01.4IB.65201 PowlVac 38-AR™
Arc Resistant Metal-Clad Switchgear
Equipped with CDS Circuit Breakers
38kV, 3000A, 40kA

Powered by Safety®
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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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WARNING

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

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

Before any adjustment, servicing, part replacement, or any other act is performed requiring physical contact with the electrical working components or wiring of this equipment, the power supply must be disconnected. Failure to follow this warning may result in injury or death.

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 PowlVac 38-AR™ Arc Resistant Metal-Clad Switchgear:

- 38kV, 40kA Interrupting Current, 3000A Continuous Current equipped with a CDS Circuit Breaker

Note: Also applies to the previously manufactured 38kV, 3000A CDR circuit breakers.

- This bulletin specifically addresses the ratings and characteristics of the PowlVac 38-AR switchgear designed for a 3000A circuit breaker. Refer to 01.4IB.65202A for information on equipment included in the functional switchgear lineup.

B. Purpose

The information in this instruction bulletin is intended to provide information required to properly operate and maintain the PowlVac 38-AR Arc Resistant 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 PowlVac 38-AR Arc Resistant 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. Procedure for critical adjustments
7. 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.

All illustrations and photos are shown using deenergized equipment.

⚠️ WARNING

Be sure to follow the appropriate safety precaution while handling any of the equipment. Failure to do so may result in serious injury or death.

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

NOTICE

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

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 with the Instruction Bulletin number in the subject line.

D. ASSOCIATED INSTRUCTION BULLETINS

- 01.4IB.65080A PowlVac 38™ CDS 3000A Vacuum Circuit Breaker
- 01.4IB.65202A PowlVac 38-AR™ Arc Resistant Metal-Clad Switchgear 1200A & 2000A with CDS Circuit Breakers
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-clad 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 PowlVac 38-AR™ 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 the switchgear’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.

4. PowlVac 38-AR™ Arc Resistant Switchgear is designed to operate with the access doors to high voltage compartments closed. If a circuit breaker or auxiliary component is removed for any reason, the door must be re-closed and properly secured.

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 mechanisms must be serviced only by skilled and knowledgeable personnel capable of releasing or discharging each spring load in a controlled manner. Detailed information regarding these mechanisms is found in circuit breaker instruction bulletin.

4. **DO NOT ATTEMPT TO CLOSE THE CIRCUIT BREAKER MANUALLY ON AN ENERGIZED CIRCUIT.** Without control power to operate the trip function, if the circuit breaker experiences a fault of some type, there is no reliable means to operate the circuit breaker before damage or personnel injury could occur.

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.**
7. Closed-door operation features on the PowlVac 38-AR™ allow circuit breakers to be connected to or disconnected from the power circuit with the compartment door closed. Maintenance functions will require opening the compartment door to remove the device. Opening the compartment door with the bus energized removes the arc resistant features of the design. Personal Protective Equipment (PPE) suitable for the potential exposure hazard must be worn if the operator opens any high voltage compartment door while the equipment is energized. Maintenance operations, such as fuse replacement on the auxiliary device, require opening the compartment door. While it is common practice to replace fuses in auxiliary devices with the equipment energized, this practice is not recommended.

8. Interlocks are provided to ensure the proper operating sequences of the PowlVac 38-AR Switchgear, circuit breakers and for the safety of the user. If for any reason an interlock does not function as described, do not make any adjustments, modifications, or deform the parts. Do not force the parts into position. Contact Powell for further instructions.

E. X-Rays

When high voltage is applied across the contacts of a vacuum interrupter, there is the possibility of generation of X-rays. The intensity of the X-radiation is dependent on the peak voltage and the contact gap. At the normal operating voltage for this type of equipment, the radiation levels are negligible. At the voltages specified for testing, test personnel shall be in front of the circuit breaker such that the two layers of steel used in the frame and front cover construction are between the test personnel and the vacuum interrupters, and that the test personnel be no closer than one meter (3’) from the front of the circuit breaker.

THE CIRCUIT BREAKER SHALL BE EITHER FULLY OPEN, OR FULLY CLOSED WHEN MAKING HIGH POTENTIAL TESTS. DO NOT TEST WITH CONTACTS PARTIALLY OPEN.

F. 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 in and on the switchgear and on the circuit breaker removable element. Always observe these warnings and caution labels. 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.

PowlVac 38-AR™ Arc Resistant Switchgear is defined as switchgear that is designed to withstand an internal arcing fault and able to direct the flow of the resulting gases and debris away from adjacent equipment and operating personnel. The result is increased operator safety.

The PowlVac 38-AR switchgear is used to protect and control medium voltage, alternating current power distribution systems. The arc resistant design combines circuit breakers, auxiliary devices, and switchgear structures that are completely designed and fabricated by Powell. The circuit breaker design incorporates vacuum interrupters utilizing chrome copper contacts. The standard switchgear design incorporates a plenum and exhaust vents, double walls between sections, reinforced door assemblies, and both electrical and mechanical interlocks for increased safety. Customer specified components (i.e. instrument transformers, instruments, meters, and relays) are installed within this structure to complete a finished product that meets all applicable industry standards developed by ANSI, NEMA, and IEEE. This instruction bulletin should be used in conjunction with the appropriate PowlVac 38™ vacuum circuit breaker instruction bulletin as well as any other components of the metal-clad switchgear.

PowlVac 38-AR is available as indoor equipment only. For outdoor installations, the equipment is provided in a Power Control Room (PCR®).

1) One-High Construction

The basic one-high construction standard measurements are 92” high x 54” wide x 1313/8” deep (Figure 1). The compartment holds one circuit breaker or auxiliary device. Each unit includes the primary and secondary compartments as shown in Figure 2.

B. Primary Compartment

The primary compartment contains the high voltage equipment and connections arranged in compartments to offer increased safety by minimizing personnel exposure and limiting the effects of faults.
Figure 1  PowlVac 38-AR™ Arc Resistant Switchgear Lineup
Figure 2  Typical Section View

- Plenum
- Top Blow-Out Vents
- Blow-Out Panels
- Main Bus
- Cable Compartment
- Circuit Breaker Compartment
- Secondary Upper Compartment
- Secondary Lower Compartment
- Primary Compartment

Dimensions:
- 92.46
- 68.375
- 132.25
- 134.57
- 61.86
- 123.18
- 121
- 123.38
- 121
C. **Secondary Compartment**

The secondary compartment (Figure 2) is located at the front of the construction. It consists of two compartments, upper and lower, with a hinged door or panels, which is mounted with the necessary instruments, controls, and protective devices. The terminal blocks, fuse blocks, and some control devices are mounted inside the compartment on the side sheets and barriers. Circuit breaker control accessories, such as the secondary disconnecting device, and the mechanism operated cell switch (MOC) and the truck operated cell switch (TOC), are mounted in the lower compartment (Figure 4). Penetrations are provided to allow passage of control wiring between the compartments near the center of all units.

D. **Doors**

All doors covering access to the primary circuit components are constructed with arc resistant features. These doors MUST remain closed when the equipment is energized to maintain the assigned Internal Arcing Accessibility Type shown on the equipment nameplate. These doors vary in size and construction based on fault rating and function. View windows are provided on all front doors.

1) **Circuit Breaker Compartment Doors**

These doors are essentially identical with respect to latching and physical size. The doors are single step latching; rotate the handle to the latched position and the door meets the requirements for the Internal Arcing Fault rating assigned. No additional operations or specialized tools are required to operate the door.

*Figure 3   Inside View of 3000A Compartment Door*

![Inside View of 3000A Compartment Door](image)

- a. View Window
- b. Racking Access Port
- c. Blast Shield
- d. Manual Trip Operator
2) **Rear Doors**

Rear doors are full height doors that have four additional bolts on the top and bottom corners holding the doors secure. The doors also have a handle with latching that is similar to the front doors.

**E. Ratings**

PowlVac 38-AR™ Metal-Clad Switchgear is available in the standard voltage ratings listed in Table A, Ratings for PowlVac 38-AR™ Arc Resistant Metal-Clad Switchgear. These ratings correspond to the ratings of the circuit breaker used.

<table>
<thead>
<tr>
<th>Rated Maximum Voltage (kV, rms)</th>
<th>Rated Short Circuit Current (kA) (K Factor = 1.0)</th>
<th>Rated Continuous Current @ 60Hz Amps, rms</th>
<th>Rated Internal Arcing Fault Accessibility Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>38</td>
<td>40</td>
<td>3000</td>
<td>28</td>
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**F. Basic Impulse Level**

- 150kV for 38kV class switchgear

**G. Factory Dielectric Test**

Power Frequency Withstand (ANSI C37.20.2) is 80kV for 38kV class switchgear.

*Note:* If required, 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 5 Operation, M. Testing and Inspection* for values to be used.

