgear ground bus must be connected to the station ground bus by a conductor having a current-carrying capacity equal to that of the switchgear ground bus.

---

**CAUTION**

It is very important that the equipment be properly grounded to protect the operator from injury when short circuits or other abnormal occurrences take place, and to ensure that all parts of the equipment, other than live parts, are at ground potential.

S. **SURGE PROTECTION**

When surge arresters are furnished, the primary cable terminal will be insulated at the factory unless it must be disconnected for shipment. When this connection is completed in the field, it will be necessary to insulate the primary connection before the switchgear is energized. PVC boots will normally be supplied to insulate these connections.

When surge arresters are not furnished, it will be the responsibility of the user to provide suitable protection for switchgear from damage due to lightning or other surges.
T. **ROOF ENTRANCE BUSHINGS**

When assembling the connection bar end of roof entrance bushings inside of the switchgear and other terminations where porcelain insulators are used, refer to the specific drawings furnished with the equipment describing the specific installation instructions. In most applications, insulation should be applied as follows:

1. Prepare the connection bars for insulation as outlined in *Ch 4 Installation, L. Connections.*
2. Tape the joint as outlined in *Ch 4 Installation, M. Main Bus Assembly, 1) Wrapping of Joints.*

**Figure 39 Roof Bushing**

<table>
<thead>
<tr>
<th>Table L Pothead, Bushing, or Terminator</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Insulation Level (kV)</strong></td>
</tr>
<tr>
<td>---------------------------</td>
</tr>
<tr>
<td>5 or 15</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

**Note:** *Electrical grade rubber base putty 0282A3529P008 in roll form will be used to grade voids and smooth out sharp edges of joints. This putty has no insulation value. 1 roll is ½" x 1½" x 5’ long.*

∆ HV Tape 0282A3529P004 roll is .030” x 2” x 30’ long. Apply with mastic side down.

U. **TESTING AND INSPECTION**

**WARNING**

*Do not connect primary cable/bus or control wiring of the switchgear assembly to an energized system until all preliminary tests have been made to the switchgear assembly.*

For test and inspection instructions, refer to applicable instruction bulletins and any supplemental documents. For assistance with testing and inspection, contact Powell on our website at powellind.com, or call 1.800.480.7273.

**WARNING**

*Prior to adjustments, servicing, maintenance, or any act requiring the operator to make physical contact with the equipment, the power source must be disconnected and the equipment grounded. Failure to do so may result in death or serious injury.*
After the equipment has been installed and all connections made, it should be tested and inspected before putting it in service. Although the equipment and devices have been completely tested at the factory, a final field test should be made to ensure that the equipment has been properly installed and that all connections are correct and have not become loose in transportation.

If users perform AC hipot testing on high voltage cables used to connect the switchgear to loads, the following testing practices are recommended:

1. AC hipot testing voltage must be limited to no more than 27kV (75% of 36kV). DC hipot testing is not recommended. If DC hipot testing must be performed, consult with Powell prior to testing.
2. Surge arrestors, if present, must be disconnected before hipot testing.
3. Voltage Transformers and Control Power Transformers must be moved to the “DISCONNECTED” position before AC hipot testing.

Directions for testing devices such as relays, instruments and meters are given in the instruction bulletin furnished for each device. The settings of the protective relays must be coordinated with the other relays on the system and therefore, these relays must be set by the user. General instruction bulletins are furnished with the equipment, containing the instruction material for all individual devices used in the equipment.

When transformers are furnished to supply the control power, the primary taps should be selected so that the control voltage indicated on the wiring diagram is obtained on the secondary of the transformer. When a battery is used to supply the control power, the cables from the battery to the switchgear should be large enough to avoid excessive voltage drop. When supplied by a battery, the voltage at the terminals of the operating coils, shall not be less than 112.5 volts for 125 volt coils and 225 volts for 250 volt coils.

The operation of the breaker with its associated devices may be tested in the unit while the equipment control power is energized by racking the breaker into the test position and engaging the secondary coupler. This is accomplished by lowering the handle on the right hand side of the breaker mechanism and pushing forward until the coupler engages.
Ch 5 Operation

A. General

**WARNING**

**Compartment access shall be permitted ONLY to “Qualified Person”, as defined in NFPA 70E, using “approved safe work practice” and “appropriate PPE”. Failure to do so could result in death or serious injury.**

All removable elements of the same type and rating which have duplicate control wiring may be interchanged.