**H. Circuit Breakers**

PowlVac 38-AR switchgear is designed to house the many different types of components required to distribute and control electricity. The primary component in this distribution system is the circuit breaker. The PowlVac 38™ 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 detailed description of the circuit breaker and its operation refer to the appropriate instruction bulletin for PowlVac™ CDS vacuum circuit breakers.
**Figure 4** Inside View of the Compartment

a. TOC Switch & Operating Mechanism  
b. Shutters  
c. Shutter Operating Mechanism / Racking Arms  
d. Cam Plate/Padlock Provision  
e. Primary Disconnect Devices  
f. MOC Switch & Operating Mechanism  
g. MOC Test Position Lever  
h. Ground Bus  
i. Floor Pan  
j. Manual Push To Trip / Circuit Breaker Trip Free Interlock  
k. Control Cable Entry
I. **Safety Interlocks and Provisions**

**NOTICE**

*Warning and Caution labels are located in various places in and on the switchgear and on the circuit breaker removable element. Always observe these warnings and caution labels. Do NOT remove or deface any of these warning/caution labels.*

1) **Key Interlocks**

Key interlocks are often supplied in conjunction with disconnecting switches, removable elements, and special compartments where access is dependent on other actions. The operation of key interlock schemes is generally described by a note or key chart on the specific work order drawings.

**NOTICE**

*Before placing metal-clad switchgear with key interlocks in operation, the key scheme must be carefully checked and only proper keys left in the locks.*

All extra keys must be removed and destroyed, or secured where they are accessible only in an emergency.

2) **Circuit Breaker Compartment Safety Provisions**

The PowlVac 38™ circuit breaker is equipped with a positive mechanical interlock that prevents moving the breaker unless the primary contacts are open. To rack the circuit breaker in any direction, the circuit breaker must first be opened. The interlock then interfaces with an actuator located in the circuit breaker compartment of the switchgear to hold the circuit breaker in a “trip-free” condition while the circuit breaker is being racked into or out of the connected position.

Safety shutters (Figure 4, b) open and close over the stationary primary disconnect devices in response to the movement of the circuit breaker racking mechanism. A spring discharge interlock is provided to discharge the main closing spring when a circuit breaker is inserted into or withdrawn from the compartment. This interlock is activated by unplugging the secondary disconnect plug or the disconnect override device accessory.

A circuit breaker compartment interference plate is provided which is designed to hinder insertion of an incorrect type or rating circuit breaker into the compartment.

The circuit breaker rating should always be checked against the rating of the metal-clad switchgear. Under no circumstances should the interference plate be removed from the circuit breaker or the switchgear as this action may allow the installation of a circuit breaker not rated for the compartment.

**WARNING**

*Always refer to work order information, drawings, and schemes to make certain that the circuit breaker and metal-clad switchgear are coordinated for operation.*

An anti-rollout stop block is provided to deter the removal of the circuit breaker from the compartment until the rollout latch on the circuit breaker is depressed.
J. **Main Bus, Main Bus Taps, Ground Bus, and Supports**

The main bus, main bus taps, and ground bus conductors are made of copper. The main bus, main bus joints, and taps are insulated. The bolted connections are silver-plated or tin-plated. The main bus supports are made of polyester fiberglass with epoxy inserts.

K. **Primary Disconnect Devices and Bushings**

The stationary primary disconnecting devices are brazed tubular silver plated connections located within the primary disconnect bushing. These mate with the self-aligning fingers of the primary disconnect on the circuit breaker removable element. Contact pressure is ensured by garter springs around the exterior of the primary disconnect devices of the circuit breaker removable element. All mating surfaces are silver plated to reduce contact resistance and prevent oxidation.

L. **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

The secondary disconnect plug is an umbilical cord device. This multi-pin plug is located at the end of a cord attached to the top of the compartment. In order to rack the breaker into the compartment this plug must be inserted in the secondary disconnect receptacle. Once the plug is inserted and the breaker is racked past the “test position”, the plug is held captive and cannot be removed from the breaker.
1) **Disconnected 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 primary stationary connections preventing the circuit breaker disconnects from coming into contact when in the disconnected and test positions.

2) **Test Position**

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 (switchgear) into the secondary disconnect receptacle of the circuit breaker. 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”.

3) **Connected 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 prevent the closing of the breaker between the disconnect/test and connected 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 01.4IB.65080A PowlVac 38™ CDS 3000A Vacuum Circuit Breaker bulletin.

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**CAUTION**

If the control circuits are energized, the spring charging motor will operate to charge the circuit breaker’s main closing spring as soon as the secondary disconnect plug is inserted into the secondary disconnect receptacle.

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**CAUTION**

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

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**M. Auxiliary Compartments**

Many sizes of auxiliary compartments may be furnished in PowlVac 38™ lineups for various purposes. Consult the factory for special applications or requirements. Some examples are listed below:

- Bus transitions to transformers
- Cable or bus duct entrance compartments
- Relay and metering compartments
- Instrument transformer compartments
- Utility metering compartments
N. Unit Space Heaters

Unit space heaters are provided in all outdoor equipment, and in indoor equipment when specified, in order to facilitate drying and prevent condensation. It is recommended that heaters be energized at all times; accordingly, no switch or thermostat is provided in the heater circuit unless specified. Two heaters, each providing 250 watts of heat, are furnished for each compartment.

Heaters in breaker units are located in the rear of the front compartment, below the lower primary disconnect devices, and in the rear cable compartment. Heaters in auxiliary units are placed in a similar location. In auxiliary units equipped with rollouts, it may be necessary to remove the lower rollout to gain access to the heater.

O. Primary Disconnect Devices and Supports

Window-type current transformers are positioned around the primary disconnect device bushings as required. They are removable from the front and may be located on upper and/or lower primary disconnect device bushings. If necessary, current transformers may be mounted outside the circuit breaker compartment of the primary enclosure.

P. Lighting

Closed-door racking switchgear is equipped with a 120VAC interior light and a door mounted light switch. When the interior light is switched on in the circuit breaker compartment, the user can read “breaker test/disconnect” or “breaker connected” on the circuit breaker position indicator through the view window.

⚠️ WARNING

Before any adjustment, servicing, parts replacement, or any other act is performed requiring physical contact with the electrical working components or wiring of this equipment, the power supply must be disconnected and deenergized.
Ch 4 Installation

Contact the Powell Service Division for installation, maintenance, and renewal parts assistance. To contact the Powell Service Division call 1.800.480.7273 or 713.944.6900, or email info@powellservice.com.

It is the responsibility of the purchaser to set or program components such as protective relays, meters, timers, etc., in accordance with the requirements of the particular installation, before placing the switchgear with vacuum circuit breakers into service. Programmable devices may be shipped with temporary programming, used to test the switchgear. Electromechanical relays may be shipped in a blocked position to avoid damage during shipment. Refer to separate instructions for these components for information on setting or programming.

A. General

This section contains information on receiving, handling, positioning, power cable termination, grounding, and checks to make the equipment ready for operation.

Once the assembly of the metal-clad switchgear is completed on site, all joints and hardware, including bus connections, structural assemblies, and control connections should be checked for tightness and proper torque values.

B. Receiving

PowlVac 38-AR™ Metal-Clad Switchgear is fabricated in rigid, floor mounted, steel vertical sections. Indoor shipping assemblies are enclosed in a covering to protect the switchgear lineup from the weather. The switchgear vertical sections are shipped in an upright position, and when received should be kept upright.

When the switchgear lineup reaches its destination, the purchaser should check the material actually received against the shipping list to be sure that all parts have been received. If damage is found or suspected, file a claim as soon as possible with the transportation company and notify the nearest Powell representative.

The removable elements such as the circuit breaker will be shipped separately. Refer to the instruction bulletin furnished for receiving, storage, and handling instructions on the circuit breaker.

Some components such as top-mounted resistors or potential transformers, may also 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

If the switchgear is provided in a PCR®, refer to the handling instructions contained in the instruction bulletin for the PCR.

It is always preferable to handle a PowlVac 38-AR switchgear lineup with an overhead crane utilizing the lifting means provided on the switchgear. Because of the weight of the arc resistant equipment it may be necessary to separate the shipping split into single vertical sections. This will increase the maneuverability and reduce the chances for damage while moving the switchgear. Never attempt to move more than two sections at a time, even when a crane is available.
Do not attempt to move the switchgear by opening the doors or pressure relief vents to attach straps or insert the forks of a forklift as the accessible surfaces are not designed to support the weight of the switchgear.

If a plenum is present, do not attempt to lift the unit by attaching straps or chains to or through the plenum shell or to the lifting angle on the plenum (it is provided to lift the plenum only). Further, when attaching chains or straps to the appropriate lifting points, use caution to prevent damage to the plenum. It is advisable to remove the plenum when possible.

Failure to follow these cautionary advisements may damage the equipment and reduce or negate its intended arc resistant function.

The use of a forklift is not recommended on the switchgear, however if no other method for handling is available, the forks must go directly under the bottom base to avoid damage to the switchgear. Caution must be exercised to avoid deforming the switchgear frame due to uneven weight distribution when lifting with a forklift.

If roller or heavy-duty pipe is used to move the switchgear, the following precautions must be taken:

1. If pipe is used, it must extend past the edges of the switchgear on both sides.
2. If rollers are used, they must be placed on the corners of 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. Preparation of Floor Anchoring**

The station floor must be strong enough to prevent sagging due to the weight of the switchgear structure and to withstand the impact stress caused by the opening of the circuit breakers under short circuit conditions. The impact loading is approximately 1 ½ times the static load. It is essential that the floor be level to avoid distortion of the switchgear structure, and that the switchgear be completely aligned prior to final anchoring. This is accomplished by using floor leveling channels. The leveling channels should have a minimum web dimension of 4 inches. The required quantity and locations of the leveling channels and the spacing of the leveling channels, including the center channel, is shown on the drawings furnished with the order. Figure 6 shows the recommended orientation for the channels to be placed in the floor. The floor channels must be level and straight with respect to each other. The exposed top surface of the leveling channels must be flat and form a level surface plane for the entire switchgear assembly to rest upon. The surface plane of the leveling channels should be flat within 1/8” (the two planes defined by the highest point and the lowest point of the leveling channels must be within 1/8”). The overall floor slope should not exceed 1/8” across the front-to-back or end-to-end dimension of the switchgear lineup. In no case may the concrete floor rise above the level of the floor leveling channels.

The switchgear units must be placed on floor leveling channels in such a manner that the base of each unit rests directly on each of the floor channels. Even though the switchgear is not anchored to the center channel, its location is important to the proper support and alignment of the switchgear. Shims, not to exceed 1/8” total thickness, may be used for final leveling.
Care should be taken to provide a smooth, hard and level floor surface in front of the units to facilitate installation and removal of the circuit breakers. The floor in front of the circuit breaker compartments should be level with, or slightly below, the base of the switchgear to facilitate inserting and withdrawing the circuit breakers. The step up from the floor into the circuit breaker compartment should be no more than the two metal thicknesses that make up the compartment floor and breaker pan. Critical components on the circuit breaker may be damaged if the step is larger. Should there be a gap between the concrete floor and the top of the floor leveling channel at the front of the lineup, the floor must be leveled relative to the circuit breaker compartments for approximately 36" extending away from the switchgear. This will assure the circuit breaker enters its compartment with a step up of no more than ⅛".

When installing the switchgear on existing floors, it is recommended to pour a new finish floor with embedded channels, or to cut slots in the floor for embedding and leveling the supporting channels.

Encircling loops of reinforcing or building steel around single-phase conductors should be avoided in the areas for main cables when these circuits are rated at 600 amperes or above.

The user must provide suitable means for anchoring the switchgear to the floor. Recommended practice for anchoring the switchgear to the floor is to weld the switchgear structure to the floor channels using a tack weld at points indicated for anchoring on the drawing. After welding, any damaged paint should be removed and the weld and surrounding metal painted to deter corrosion. If welding facilities are not available, the switchgear should be bolted to the floor channels. The switchgear must be in full contact with the leveling channel at the point of bolting to avoid distortion when tightening the hardware.

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 order. If desired, the conduits may be installed before the switchgear. Positioning rollers, if used, should be high enough to allow the switchgear to pass over any conduits that might be required for future connections.
After all the equipment is located and fully installed, examine the bottom edge of the switchgear at the floor for gaps. Any gap greater than 1/8” between the concrete floor and the switchgear must be filled. Silicone RTV is suitable for filling gaps ¼” or less. For gaps greater than ¼” it is recommended that concrete or mortar be used. Failure to fill these gaps may result in hazardous gas escape from under the switchgear in the event of an internal arcing fault.

Figure 7  Anchoring with Channel Base

**CAUTION**

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

When installing a unit substation or power center, the power transformer and the adjacent 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 units should then be installed.

Additional shipping members may have been installed in the bus or primary area to ensure against shipping damage. It is imperative that all shipping members are removed, and joints properly tightened and insulated before energizing the bus.

Mats, screens, railing, etc., which are external to the switchgear may be required to meet local codes, must be furnished by the purchaser. Be sure to discuss these items with the manufacturer prior to installation as they may affect the performance of the switchgear.

F. **Positioning the Metal-Clad Switchgear**

1) **General**

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, for inspection and maintenance, and on some switchgear to rollout voltage or control power transformers. The dimensions shown on the switchgear drawings are those required for proper operation of the switchgear. The space at the ends of the lineup can affect the function of the switchgear. There must be 44 inches from the right end (operator’s left while facing the switchgear) of the lineup to the wall or adjacent equipment to fully open the circuit breaker compartment door.
2) Assembly of Shipping Splits

Much of the arc resistant functions come from proper assembly of the switchgear. The procedures for free-standing equipment and PCR® installed equipment are slightly different. When reassembling the shipping splits use the following guidelines:

a. Free-Standing Switchgear (Customer Building)

Refer to this section and **Ch 4 Installation, C. Handling** for instructions on moving the equipment into position.

Once in position, final alignment is based on the hardware locations. There are five (5) vertical rows of hardware (Figure 9, a) to connect each vertical section to the adjacent section. Note that the front and rear rows are assembled with full hardware sets (nuts, bolts, and washers). The center locations may utilize either hardware sets or captive nuts in one section. If square holes are present in the equipment, use captive Tee-Nuts. Insert hardware in all holes and tighten to specification. Figure 1 shows a typical lineup with a fault current rating of ≤ 40kA.

b. Switchgear Inside a Power Control Room

Generally, the equipment provided in a PCR® is located in its proper place and fully assembled except for the sections on the shipping split. There is often a transition compartment provided at the split to serve as an easily accessible point to break the bus or to clear the wall and ceiling beams of the PCR.

Remove the main bus access covers in the rear compartment to gain access to the center set of mounting hardware holes. Figure 11 shows the main bus exposed after removing the rear covers. Figure 12 shows the main bus exposed after removing the front covers. It is not necessary to remove both sets of covers to access the bus, but this may make the assembly easier. Follow the instructions in **Ch 4 Installation, J. Connections, 1) Main Bus Assembly and Insulation**, to complete the support assembly and installation. These covers should remain off until after the bus is installed. See **Ch 4 Installation, F. Position the Metal-Clad Switchgear, 1) General** and Figures 9-12 for information on aligning the switchgear.
i.  Assembly Without a Transition

The adjacent sections of switchgear are already attached to the floor (and rear wall for wall-mounted gear). With the building components correctly aligned, the switchgear should also be aligned. From inside one of the two sections locate the attachment points between the adjacent vertical sections of switchgear. There are five (5) vertical rows of hardware to connect each vertical section to the adjacent section. See Figure 9 for locations. Note that the front and rear rows are assembled with full hardware sets (nuts, bolts, and washers). The center locations may utilize either hardware sets or captive nuts in one section (when square holes are present). Insert hardware in all holes and tighten to specification. Figure 1 shows a typical lineup with a fault current rating of ≤ 40kA under construction. The exposed end is ready for the next shipping split to be located and attached.

ii. Assembly With a Transition

Prior to reassembly of the PCR, determine if the transition components are attached to the adjacent section of switchgear and if there are any components (such as bus bar and transition plenum components) that should be placed in the equipment prior to reassembly to facilitate the process. The transition components mount to the switchgear at the same points shown in Figure 9. Assemble the transition right side components to the left side of the switchgear. Assemble the transition left side components to the right side of the switchgear. The main bus cut-out on each adjacent switchgear section is fitted with a collar that the bus barriers are installed to after the shipping split is assembled.

With the building components correctly aligned, the switchgear should also be aligned.

To assemble the transition attach the inside main bus barrier assembly. Then attach the top assembly followed by the front and rear assemblies.

The adjacent section of switchgear are already attached to the floor (and the rear wall for wall-mounted gear). The shipping split transition is 24” wide and is designed with slotted holes in the barriers to expand or contract to accommodate fluctuations in equipment size and alignment.
Figure 8  Vent Duct Assembly

Notes:
1. This figure is for reference only.
2. The 24h x 34w wall cutout at a height of 102.83" (103.33"-.5") is required for an arc duct ≤5'.
   The height of the cutout for arc ducts ≥5' is 102.33" (103.33"-1").
3. 103.33" is for 92" high switchgear. Special height configurations should have layout drawings with the correct dimensions to mount the duct.
c. **Bus Assembly**

i. Follow the recommended torque instructions found on labels inside the rear compartment and *Table B, Bolt Torque Values for Powell Medium Voltage Metal-Clad Switchgear*.

ii. Cover bus joints with appropriate boot or other insulating material provided. See *Ch 4 Installations, J. Connections* for details on all appropriate insulation methods and assemblies.

iii. Connect the ground bus located in the bottom rear of the cable compartment. Refer to *Ch 4 Installation, J. Connections*.

3) **Plenum Assembly**

The preferred method of controlling the by-products of an internal arcing fault is to channel these gases out of the room where the gear is located. This task is accomplished by use of a plenum located above the switchgear and venting ducts which carry the gases from the plenum to a desired location.