During operation, all live parts are enclosed by barriers which permit the operator to perform work with maximum safety. Separate covers are provided over each different compartment, so that any compartment of an enclosure may be exposed without exposing other compartments.

All Power/Vac® circuit breakers are equipped for electrical operation. A manual charging handle is supplied as part of the accessories to permit manual operation of the circuit breaker during maintenance.

**WARNING**

**This device must not be used to close the circuit breaker on any energized circuit. If done, it could result in death or serious injury.**

The control circuits may be checked accurately and safely by moving the circuit breaker to the test position where the main circuits are disconnected and the control circuits are completed.

B. Inserting the Removable Element Into the Compartment

With all primary and control power circuits deenergized and before installing the breaker, clean the mating surfaces of the metal-clad switchgear and circuit breaker primary disconnects, secondary disconnects, and ground shoe then apply a thin coating of 0282A2048P009 contact grease. This will prevent galling of the silvered contact surfaces.

Check the racking mechanism to make certain that it is in the disconnect position. The tape indicator should read “Disc/Test” and the drive nuts on the jack screws should be in the forward position against their respective stops. The racking mechanism is accurately leveled and checked at the factory and should need no adjustment.

Check the circuit breaker to ensure that it is in the “OPEN” and “DISCHARGED” position. Attach the lift truck to the equipment, after it has been prepared for docking, by adjusting the height of the carriage until the docking hooks at the ends of the arms are slightly higher than the rail surface in the equipment. When this is done, position the hooks over the slots in the rails, and lower them into the slots. Depress both track roller blocking interlocks (Figure 40, c) slightly and extend the docking interlock bars. The interlock bars will pass under the equipment rails and lock the lift truck arms to the rails. Do this on both sides. The track roller blocking interlocks are now in the raised position and are thus no longer blocking the track rollers. The lift truck arms should be approximately level. The breaker can now be rolled onto or off of the lift truck.

To load the breaker onto the lift truck, extend each docking interlock bar by slightly depressing the track roller blocking interlock (Figure 40, c) and then moving the handle.
(Figure 40, d) away from the mast as far as it will go toward the end of the arms. This permits the track roller blocking interlocks to be in their raised position. The height of the arms should be adjusted to engage the track rollers on the sides of the breaker. Depress each track roller blocking interlock (Figure 40, c) fully, and return each docking interlock bar to its retracted position by means of handle (Figure 40, d). The breaker is now blocked in position on the lift truck.

Remove the breaker from the equipment by releasing and rolling it fully onto the lift truck rails until it touches the stop on the rails. Depress both track roller blocking interlocks (Figure 40, c) fully and then move handles (Figure 40, d) as far as they can go toward the mast. Release the track roller blocking interlocks. Release the track roller blocking interlocks. Raise the carriage slightly to release the docking hooks from the slots in the equipment rail; move the load a short distance from the equipment, and lower it to just above floor level before transporting it away from the area.

To remove the lift truck and set the breaker on the floor, lower the carriage until the breaker is resting on the floor and the load of the track rollers is no longer being supported by the lift truck arms. Depress the track roller blocking interlocks (Figure 40, c) slightly and move handles (Figure 40, d) as far as they can go away from the mast. Do this on both sides. The track roller blocking interlocks (Figure 40, c) are now in their raised position. The lift truck can now be pulled away from the breaker, but the truck safety latch must be held in the released position by moving the handle (Figure 40, b) located on the right arm, away from the mast. This permits the track rollers to pass under the latch.

Lift the breaker for insertion into the equipment as follows. After the breaker has been loaded onto the lift truck and before raising it from the floor, check to make sure that the track roller blocking interlocks (Figure 40, c) are in the depressed position and that the docking interlock bars (Figure 40, a) are retracted by moving handles (Figure 40, d) towards the masts. Raise the load by turning the winch handle clockwise. If the cable has been slack, guide it so that it winds evenly on the drum until it starts to tighten under load. As the load is lifted, there will be a clicking noise due to the winch pawl. If the noise stops, maintain grip on the handle and lower the load to the floor. Investigate why the pawl is not engaging and make repairs before attempting to lift the load any further. Raise the load to the required height and proceed as instructed earlier in attaching the lift truck to the equipment.