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**WARNING**

*It is critical to the performance of the switchgear protective scheme that the plenum and ducting be properly assembled and supported. Failure to follow the assembly instructions may result in the release of arc fault by-products at undesired locations or compromise the performance of the switchgear barrier system.*

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**CAUTION**

*Designs that allow venting into the equipment room have been evaluated for the flash hazard only. These designs meet the requirements of arc fault testing, but provide no mitigation for by-products such as smoke and sound pressure. The user should evaluate those risks.*
Figure 9  Side View of Typical Shipping Split

a. Five Rows of Hardware
Figure 10  Front View of Typical Shipping Split
Figure 11  Rear Compartment Shipping Split Assembly
Figure 12  Bus Installation
b. **Assembly of Plenum or Barrier in a PCR®**

Reassembly of the equipment, including the plenum, is required at the PCR shipping split for all equipment crossed by the split. The components for the shipping split transition plenum assembly will be shipped as a separate item.

i. **Barrier Assembly** - Connect the front vertical barriers (and rear if the switchgear is not mounted against an outside wall) using the hardware provided and attach the barrier to the PCR ceiling.

ii. **Modular Shroud** - Typically, a transition is used to span the shipping split. The transition is designed to expand or contract to accommodate variations in manufacturing tolerances and the reassembly process. The plenum is also designed to expand or contract to fit the open space between the adjacent switchgear sections. Once the transition components are reassembled, the plenum components may be installed.

- Attach the left and right side components to the respective switchgear plenums and install the covering piece(s).
- Attach the plenum components across the front and rear to the top of the transition assembly using the hardware provided.

Note: One side is a round hole and the mating piece will be slotted to aid in alignment.

iii. The ends are sealed with plates that attach to the edge of the plenum to the top of the switchgear and across the side of the switchgear.

c. **Assembly of Plenum in an Open Building**

For installation in a customer building, PowlVac 38-AR™ is typically split into two vertical sections. The plenum may be attached to the switchgear during shipment. If the plenum is attached to the switchgear the following precautions must be taken when handling the equipment:

i. If the equipment is to be lifted via overhead crane, a spreader bar must be used to avoid damaging the plenum.

ii. The path to the installation location must be evaluated for adequate overhead clearance.

iii. The equipment must never be lifted by the plenum. The plenum is not designed or attached to the equipment in a manner capable of supporting the equipment weight.

If the plenum shrouds are shipped separately:

i. Attach the plenum to the top of the switchgear using the sets of holes at the back of the instrument compartment and the middle of the cable compartment. Use the \(\frac{3}{8}\)" captive nuts and \(\frac{1}{2}\)" weld nuts provided.

ii. Connect the adjacent plenum components across the front, top, and rear using the hardware provided.

Note: One side is a round hole and the mating piece will be slotted to aid in alignment.

iii. The ends are sealed with plates that attach to the edge of the plenum to the top of the switchgear and across the side of the switchgear.
iv. This type of plenum may be provided with or without an exhaust duct. If there is sufficient clearance above the equipment, a louvered plenum may be provided to exhaust fault gases into the equipment room. Be certain during installation the louvered plenum(s) is located exactly where it is shown in the layout drawings for the job and that no obstructions are placed above the louvers to impede gas flow from the equipment.

![WARNING]

Failure to provide adequate clearance above the louvered plenum section(s) can compromise the internal arcing fault accessibility type and possibly reflect hot gases capable of causing serious injury or death.

4) Exhaust Duct Installation

All plenum assemblies require a method to vent the fault gases from the plenum to a designated area away from other equipment and personnel; typically out of the room.

In a PCR® installation, the exhaust vent(s) are built into the walls of the PCR and all necessary precautions have been included in the design and installation.

When the exhaust duct is provided and field installation is required, the following rules apply:

a. The duct must slope away from the equipment. A drop of 0.5 inches over a 5 foot length of duct is sufficient. For longer ducts, a drop of 1 inch over the total length is recommended. (Figure 8).

b. The duct must be adequately supported. Do not omit any of the provided mounting brackets. It is recommended by Powell to keep the duct length to less than 10 feet. In this case, the connection to the switchgear and wall provide the required support. Where longer ducts are necessary, support should be provided approximately every 10 feet, typically at the connection between sections. Standard duct weighs approximately 45lbs/linear foot.

c. The exit point for the duct must be sealed to the building wall, weather-tight, and secured to the duct.

5) Access

All plenum assemblies will have an access point to facilitate initial assembly and maintenance. This access point is typically located in one of the panels along the front of the equipment, but may be located on an exposed end (if an end is exposed in the lineup). Figures 13 & 14 show a typical access point with cover panel partially open.
**WARNING**

Do not remove the cover of the plenum access point while the switchgear is energized.

It is critical to the performance of the switchgear protective scheme that the cover for the access point to the plenum be properly installed while the equipment is energized. Failure to install or properly secure this cover may result in the release of arc fault by-products at undesired locations or compromise the performance of the switchgear barrier system.

**WARNING**

Do not enter the plenum with any part of the equipment energized.

Doing so will expose the operator to the potentially lethal by-products of an internal arcing fault.

**WARNING**

Entering the plenum may expose the operator to hazardous voltages on incoming lines. Verify that the incoming lines are deenergized and grounded prior to working in the plenum.

6) Placement of Equipment Near Exhaust Ducts

When a plenum and ducting system is utilized to control the by-products of an arcing fault, several site considerations must be made with respect to where the gas will be vented. Because the gas release is at an elevated temperature and pressure and contains metallic particles and toxic components, the location of the vent must be isolated from personnel and sensitive equipment. Further, when the gas is vented into the building the structural capability of the building to withstand the overpressure and the effects of the smoke and toxic gas in a closed area must also be evaluated.

Due to the circuitous route the arc blast takes through the switchgear, the plenum, and the duct system, a large part of the fault energy is attenuated inside the switchgear system. There is still a significant amount of energy that leaves the exhaust port and, depending on the speed of the protective scheme, a significant level of toxic gas and smoke may be released.

Pressure measurement in the switchgear during testing reveals significant drops in value as the gas works its way to the exit point of the duct. A typical 40kA three phase fault in a circuit breaker compartment sees a average peak pressure in that compartment of 12psi. The pressure is reduced to approximately 2psi when it reaches the exhaust duct external cover. At this point the gas has traveled at least 8 feet and the drop in pressure reflects the loss of energy that occurs.

The gas temperature also drops exponentially as it moves from the source. The temperature of the fault gases exiting the duct in the typical test sample are around 200°C and will continue to cool as it moves from the vent. The toxic nature of this gas does not decrease based on distance traveled and for that reason it is preferred to vent the gases outside of the building.
Figure 13  Plenum Overview

Figure 14  Plenum End View
Additional precautions, beyond those concerned with the temperature of the gases, will be required when the gas is released in a confined space or building. These precautions include evaluation of the effect of an overpressure on the structure and the availability of light and fresh air.

The isolation area for the exhaust duct to vent into can be visualized as a 5 foot diameter cylinder around the center line of the exhaust duct that extends 7 feet out from the exhaust duct opening. While the actual flow of gas resembles an ellipsoid within the borders of the described cylinder and will vary in intensity based on fault current level and proximity to the vent opening, using the cylinder dimensions as the borders of the isolation area provides a simple and effective method to define the space. This space must be free of personnel, sensitive equipment, and physical impediments to gas flow when the equipment is energized.

**Figure 15  Exhaust Duct Gas**

**G. DOOR ALIGNMENT**

If for any reason it is necessary to realign the doors of the switchgear during installation, perform the following:

1. After checking that the switchgear is level and plumb as earlier described, start at either end of the switchgear lineup and realign each door individually as required.
2. The top of each door should be level with the adjacent doors; the sides of each door plumb; the surface of each door flush with adjacent doors; and the space between adjacent doors equalized to permit their free swing and present a neat appearance.
3. Door may be raised or lowered vertically, moved left or right horizontally, or rotated to plumb them, by loosening the mounting screws which attach the door to the moveable half of the hinge assembly. These screws are located on the inside of the door. The door assembly may then be adjusted as allowed by the holes in the door, which are slightly oversized.
4. PCR® Rear Doors - When properly aligned, the rear doors of the switchgear (exterior doors of the PCR) should be tightly seated on the gasket that surrounds the door opening. After aligning the door as described above, close and latch the door and check the seal by inspecting the gasket for compression.
5. Check alignment of door shutter position interlock. With the equipment deenergized and the circuit breaker removed, enter the breaker compartment and close the door until the shutter position interlock actuator on the door contacts the upper linkage on the interlock. Verify that there is proper engagement and that the actuator will not move enough to miss the linkage. Verify that with the door fully closed, the lower linkage of the interlock will operate the latch so that the safety shutters are free to move.
H. Removable Element

The removable element (circuit breaker) device may be shipped loose in its own protective box or inserted in the switchgear when the equipment is installed in a PCR. If the circuit breaker is in the switchgear, it will be locked in place by a special bracket designed to prevent motion during shipment. This bracket must be removed and discarded in order to move the circuit breaker.

Before installing or operating a removable element consult the instruction bulletin for directions on installation, maintenance, and renewal parts for that particular element.

**CAUTION**

Prior to inserting a removable element into the compartment, manually check the shutter mechanism, the mechanism-operated cell (MOC) switch and operating mechanism, and the truck-operated cell (TOC) switch for free movement. These checks should be made with all circuits deenergized.

Removable elements may be rolled into the vertical section of the switchgear from the floor.

For a detailed description of the circuit breaker and its operation, maintenance, and renewal parts, refer to the appropriate PowlVac® circuit breaker instruction bulletin.

See Ch 5 Operation for specific details on inserting the removable element into the compartment.

I. Grounding

The switchgear assembly must be grounded before power connections are made.

External power connections should be installed after the equipment is placed in its permanent location and the grounding connections are completed. Temporary safety grounding cables must be connected to the equipment ground bus and all high voltage terminals that are handled or touched during power connection and installation.

**CAUTION**

Ensure that the switchgear vertical sections are grounded prior to making power connections.

A ground bus is furnished with lugs at each end for connection to the station grounding system.

The ground is bolted to the rear of the vertical section near the bottom. It is arranged so that connections to the station ground can be made in any unit. Where equipment is shipped in more than one group, the sections of 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, J. Connections. 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. It is very important that the equipment be adequately grounded to protect the operator from injury if 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.
It is recommended that the connection to the station ground have a cross section of 500,000 circular mils (240mm²) or greater if the soil in which it is buried is of such character as to cause appreciable corrosion. This is especially true where electrolysis from stray currents or contact with dissimilar metals exist. The resistance of the soil surrounding a station ground depends on the condition of the soil, as well as its chemical content. Dry, loose, sandy, or frozen soils will have a high resistance as compared with moist soils or soils containing ashes, cinders, or salt solution. The IEEE Standard 142 states that grounding impedance in the range of 1 to 5 ohms is generally acceptable for industrial substations. Ground resistance testing is recommended to verify that the ground resistance falls within this range.

J. CONNECTIONS

The main bus bars and other connection bars are copper. The connection surfaces are silver surfaced or equivalent. The silver plating used on bolted contact surfaces is approximately 0.0001” thick. All field assembled joints in primary conductors, regardless of method of installation, 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 1/2 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 1/4 inch thick copper bars are to be connected, the bolt should be 1 3/4 inch long. In addition to proper length bolts, the bolt assembly must include flat washers, split ring lock washers, and nuts. All hardware must be SAE Grade 5 or better. See Figure 16 for proper hardware assembly.

**Figure 16  ** Ground Bus Splice Bolt Assembly

![Diagram of Ground Bus Splice Bolt Assembly]

- a. Bolt
- b. Flat Washer
- c. Bus Bar
- d. Split Lock Washer
- e. Nut

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 B, Bolt Torque Values for Powell Medium Voltage Metal-Clad Switchgear.
1) **Main Bus Assembly and Insulation**

The main and riser bus structure of PowlVac 38™ Metal-Clad Switchgear is made up of ½” x 6” and ¾” x 4” copper bus sections. This bus structure is supported by conical cast epoxy bus support inserts mounted on a polyester-glass barrier.

The insulation system of the main bus has been designed to minimize electrical stress on the insulation while maintaining the minimum practical size of the bus structure. It is very important to the successful operation and long life of this equipment that the main bus assembly and insulation be done very carefully, following these instructions step by step.

The main bus of the metal-clad switchgear may be reached through access covers both in front of and behind the bus. See Figure 2. The front bus access cover may be removed from inside the circuit breaker compartment, while the rear bus access cover may be removed from the cable entry compartment.

2) **Installing and Connecting Main Bus Conductors**

The installation and connections of the main current carrying conductors must be done correctly to ensure compliance with equipment basic impulse level (BIL) and factory dielectric test (Hi-Pot) requirements. By following the series of instructions below, maximum operator safety and equipment integrity can be expected.

a. Remove the compartment covers.
b. Loosen the splice plate bolts at the bolted joints in the equipment, where the bus conductors being installed will be connected.
c. Clean contact surfaces of bus conductors as described previously in **Ch 4 Installation, J. Connections**.
d. Carefully insert the bars through the main bus supports making sure to not push them out of the conical bus supports. Note the conical supports might be installed in different directions for splice clearance reasons.

| Table B Bolt Torque Values for Powell Medium Voltage Metal-Clad Switchgear |
|-----------------------------|-------------------|------------------|
| Bolt Dimensions (inches) | Bolt Head | Torque |
|                            |          | Ft-Lbs | Kg-M |
| 5/8                        | octagon  | 55-70  | 7.6-9.7 |
| 1/2                        | octagon  | 35-50  | 4.8-6.9 |
| 3/8                        | octagon  | 20-30  | 2.8-4.2 |
| 1/4                        | octagon  | 5-7    | 0.7-0.97 |

3) **Main Bus Joint Insulation**

Main bus joints are insulated with either a custom fitted boot or with hand applied insulating tape. **Ch 4 Installation, J. Connections**, 4) Wrapping of Joints will describe the procedure for hand applied insulating tape wrapped joints. After installing main bus conductors as described in **Ch 4 Installation, J. Connections**, 2) Installing and Connecting Main Bus Conductors the joints must be insulated as follows.
a. Tighten the bus bar splice plate bolts properly. See Table B, Bolt Torque Values for Powell Medium Voltage Metal-Clad Switchgear. Once the joints are insulated, it will not be possible to retorque the bolts without removing the boot.
b. Place the boot over the joint (Figure 17).

Figure 17 Placing Boot over the Joint

Figure 18 Installing Brackets on the Boot

4) Wrapping of Joints

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 described above 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 20).

Table C 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 20  Insulation of Bus Bar**

- Diagram of 1/2 LAP Starting with 1 Full Turn - Apply with Mastic Side Down
- NOTE: Overlap an Expired Roll by 1/2 Turn
- Approximate Tensioned Dimensions: 1.75 (44.4) or 3.5 (88.9) "A" + 1/4 "A" = Contact Surface

**Table D Insulation of Bus Bar**

<table>
<thead>
<tr>
<th>Insulation Range (volts)</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&quot; &amp; 4&quot; Wide Rolls are 30' Long)</th>
</tr>
</thead>
<tbody>
<tr>
<td>34,500</td>
<td>4 Layer + ½ Lap *</td>
<td>2,4</td>
<td>14,16,18,19,23,26,29,29,36,37,39,39</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 - 1/2 lap for conductors passing through CT’s.

**Figure 21  Single Bus Bar Connection Joint**

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

<table>
<thead>
<tr>
<th>Insulation Level (kV)</th>
<th>Inner Filler &quot;A&quot;</th>
<th>Outer Wrap &quot;B&quot;</th>
<th>“C” (inches)</th>
<th>Approx. Number Rolls per Joint of HV Tape ∆</th>
</tr>
</thead>
<tbody>
<tr>
<td>34.5</td>
<td>RB Putty* &amp; 4 Layers</td>
<td>HV Tape</td>
<td>5 Layers</td>
<td>1 Roll RB Putty* &amp; 1 Roll HV Tape ∆</td>
</tr>
<tr>
<td>2&quot; or 3&quot; Bars</td>
<td>4&quot; or 6&quot; Bars</td>
<td></td>
<td></td>
<td>2 Rolls RB Putty* &amp; 2 Rolls HV Tape ∆</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.
- ∆ High voltage insulating tape 0282A3529 P004 - Roll is .030 x 2” x 30’ long. Apply with mastic side down.
**Figure 22** Double Bus Bar Connection Joint

4" (101.6) Wide PAD HV Tape #

RB Putty * Framework

4" (101.6) Wide PAD HV Tape #

RB Putty * Framework

<p>| Table F Insulation of Double Bus Bar Connection Joint |
|---------------------------------|-----------------|-----------------|---------------------------------|</p>
<table>
<thead>
<tr>
<th>Insulation Level (kV)</th>
<th>Inner Filler “A”</th>
<th>Outer Wrap “B”</th>
<th>Approx. Number of Rolls per Joint of HV Tape ∆</th>
</tr>
</thead>
<tbody>
<tr>
<td>34.5</td>
<td>RB Putty* &amp; 4 Layers HV Tape ∆</td>
<td>5 Layers HV Tape ∆</td>
<td>7 1 Roll RB Putty * 1 Roll HV Tape ∆ 3 Roll HV Tape ∆ 6 Rolls 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.

# 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 23** Tee Connection Joint

Epoxy Insulation Thermoplastic Sleeving or Tape Insulation

.50 (12.7) Min

RB Putty * Both Ends

Overlap Tape in a Figure Eight Pattern

.50 (12.7) Min

RB Putty * Both Ends

<p>| Table G Insulation of Tee Connection Joint |
|---------------------------------|-----------------|-----------------|---------------------------------|</p>
<table>
<thead>
<tr>
<th>Insulation Level (kV)</th>
<th>Inner Filler “A”</th>
<th>Outer Wrap “B”</th>
<th>Approx. Number of Rolls per Joint of HV Tape ∆</th>
</tr>
</thead>
<tbody>
<tr>
<td>34.5</td>
<td>RB Putty* &amp; 4 Layers HV Tape ∆</td>
<td>5 Layers HV Tape ∆</td>
<td>7 1 Roll RB Putty * 3 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 1/8” x 1½” x 5’ long.

Δ HV Tape 0282A3529 P004 roll is .030” x 2” x 30’ long. Apply with mastic side down.
Figure 24  Dead End Bus Joint Insulation

Pre-Insulation Epoxy Insulation
Thermoplastic Sleeving or Tape Insulation

![Diagram of Dead End Bus Joint Insulation]

```
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.
```

6) 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.