To move the breaker from the lift truck into the equipment, the safety latch must be held in the released position by moving the handle (Figure 40, b) located on the right arm, away from the mast. When moving the breaker onto the lift truck the track rollers will lift this latch, making it unnecessary to operate the handle. The purpose of the safety latch is to provide an automatic means of retaining the breaker on the truck if the track roller blocking interlock has not been operated to its blocking position before lifting the breaker from the ground. See the latest version of instruction bulletin 01.4IB.66000 for more information.

After the safety catch on the right handrail has been engaged, the breaker can now be rolled forward on the lift truck for transporting.

After the breaker has been racked fully into the connected position and then is removed from the unit, the engagement and alignment of the primary disconnect fingers on the breaker...
studs may be checked with respect to the stationary conductor in the unit.

**CAUTION**

*The primary circuits must be deenergized prior to performing this check.*

Use the racking handle to turn the jackscrew several turns toward the connected position, until the shutters are opened to uncover the opening to the insulation tube and stationary conductor in the unit. Inspect the impression made in the coating of contact lubricant 0282A2048P009 in the stationary conductor surface by the breaker primary disconnect fingers.

On 1200 and 2000A ratings, there must be heavy impressions of all fingers on both the top and bottom of the stationary conductor bars. The impression should extend back from the front end of the bar a minimum of 1/2 inch and should be no closer than 3/16 inch to either side of the bar.

On 3000A ratings, there must be heavy impressions of all fingers on the cylindrical conductor. The impressions should extend back from the front end a minimum of 1/2 inch.

If the contact wipe is not proper, do not make any adjustment. Contact the nearest Powell Service representative for instructions.

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**Figure 40 Lift Truck**

- a. Lift Truck Brace
- b. Safety Latch Handle
- c. Wheel Locking Plate
- d. Truck Locking Bar Handle

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**C. Breaker Racking with Front Door Closed**

The circuit breaker can be racked in and out of the “Connect” position with the front door of the metal-clad switchgear closed. For maximum safety the breaker must always be racked with the front door closed when primary power is connected to the metal-clad switchgear. Make sure the breaker is open before attempting to rack the breaker. The breaker is installed in the metal-clad unit as described in Breaker Installation. Engage the racking arms and then close the front door of the unit and secure it. Insert the racking handle into the hole in the left side of the front door and engage the racking mechanism by pushing it in fully. Rack the breaker by rotating the handle clockwise (60 turns are required) until a positive stop is felt. Do not exceed 60 ft-lbs. torque. The breaker is now in the fully connected position and the tape indicator should read “Conn”.

To rack the circuit breaker from the “Connected” to the “Disconnect/Test” position be sure that the breaker is open then turn the handle counterclockwise.
D. **Remote Racking Device**

The breaker can be racked between the “Disconnect/Test” and “Connected” positions electrically using the remote racking device. Refer to *Ch 3 Equipment Description I. Remote Racking*.

E. **Positive Interlock**

The positive interlock functions to prevent racking a breaker between the “Connect” and “Disconnect/Test” positions except when the primary contacts are open.

The positive interlock consists of a bar which protrudes from the left side of a closed breaker to engage a slot in the left side racking mechanism when the breaker is in either the “Disconnect/Test” or “Connected” position. When the interlock is engaged the racking mechanism cannot be operated.

To test the function of the positive interlock install a circuit breaker following the instructions given in *Ch 5 Operation, B. Inserting the Removable Element Into the Compartment*. For the test the control power circuits in the metal-clad switchgear must be energized.

Place the breaker in the “Disconnect/Test” position and connect the secondary disconnect device by pulling down on the breaker handle and horizontally inserting the lever arm fully into the breaker to engage the secondary disconnects. This will actuate the spring charging motor and charge the breaker closing springs.

**CAUTION**

*The primary circuits must be deenergized prior to performing this check.*

F. **Negative Interlock**

The negative interlock functions to hold the breaker in a mechanical and electrical trip free mode when it is being racked between the “Disconnect/Test” and “Connect” positions. As an added precaution, the negative interlock will trip the breaker and hold it trip free if an attempt is made to operate the racking mechanism when the breaker is closed and in either the “Disconnect/Test” or “Connect” position, and the positive interlock fails to function.

The negative interlock consists of two notched members in the left side track assembly which operate the negative (trip latch) interlock roller on the left side of the breaker (*Figure 41*). On
the metal-clad switchgear, one member is stationary and the other is a spring loaded slide attached to the racking mechanism. A third member, a notched sliding link, provides the key lock functions and is described under Key Locks (Figure 41).