K. Primary Cables

The primary cable connections in PowiVac 38-AR™ switchgear are reached by opening the rear hinged doors.

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.

Table H 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>
<th>2” or 3” Bars</th>
<th>4” or 6” Bars</th>
</tr>
</thead>
<tbody>
<tr>
<td>34.5</td>
<td>RB Putty* &amp; 4 Layers HV Tape</td>
<td>5 Layers HV Tape</td>
<td>50 (12.7) Min</td>
<td>7</td>
<td>⅛ Roll RB Putty*</td>
<td>⅛ 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. This putty has no insulation value. 1 roll is ⅛” x 1½” x 5’ long.

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

5) Incoming Power Connections

Incoming power connections to the switchgear may be connected in various configurations depending on the equipment application. Review the elevation drawings delivered with the equipment for site specific connection details.
There are several 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.

L. INSULATING PRIMARY CABLE TERMINATIONS

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, J. 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, J. 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.

**Figure 25  Cable Termination Joint**

![Cable Termination Joint Diagram]

**Table I  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 ∆</th>
</tr>
</thead>
<tbody>
<tr>
<td>34.5</td>
<td>R5 Putty* &amp; 4 Layers HV Tape ∆</td>
<td>5 Layers HV Tape ∆</td>
<td>7</td>
<td>1 Roll RB Putty* &amp; 3 Roll HV Tape ∆</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 Roll RB Putty* &amp; 6 Roll HV Tape ∆</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 ¼” x 1½” x 5’ long.*

∆ HV Tape 0282A3529 P004 roll is .030” x 2” x 30’ long. Apply with mastic side down.
M. **Ground Fault Current Transformers**

(Window Type)

Window-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.

Where armored cable is used, the armor must be terminated and grounded before the cable passes through the transformer. Armor clamps are furnished for this purpose when specified.

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.

All cables should be kept as close to the center of the current transformer window as possible.

---

**Table J Bar-Type Current Transformer Joint Insulation**

<table>
<thead>
<tr>
<th>Insulation Level (kV)</th>
<th>Inner Filler &quot;A&quot;</th>
<th>Outer Wrap &quot;B&quot;</th>
<th>&quot;C&quot; (inches)</th>
<th>&quot;D&quot; (inches)</th>
<th>Approx. No. of Rolls per Joint of HV Tape &amp;</th>
</tr>
</thead>
<tbody>
<tr>
<td>34.5</td>
<td>RB Putty* &amp; 4 Layers HV Tape</td>
<td>5 Layers HV Tape</td>
<td>7</td>
<td>5 #</td>
<td>1 Roll RB Putty* &amp; 3 Roll HV Tape Δ</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 Roll RB Putty* &amp; 6 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 ¼" 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.
N. 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. The control cables may be pulled through the conduits before or after the switchgear is installed, whichever is more convenient. However, if the cables are pulled before the switchgear is installed, they must be threaded through the opening in the switchgear floor plate when setting the switchgear in place.

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.

O. 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.

P. 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, J. Connections.
Figure 27  Roof Bushing

Q. BUS DUCT ENTRY

Bus duct entry into the switchgear must penetrate the plenum (when a plenum is present). There are several methods available to make the connections:

1. Plenum Type II has an alternate configuration that contains compartments designed to accommodate bus entry and maintain both metal-clad switchgear isolation and arc fault integrity. Connections to the bus are made from the outside of the equipment as is typical with standard bus duct.

2. Plenum Type I and III may also be configured with bus duct; however, the duct is not integral to these plenum designs. Here standard bus duct is run inside the plenum assembly and sealed as it exits the perimeter wall of the plenum.

In all cases, there will be a fire barrier inside the duct at the point it exits the boundaries of the plenum.

R. AUXILIARY DEVICE ROLLOUT CARRIAGES

Auxiliary device rollout carriages are not available for PowlVac 38-AR® 3000A switchgear.

Table K Pothead, Bushing, or Terminator

<table>
<thead>
<tr>
<th>Insulation Level (kV)</th>
<th>Inner Filler &quot;A&quot;</th>
<th>Outer Wrap &quot;B&quot;</th>
<th>°C&quot; (inches)</th>
<th>Approx. No. of Rolls per Joint of HV Tape Δ</th>
</tr>
</thead>
<tbody>
<tr>
<td>34.5</td>
<td>RB Putty* &amp; 4 Layers HV Tape Δ</td>
<td>5 Layers HV Tape Δ</td>
<td>7</td>
<td>1 Roll RB Putty* &amp; 3 Rolls HV Tape Δ</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 Rolls RB Putty* &amp; 6 Rolls 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" \times 1\frac{1}{2}" \times 5' long.

Δ HV Tape 0282A3529P004 roll is $.030" \times 2" \times 30’ long. Apply with mastic side down.
Ch 5 Operation

A. General

⚠️ DANGER

Compartment access shall be permitted ONLY to “Qualified Person”, as defined in NFPA 70E, using “approved safe work practice” and “appropriate PPE”.

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 PowlVac 38™ 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.

⚠️ CAUTION

This device must not be used to close the circuit breaker on any energized circuit.

The control circuits may be checked 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

⚠️ WARNING

Opening the circuit breaker compartment door to install a circuit breaker exposes the operator to potentially lethal conditions by removing the arc resistant protection during the time the door is open and unlatched. The operator must wear the appropriate Personal Protective Equipment (PPE) for the level of flash hazard exposure indicated by the short-circuit rating of the equipment.

Do not place the circuit breaker into the compartment until the switchgear lineup installation is complete. If the circuit breakers are placed into the switchgear lineup before the installation is complete, trouble may occur from foreign materials in the compartments and from a non-level foundation or from distortion caused during shipment or handling.

1. Verify that the circuit breaker open/closed indicator displays “BREAKER OPEN” and if not, press the manual trip operator to open the circuit breaker.

2. To insert the circuit breaker into the circuit breaker compartment, open the compartment door and align the wheels with the floor pan channels of the compartment. Verify that there are no locks or tags on the circuit breaker or the shutter interlock that would block operation or indicate an issue with the equipment and that the floor pan channels are free of debris prior to inserting the circuit breaker.
3. Roll the circuit breaker in the compartment until the racking crank arms make contact with the vertical slots in the compartment. The anti-rollout latch on the lower right side of the circuit breaker will engage the block in the compartment, preventing accidental removal of the circuit breaker from the compartment.

This is the disconnected position.

C. **Racking Mechanism**

The racking mechanism consists of two slotted cam plates mounted on each side of the compartment (located behind the shutter actuators shown in Figure 4) and the racking mechanism on the circuit breaker. The crank arm rollers at the ends of the racking crank arms of the circuit breaker will engage the cam plates in the compartment and the act of moving the circuit breaker from one position to another can be performed. The procedure that moves the circuit breaker from one position to another is known as “racking”. Arc resistant switchgear requires this procedure be performed with the compartment door closed for normal operation via one of the following options:

1) **Closed-Door Racking**

This is the standard for arc resistant switchgear. The front door of the circuit breaker compartment has an opening which enables the racking shaft of the circuit breaker to be accessed with the door closed and latched. The shaft is held captive and sealed to the door to maintain the arc resistant integrity. The opening is covered by a teardrop cover which automatically closes by gravity when the racking handle is removed. The door is also provided with a viewing window and the compartment light to allow viewing the position and condition of the circuit breaker without opening the door.

2) **Remote Racking Device**

The closed-door racking design allows the use of remote racking devices. The door is equipped with the appropriate connection points to mount an external remote racking device (contact Powell for appropriate device and instructions).
D. Racking Procedure (Manual)

**CAUTION**

Before inserting the circuit breaker into the compartment, be sure that the racking crank arms of the circuit breaker are in the fully withdrawn position, pointing towards the moveable primary disconnects. Otherwise, the primary disconnects, shutters, or the racking mechanisms may be damaged.

**CAUTION**

Before racking a circuit breaker in or out of the compartment, make sure that the key interlock is unlocked and in the opened position. Otherwise, the racking mechanism may be damaged.

**WARNING**

Opening the circuit breaker compartment door to install a circuit breaker exposes the operator to potentially lethal conditions by removing the arc resistant protection during the time the door is open and unlatched. The operator must wear the appropriate Personal Protective Equipment (PPE) for the level of flash hazard exposure indicated by the short-circuit rating of the equipment.

The procedure for racking the circuit breaker from the disconnected to connected position is identical for both lower and upper compartments.

1) Racking the Circuit Breaker to the Connected Position

a. Insert the circuit breaker compartment’s secondary disconnect plug into the circuit breaker’s secondary disconnect receptacle. Once the plug is fully inserted, move the secondary disconnect latch from left to right until it has engaged the housing of the secondary disconnect plug. When control power is present in the equipment, the spring charging motor will immediately begin to charge the closing spring after the secondary disconnect is inserted.

b. Ensure the telescoping racking shaft of the circuit breaker is pushed into the breaker (shaft is fully compressed) and close the compartment door by pushing the door tightly against the front of the compartment and rotating the latch handle of the door in a counterclockwise direction approximately 90°.