To test the function of the negative interlock, install a circuit breaker following the instructions given in Ch 5 Operation, B. Inserting the Removable Element Into the Compartment. For this test the control power circuits in the metal-clad switchgear must be energized.

Place the breaker in the “Disconnect/Test” position and connect the secondary disconnect device by pulling down on the breaker handle and inserting the level arm fully into the breaker. This will actuate the spring charging motor and charge the breaker closing springs. Push the sliding link located on the front of the left track to the rear (Figure 41). This will cause the negative interlock roller on the breaker to depress and keep the breaker in the trip free mode. Leave the sliding link in the rear position and attempt to close the breaker using the control switch. Nothing should happen. Now attempt to close the breaker by depressing the manual close button. The closing springs will discharge but the breaker should remain open. Return the sliding link to the forward position.

Rack the circuit breaker into the connected position and close either manually or electrically. With the sliding link in the rear position, attempt to close the breaker using the control switch. Again, nothing should happen. Now attempt to close the breaker by depressing the manual close button. Again, the closing springs will discharge but the breaker should remain open.

**CAUTION**

If the interlock does not function as indicated in either of the above cases DO NOT MAKE ANY ADJUSTMENTS. Contact the nearest Powell Service representative for additional instructions.

G. Spring Discharge Interlock

The spring discharge interlock consists of a notched member in the right side track assembly which activates the spring discharge roller on the right side of the breaker (Figure 42).

The function of the spring discharge interlock is to prevent the breaker closing spring from being charged unless the breaker is in the “Connect” or “Disconnect/Test” position or removed from the compartment. In addition, it will mechanically discharge the breaker springs when the breaker is moved between any of the above mentioned positions and prevent recharging by opening the close latch monitoring switch in the breaker spring charge circuit.

To test the function of the spring discharge interlock, install a circuit breaker following the instructions in Ch 5 Operation, B. Inserting the Removable Element Into the Compartment. For this test the control power circuits in the metal-clad switchgear must be energized.

Place the breaker in the “Disconnect/Test” position and connect the secondary disconnect device by pulling down on the breaker handle and inserting the level arm fully in the breaker. This will actuate the spring charging motor and charge the breaker closing springs.
Rack the breaker toward the connected position using the manual racking handle. The spring discharge interlock should discharge the breaker springs in three to five turns.

Continue to rack the breaker to the connected position. Just before reaching the connected position, the spring charging motor will reenergize to charge the closing spring. Close the breaker. Attempt to install the racking crank. This should not be possible because it should be blocked by the positive interlock. Trip the breaker. Rack the breaker toward the disconnected. The spring discharge interlock should discharge the breaker closing springs in 3 to 5 turns. Continue to rack the breaker to the disconnected position. Re-energize the secondary disconnect device as before to cause the spring charging motor to charge the breaker closing springs. Raise the racking arms to the release position and roll the breaker forward. The spring discharge interlock should discharge the breaker closing springs before traveling 1/2 inch.

If the interlock does not function as indicated DO NOT MAKE ANY ADJUSTMENT. CONTACT THE NEAREST POWELL SERVICE REPRESENTATIVE FOR INSTRUCTIONS.

H. Interference Interlock

The function of the mechanical interference interlock is to permit only breakers with the same ratings to be inserted in any specific compartment.

This interlock consists of two mated comb-like plates, one on the equipment and one on the breaker. The equipment interference plate is permanently fastened to a cross member located just below the breaker mechanism frame device panel.

<table>
<thead>
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<th>CAUTION</th>
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<tr>
<td>To prevent damage, DO NOT remove, replace, or readjust the rating interference plates on wither the metal-clad switchgear or the Power/Vac circuit breaker. In case of a problem consult the nearest Powell service representative.</td>
</tr>
</tbody>
</table>

I. Closing Spring Gag Interlock

An interlock is provided at either the front or rear on the left side of the breaker frame to prevent racking in a breaker which has the spring blocking device (pin or plate) in the gagged position. The spring blocking device must be removed so that the interlock interference may reset to allow the breaker to be racked.

See the latest version of the circuit breaker instruction bulletin 01.4IB.66000 for use of the closing spring blocking device.

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gagging closing springs when they are in the discharged position can damage the breaker. The breaker side frame may be deformed and/or the gearmotor may be be damaged.</td>
</tr>
</tbody>
</table>
**Figure 41  **Left Side Racking Rail

- a. Position Indicator
- b. Racking Shaft
- c. Racking Nut
- d. Bearing
- e. Rail
- f. Slot
- g. Notched Sliding Link
- h. Detent
- i. Bolt
- j. Keylock
- k. Interference Interlock

**Figure 42  **Right Side Racking Rail

- a. Racking Nut
- b. Bearing
- c. Jack Screw
- d. Rail
- e. Operating Cam
- f. Disconnect/Test Slot
- g. Connect Slot
J. **Key Locks**

On the left side breaker racking mechanism track is a provision for a key lock (Figure 41, j). The purpose of this lock is to keep the breaker from closing in the “Test” and “Connect” positions by operating the negative interlock. To remove the key, push slide to the rear and extend the bolt of the lock into slot. This allows the key to be removed and prevents the breaker from closing. The key lock does not prevent motion of the racking mechanism.

**Figure 43  Stationary Auxiliary Switch & Circuit Breaker Position Indicator**

![Figure 43](image)

- a. Secondary Coupler
- b. Position Switch Actuator
- c. Position Switch
- d. Ground Shoe
- e. Station Auxiliary Switch Connect Position Actuator
- f. Stationary Auxiliary Switch
- g. Stationary Auxiliary Switch Test Position Actuator

K. **Padlocks**

Two positions for a possible 3 padlocks each are provided on the racking mechanism. The front position keeps the breaker from closing in the “Test” and “Connect” position. To obtain this position push slide to the rear and insert the padlock in the slotted opening just forward of the key lock. This gives the same interlocking functions as the key lock and does not block the motion of the racking mechanism.

The second position for padlocks is behind the key lock. A padlock in this slot will prevent any motion of the racking mechanism by keeping the hexagon turning shaft covered.

L. **Stationary Auxiliary Switch**

An auxiliary switch can be provided at the bottom of the breaker compartment so that additional contacts can be actuated by the operation of the breaker. The breaker will operate this switch when it is in the “Test” or “Connect” position (Figure 43).

M. **Breaker Position Switch**

A position switch can be provided at the bottom of a breaker compartment so that it will be operated by a bracket on the breaker frame when the breaker is in the “Connect” position. When the breaker is withdrawn, a spring will return the switch to its normal position (Figure 43).

N. **Space Heaters**

Space heaters are provided in all outdoor switchgear in order to keep the inside temperature several degrees higher than the outside. Heaters are also furnished for indoor switchgear when it is known that abnormal atmospheric conditions exist at the installation, or when specified by the customer.
By maintaining a slight temperature differential, the heaters help facilitate drying and prevent condensation and the resulting corrosion and insulation deterioration which might occur.

Four 75-watt heaters are provided in each vertical section. One heater is located in each breaker or auxiliary compartment on the bottom at the rear. One heater is also located at the bottom of each cable compartment when breakers are stacked two high. When there is only one breaker per section both heaters are located in the cable compartment at the bottom of the section. Heaters may also be located in transition compartments and in bus ducts if the operating conditions require them.

Before energizing the heaters, be sure the power source is of the proper voltage, frequency, and is connected in accordance with the wiring diagrams furnished with the switchgear. Also, be sure to remove all cartons and miscellaneous material packed inside the units before energizing the heaters.

The heater circuit should be inspected several times a year to make sure that it is energized.
Ch 6  Maintenance

A. General

Contact Powell Service Division for assistance in performing maintenance or setting up a maintenance program. Email info@powellservice.com or call 1.800.480.7273.

A regular maintenance schedule should be established which obtains the best service and reliability from the switchgear. Plant operating and local conditions will dictate the frequency of inspection required. For specific information regarding the maintenance of devices, removable elements such as circuit breakers, relays, motors, etc., refer to the separate instruction bulletin furnished with each device. The test cabinet, when furnished, provides a convenient means for maintaining the circuit breakers. Under normal conditions, the protective relays do not operate, therefore, it is important to check the operation of these devices regularly.

A permanent record of all maintenance work should be kept, the degree of detail depends upon the operating conditions. The record will be a valuable reference for subsequent maintenance work and for station operation. It is also recommended that the record include reports of tests performed, condition of the equipment, and any repairs or adjustments that were performed. This record should begin with tests performed at the time of installation and energizing, and all data should be graphed as a function of time to ensure a proper maintenance cycle is scheduled.