This is the test position.

c. Rotate the racking access (teardrop) cover on the compartment door 180° to gain access to the racking shaft.

d. Insert the racking handle onto the racking drive shaft extension.
Operation

E. Racking Procedure (Electrical)

This is an alternative to the manual racking procedures described above utilizing a motor driven mechanism and electric control, allowing the user to perform the racking function without being located in front of the circuit breaker compartment. The remote racking device mounts onto the compartment door. Refer to the instruction bulletin provided with the remote racking device for the proper operational procedure.
F. INTERLOCKS

Refer to instruction bulletin 01.4IB.65080A for information on CDS circuit breaker interlocks.

G. ELECTRICAL OPERATION

1. A one-line or three-line diagram and a schematic diagram are prepared for each switchgear lineup. All diagrams shall be thoroughly studied and completely understood by the user before the switchgear is placed into service.

2. The reading of indicating, recording instruments, and meters is common knowledge to electrically trained personnel. The use of instrument, rheostat control, and governor motor control switches are also common. Synchronizing switches are usually provided on generator and incoming line units with a synchronizing switch contact which is wired in series with the circuit breaker control switch “close” contact. The synchronizing switch should always be turned “on” first and the circuits adjusted should be in synch as indicated by the synchroscope before the circuit breaker is closed.

3. A green light indicates that the circuit breaker is open and a red light indicates that the circuit breaker is closed. For the DC control schemes, the red light is also arranged to supervise the trip coil and indicate that the trip coil circuit has continuity.

H. SHUTTERS

Metal shutters (Figure 4, b) cover the primary disconnect contact when the removable element is withdrawn from the compartment.

Cam plates located on each side of the compartment are operated by the circuit breaker crank arm rollers which will then operate the switchgear shutters. As the circuit breaker mechanism is operated past the disconnected position, the crank arm rollers will move the cam plates downward and open the shutters before the circuit breaker starts its forward travel to the connected position. When the circuit breaker is racked to the disconnected position, the shutters are returned to their closed position by springs attached to the cam plates.

Provisions for padlocking the shutters in the closed position are furnished on each of the two cam plates (Figure 4, d). Padlocking either of the two cam plates will deter opening of the shutters.

I. FLOOR PAN

Each compartment is equipped with a floor pan which the removable element rolls on. Each side of the pan is designed with channels, which the wheels of the removable element rolls into. The width between the channels will align the removable element laterally as it is rolled in the compartment.

The top flanges of the channel deter any tipping or vertical movement of the removable element. A rollout stop block is mounted to the floor pan. When a removable element is rolled into the compartment, the rollout latch will drop behind this rollout stop block, and deter the removal of the removable element until this latch is manually depressed.
J. **Truck Operated Cell Switch (TOC) (Optional)**

The purpose of the TOC switch is to indicate whether or not the removable element is in the connected position. When required, the switch is mounted on the top left side sheet of the secondary (Figure 4, a). A pin on the left side of the removable element engages the operating arm of the TOC switch and operates the switch as the removable element moves from the "TEST" position to the "CONNECTED" position. When the removable element is withdrawn, the spring return mechanism of the switch returns to its original position.

K. **Mechanism Operated Cell Switch (MOC) (Optional)**

The mechanism operated cell switch actuator (MOC) is an auxiliary switch which provides contacts that change position when the circuit breaker closes or opens. It is operated by an arm which projects from the circuit breaker mechanism at the lower left side of the breaker. This arm rides above the arm of the MOC. When the breaker is closed, the arm moves downward, moving the lever. The lever is connected by a linkage to the switch, and the whole assembly is spring loaded to the open position.

The switch is mounted inside the secondary enclosure on the left side sheet above the switch operating mechanism (Figure 4, f). As supplied, the MOC actuator mechanism will operate with the circuit breaker in either the "CONNECTED" or "TEST" position. If it is desired that the switch operate in the "CONNECTED" position only, remove the small bolted on MOC test position lever that forms the bottom flange at the front of the pivoted lever (Figure 4, g).

L. **Secondary Disconnect Device**

The secondary disconnect device is a 24-point plug mounted at the lower end of an umbilical cord, which hangs at the right side of the compartment. The plug mates with the secondary control socket on the lower right front of the circuit breaker.

---

**WARNING**

*Interlocks are provided to ensure proper operating sequences of the device and for the safety of the operator. If, for any reason, an interlock does not function as described DO NOT MAKE ANY ADJUSTMENTS, MODIFICATIONS, OR DEFORM THE PARTS. DO NOT FORCE THE DEVICE INTO POSITION. CONTACT POWELL FOR INSTRUCTIONS.*

Interlocks are provided to deter improper operation of the circuit breaker. These interlocks function as follows:

1. The secondary disconnect plug must be inserted when the breaker is in the "DISCONNECT" position in order to move the breaker to the "TEST" position.
2. The secondary disconnect plug must be inserted to operate the breaker in the "TEST" position.
3. The secondary disconnect plug may be withdrawn with the breaker in the "DISCONNECT" position after the secondary locking bar is lifted. The removable element cannot be operated or racked into the enclosure with the secondary disconnect plug withdrawn.
4. The secondary disconnect plug must be inserted and locked in position to rack the breaker from the "TEST" position toward the "CONNECTED" position. The secondary disconnect plug is then held captive and cannot be withdrawn until the breaker is returned to the "DISCONNECT" position.
M. Testing and Inspection

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 www.powellind.com, or call 1.800.480.6900.

**WARNING**

*Before any adjustment, servicing, parts replacement, or any other act is performed requiring physical contact with the electrical working components or wiring of this equipment, the POWER SUPPLY MUST BE DISCONNECTED AND DEENERGIZED.*

After the equipment has been installed and all connections made, it should be tested and inspected before putting 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 60kV (75% of 80kV). 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 book 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 books 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 the values listed in Table L, Rated Control Power Voltages and Ranges for Circuit Breakers.

**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.*

Check continuity between all moving and stationary contacts in both the connected and disconnected (or grounded) positions. The continuity may be verified with a multimeter or continuity tester by connecting one test lead to the bus phase that the stationary device is connected to and the second lead connected to the corresponding phase fuse holder cap.
CAUTION

Wire connections, accessible bolted bus connections, and insulated joints should be examined to make sure they have not been loosened or damaged during shipment or installation.

After the switchgear has been installed and all connections to the apparatus it is to control have been made, it should be given a final check and test before being energized.

The connections to the equipment apart from the switchgear, such as instrument transformers, remote control and interlock circuits, and auxiliary switches should be checked for continuity and phase relationship.

The covers for meters, relays, and other devices which have to be removed during the course of installation and test should be carefully handled when removed. The covers should be put back in place promptly to keep dust and dirt from collecting on the vital relay parts.

WARNING

Do not attempt to energize the equipment until the correctness of all connections is verified.

After the switchgear has been installed and put into operation, the drawings supplied with the equipment should be reviewed and notations made on them of any changes made during the installation.

Table L Rated Control Power Voltages & Ranges for Circuit Breakers

<table>
<thead>
<tr>
<th>Nominal Control Power Voltage</th>
<th>Voltage Range Required at Tripping Coil Terminals</th>
<th>Voltage Range Required (dc) at Closing Coil Terminals</th>
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</thead>
<tbody>
<tr>
<td>24VDC</td>
<td>14 to 28 VDC</td>
<td>---</td>
</tr>
<tr>
<td>48VDC</td>
<td>28 to 56 VDC</td>
<td>38 to 56 VDC</td>
</tr>
<tr>
<td>125VDC</td>
<td>70 to 140 VDC</td>
<td>100 to 140 VDC</td>
</tr>
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<td>120VAC</td>
<td>104 to 127 VAC</td>
<td>104 to 127 VAC</td>
</tr>
<tr>
<td>240VAC</td>
<td>208 to 254 VAC</td>
<td>208 to 254 VAC</td>
</tr>
</tbody>
</table>

N. FIELD WIRING AND CABLE CONNECTIONS

WARNING

Before any adjustment, servicing, parts replacement, or any other act is performed requiring physical contact with the electrical working components or wiring of this equipment, THE POWER SUPPLY MUST BE DISCONNECTED.

WARNING

Do not route any control cables in any manor or in any location which may impede the function of the interlocks, pressure relief vents, or any other moving part of the assembly.

1) Adding Control Cable

PowL Vac 38-AR™ arc resistant switchgear conforms to ANSI requirements for metal-clad switchgear and all wiring must meet the requirements of ANSI C37.20.2. Additional precautions are required to maintain the integrity of the arc resistant features. The general guidelines for adding control cables to arc resistant switchgear are as follows:
a. All penetrations into arc resistant switchgear from external sources must be made through sealed conduit or protective bushings into the instrument compartment or designated entry point.

b. The preferred entry into the switchgear is through the top of a full height instrument compartment or into the side of the end unit instrument compartment.

c. All interconnections between vertical sections should be run internally through the openings between instrument compartments (Figure 28).