WARNING

When performing maintenance the power source must be disconnected and the equipment grounded. Failure to do so may result in death or serious injury.

B. Overall Maintenance Procedures

The primary circuits of metal-clad switchgear are insulated in order to reduce the size of the equipment. However, this insulation, in most instances requires a certain amount of air gap between phases and to ground, which completes the insulation.

CAUTION

Do not place any object in this air space when energized. If done, it could result in equipment damage and/or minor or moderate injury to personnel.

WARNING

When performing maintenance the power source must be disconnected and the equipment grounded. Failure to do so may result in death or serious injury.

1) Equipment

Clean the equipment thoroughly, removing all dust and other accumulations. Wipe the buses and supports clean. Refer to Ch 4 Installation for cautions about cleaning bus insulation. Inspect the buses and connections carefully for evidence of overheating or weakening of the insulation.

2) Bus Insulation

The primary circuit bus bar is insulated with a high temperature thermoplastic or thermoset material that provides dielectric and mechanical properties. Clean the insulation to provide optimum insulation properties.
Only use denatured alcohol or isopropyl alcohol to clean the insulation. Wear protective gloves and goggles and clean the main bus bar in a well ventilated area. Wipe dirt or other foreign matter from the insulation with a clean cloth saturated with only denatured or isopropyl alcohol.

**CAUTION**

*Inhalation of vapor could result in minor or moderate injury.*

**CAUTION**

*Use only the cleaners recommended in this document. Failure to do so could result in equipment damage.*

3) **Racking Mechanisms**

Clean the mechanisms and lubricate wear points. The application of lubricants should be held to a minimum, which reduces the accumulation of dust and dirt. A periodic overhaul of the racking system should be carried out if more than 500 operations are expected in its lifetime.

4) **Primary Disconnect Device Contacts**

Check the primary disconnect device contacts for signs of abnormal wear or overheating. Clean the contacts with a silver polish. Discoloration of the silvered surfaces is not ordinarily harmful, unless the atmospheric conditions cause deposits, such as sulfides on the contacts. If necessary, the deposits can be removed with a good grade of silver polish. Before placing or replacing the circuit breaker into service, apply a thin coat of contact lubricant to main contacts for lubrication.

5) **Disconnecting Contacts**

Inspect all primary and secondary disconnecting contacts, such as those on rollout transformers for abnormal wear, fatigue, or overheating. Replace the contacts if necessary. Otherwise, clean the main disconnecting contacts with a good grade of silver polish and lubricate with contact grease as needed.

6) **Control Contacts**

Contacts should be inspected and dressed or replaced when the surface becomes seriously pitted. Unless repetitive duty has been experienced, little attention should be required.

7) **Secondary Wiring**

Check all wiring connections for tightness, including those at the current and potential transformers and at the terminal blocks where circuits leave the switchgear. Ensure that all secondary wiring connections are properly connected to the switchgear ground bus.

8) **Mechanical Parts**

Visually check and manually operate mechanical moving parts such as the shutter, TOC, and MOC assemblies, and also check the hinged doors. Examine mechanical mating parts such as the levering-in arms and the mating guide channels.

9) **Ventilation**

Check all labyrinths, grillwork, and air passages for obstructions and accumulations of dirt. The air space around the switchgear, which is necessary for the entrance of ventilating air, should be cleaned of possible debris.
10) Battery and Charging Equipment

The control battery is such an important accessory to the switchgear operation that it must be given special periodic attention if it is to have a long life of reliable service. Periodic inspections and tests are recommended in the battery supplier’s instructions. During the same time that the battery is routinely checked, inspect the battery charger and remove and accumulations of dust and dirt.

On all chargers, having a manual transfer switch for setting the charging rate, carefully check and ensure that the selector switch is returned to the value appropriate for a floating charge at the end of the periodic inspection. Serious damage to the control battery can occur if the charger is left on a high charging rate for an extended period of time.

11) Hardware

Check to see all anchor bolts and switchgear hardware are tightened to correct torque values. See Table C, Bolt Torque Values.

12) Heaters

If the switchgear is equipped with anti-condensation heaters, check to see that all heaters are energized and operating properly. This may be done by using a hook-on ammeter to measure the current drawn by the heater.

13) Testing

The condition of each switchgear unit at the time of inspection should be listed in a permanent record to become a guide for anticipating the need for replacements or for special attention between the regularly maintenance periods.

a. Insulation resistance tests are suggested for checking the insulation. A series of these tests will indicate any tendency toward a reduction in dielectric strength of the insulation. Insulation resistance readings should be taken before and after cleaning the switchgear equipment and, insofar as possible, under similar conditions at successive periods. Records should include the insulation resistance reading, the temperature, and the humidity (either by definite reading or description).

b. Acceptable limits vary with the extent and design of the bus structure. In contrast to a small installation, the longer switchgear assemblies have a more extensive bus structure with a greater number of insulators and thereby, a larger number of parallel insulation resistance paths to ground, which will tend to decrease insulation resistance readings. This variation in insulation resistance between different switchgear lineups emphasizes the value of a series of readings that can be charted to establish a normal insulation level so that progressive weakening of the insulation can be recognized. Voltage transformers and control power transformers should be disconnected during these tests, as they may not be able to withstand the switchgear tests and they may provide direct paths to ground.
c. The resistance of bus connections may be checked by passing a measured DC current of 200A or more, through the joint and measuring the voltage drop (in millivolts) across the joint. An increase in the voltage drop indicates a joint requiring maintenance.

d. Tests on circuit breakers, removable elements, and other devices which are included in the switchgear should be performed in accordance with the instructions applicable to each device.

14) Abnormal Conditions

Local atmospheric conditions such as high humidity, salty atmosphere, corrosive gases, heavy dust, extreme heat, or severe operating conditions, are considered to be abnormal, and more frequent equipment inspections are required.

A series of quarterly inspections should be performed to analyze the effect of local abnormal conditions on equipment. Then an inspection and maintenance schedule can be established to maintain the equipment in a satisfactory condition.

If maintenance and inspection frequency in abnormal conditions interferes with operating and production schedules, consideration should be given to placing the equipment in a relatively tight room. Clean air can be pumped into the room to create positive air pressure and decrease exposure of the equipment to abnormal conditions. In areas where the ambient temperature is relatively high, cooling the air will improve equipment protection from extreme heat conditions. A less frequent maintenance schedule can be established when equipment is protected from abnormal conditions.

15) Doors

Verify that all doors open without interference.

a. Exterior doors utilizing tie-down bolts should have gasket material around the tie-down bolt holes. Confirm the presence and functionality of the gasket. If the gasket is damaged, replace it.
Ch 7  **Recommended Renewal Parts and Replacement Procedures**

**A. ORDERING INSTRUCTIONS**

1. To order replacement parts from Powell, visit the website at [powellind.com](http://powellind.com) or call 1.800.480.7273.

2. Always specify the complete nameplate information including:
   - Circuit Breaker Type
   - Serial Number
   - Rated Voltage
   - Rated Amps
   - Control Voltage (for control devices and coils)

3. Specify the quantity and description of the part and the instruction bulletin number. If the part is in any of the recommended renewal parts tables, specify the catalog number. If the part is not in any of the tables, a description should be accompanied by a marked illustration from this instruction bulletin or photo.

**B. RECOMMENDED RENEWAL PARTS**

A sufficient amount of renewal parts should be stored to enable the prompt replacement of any worn, broken or damaged part. A sufficient amount of stocked parts minimizes service interruptions caused by breakdowns and saves time and expense. When continuous operation is a primary consideration, a larger quantity of renewal parts should be stocked depending on the severity of the service and the time required to secure replacement parts.

Since parts may be improved periodically, renewal parts may not be identical to the original parts. **Table M Accessories**, lists the recommended spare parts to be carried in stock by the user with the recommended quantity. As a minimum, it is recommended that one set of parts be stocked per ten circuit breakers or less.

Powell recommends that only qualified technicians perform maintenance on Power/Vac® switchgear. Refer to the **Qualified Persons** section in the front of this instruction bulletin.
## Table M Accessories

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<th>Description</th>
<th>Part Number</th>
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<td>Right Hand Racking Mechanism</td>
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</table>
01.4IB.67000
Power/Vac® Metal-Clad Switchgear

5kV & 15kV
20kA, 25kA, 31.5kA, 40kA, 50kA, & 63kA
1200A, 2000A, 3000A, 3500A, & 4000A FC

October 2018