Figure 28  Instrument Compartment Interconnecting Opening

d. Internal penetrations from various compartments to the instrument compartment should be made through the wireway provided (Figure 28) by entering the wireway at the end openings located in the center compartment. When this is not possible and the entry must be made directly into the wireway near the instrument compartment opening the entry may be made with either sealed conduit, a CGB (compression type fitting) that is filled with an appropriate barrier/sealant material. For small gaps in the wires, electrical grade silicon RTV may be used to seal the entry. For large gaps or wireways, use a fire barrier material such as Chico.

e. Entry from compartment floor:

i. Conduit penetrations may be made in the floor in the area between the circuit breaker floor pan and the side walls in either the front compartment or center compartment. This area measures 2 inches wide and is therefore limited to small conduit fittings. Two layers of 11 gauge steel must be penetrated to utilize this area (Figure 4, k).

ii. Front compartment penetration on the left side of the compartment is discouraged because of the close proximity to the MOC actuator. Front compartment penetration on the right side is limited due to the front door interlock assembly and TOC assembly.

Note: The MOC actuator pivots with the operation of the circuit breaker. Do not route any wires above the level of the floor pan side wall and directly under the MOC actuator.
iii. Penetrations in the area directly behind the circuit breaker beneath the primary disconnecting devices are the preferred method of entry into this compartment. This is accomplished by removing the cover box and making the appropriate conduit penetration openings in the cutout panel provided. The cables are shielded by replacing the cover box. Cables entering the compartment are routed through an opening in the left side of the breaker floor pan and in the wireway formed by this pan and the left side wall. A cover is provided to shield the wires in the wireway.

iv. All penetrations into the center compartment (circuit breaker compartment) must be routed into the front compartment through either the vertical side barriers or the shelf directly above the circuit breaker. No special precautions are required other than use of a bushing or similar device to protect the wires as they pass through the metal barrier.

v. Entry into the instrument compartment is made as described in Ch 5 Operation, N. FIELD WIRE AND CABLE CONNECTIONS, 1) Adding Control Cable, d.

f. In all cases, the control cable and its shielding method must not compromise the safe distances between energized conductor and ground for the rating of the equipment. The recommended minimum distances are:

- 10½” for equipment rated 38kV

These values may be superseded by any local or national regulation or requirement specific to the job site and are given only as guidance in the absence of any other requirements.

O. CONTROL CABLE REMOVAL

1) General

Removing control cables from an arc resistant switchgear design requires that the opening created by the removal be blocked to prevent the transfer of products from an arcing fault into areas intended to be protected by the rated type of equipment.

Recommended methods for blocking the openings are as follows:

a. Partial removal of cables from a CGB fitting:
   i. For removal of small quantities of cable, the CGB may be tightened to further compress the gasket.
   ii. For removal of larger quantities of cable, the CGB may be fitted with a smaller size gasket or a smaller CGB must be installed.
   iii. Abandon the cable(s) in place. Disconnect and tie-back both ends.
b. Partial removal from conduit or solid fitting:
   
   i. Abandon the cable in place. Disconnect and tie-back both ends.

c. Complete removal of all cables from any fitting is accomplished as follows:
   
   i. Remove all cables and the fitting.
   ii. Fill the opening left by removal of the fitting with a steel cover plate (do not use aluminum). A minimum thickness of 11 gauge (0.119") is recommended. Smaller openings may be filled with the largest bolt which will fit in the opening, with flat washers on both sides of the wall.
   
   iii. When a steel plate is used, its dimensions must extend past the boundaries of the opening by a minimum of 0.5 inches on all sides or 1 inch over the diameter. The plate must be mounted on the high voltage side of the wall. Example: from the circuit breaker compartment to the instrument compartment, the plate should mount on the circuit breaker compartment side of the wall.
   
   iv. The plate may be welded or bolted in place. SAE grade 5 hardware or better is required for bolting.
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 should be kept, and the degree of detail depends on the operating conditions. In any event, it will be a valuable reference for subsequent maintenance, and for station operation. It is recommended that the record include the reports of tests made, the condition of the equipment, repairs, and any adjustments that were made. Test data from successive maintenance interval should be compared, to note trends as well as any significant changes in the condition of the switchgear.

CAUTION

It is essential that the circuit breakers, or circuits be deenergized and the circuit breaker be withdrawn to the disconnected position, and tagged or locked out before any covers are removed, opening of any doors, which permit access to the primary circuits. Any portion of the switchgear that remains energized should be barricaded to prevent accidental access.

CAUTION

If maintenance is to be performed on the primary conductors within the switchgear, those conductors shall first be grounded, using grounding conductors rated for the short-circuit current rating of the switchgear.

CAUTION

If maintenance is to be performed on remote equipment connected to a unit, the circuit breaker for that unit shall be placed in the disconnected position, locked out and tagged. Also, the remote equipment shall be isolated from any other power sources connected to it.

The primary circuits of the metal-clad switchgear are insulated in order to reduce the size of the equipment. However, this insulation requires a certain amount of air gap between phases and to ground, which completes the insulation.
Inserting any object in this air space, when energized, whether it be a tool or a part of the body may in effect, short circuit the air gap and cause a breakdown in the primary circuit to ground and serious damage, injury, or both.

B. Overall Maintenance Procedures

The switchgear lineup and connections should be given the following overall maintenance at least once a year.

Powell offers a complete lubrication kit (Powlube-104) which contains all the lubricants required for maintaining Powell equipment. Powlube-104 consists of (1) A-grease, (1) B-grease, and (1) C-oil. Prior to March 2014, Powell provided Powlube-101 and Powlube-102 which contained (1) tube of Anderol 757 or Rheolube 368A, (1) tube of Mobilgrease 28, and (1) bottle of Anderol A456 oil.

A-grease should be lightly applied to those bearing surfaces that are accessible. Inaccessible surfaces, such as bearings, may be lubricated with a light synthetic machine oil such as C-oil. B-grease should be applied to the electrical contact surfaces.

For all previous lubrication requirements Powlube-104, A-grease replaces Anderol 757 and Rheolube 368A, B-grease replaces Mobilgrease 28, and C-oil replaces Mobil 1 and Anderol 456A.

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 followed by wiping all surfaces with a dry, clean, lint-free cloth.

![CAUTION]

Use alcohol in a well ventilated area to avoid inhaling vapors.

![CAUTION]

Do not use any commercial soap based or detergent based cleaner because they may damage the insulation material.

Do not use carbon tetrachloride.

Avoid prolonged exposure to solvent vapors.

Use solvents in a well ventilated area.

3) 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.
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 devices (such as those on rollout transformers) for abnormal wear, fatigue, or overheating. Replace, if necessary, otherwise treat the same as primary disconnect device contacts.

6) **Control Contacts**

The 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 the circuits leave the switchgear. Make sure that all secondary wiring connections are properly connected to the switchgear ground bus where indicated.

8) **Mechanical Parts**

Visually check and manually operate the mechanical moving parts such as the shutter, TOC, and MOC mechanism-operated cell switch assemblies, the key interlock, hinged doors, and the rollout features of the transformers and fuses. Examine mechanical mating parts such as the circuit breaker racking crank arms and the switchgear guide rails.

9) **Ventilation**

Check all labyrinths, grillwork, and air passages for obstructions and accumulations of dirt. The air space under the outdoor switchgear, which is necessary for the entrance of ventilating air, should be cleaned of leaves and other possible debris. Replace or clean dirty filters.

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 test are recommended in the battery supplier’s instructions. During the same time that the battery is routinely checked, inspect the battery charger and remove any 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.

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 regular maintenance periods.

a. Insulation resistance tests are suggested for checking the insulation. A series of these tests will indicate any tendency towards a reduction in the dielectric strength of the insulation. Insulation resistance reading should be taken before and after cleaning the switchgear equipment, and in so far 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 will vary with the extent and design of the bus structure. In contrast to a small installation, the longer switchgear lineups will 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 reading 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 100A 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) Pressure Vents

Verify that all pressure relief vents are functional and undamaged. Do not walk on pressure vents during inspection. All horizontal vents (top of gear and top of lower breaker/auxiliary compartments) can be accessed from the compartment they cover.

a. Horizontally mounted hinged vents should be checked for free movement around the hinge point. Interference fitting, where two vents are mated over an opening, is acceptable (i.e. the two covers over the circuit breaker compartment may bind slightly on each other as they are closed but they should close completely on to the top of the compartment. Further, they should move freely once clear of each other when opened).

b. Vertically mounted vents should be checked to assure they are still flush to the mounting surface and that no objects could potentially impede opening. Do not attempt to open these vents as they are designed to deform when called upon to operate and are rated for single operation. Attempts to open or otherwise move these vents could damage them. These types of vents should be inspected for damage that would cause them to open partially and potentially expose energized components. Repair or replace as necessary.

15) Doors

Verify that all doors open without interference.

a. The handle should rotate easily to open or close the latch pins (the latch pins should be cleaned and lightly lubricated with A-grease).

b. The rear frame of the door, including the protruding latch pins should clear the switchgear side door frame without contact. If there is contact, adjust the door in accordance with the instructions in Ch 4 Installation.

c. Both front and rear doors should seal with little or no “play” in the fit. Confirm that the latched door has 1/6” or less movement. When the rear door includes a gasket for a weather seal, verify that the gasket is contacted across all mating surfaces by confirming compression marks in the gasket.

d. 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.

16) Actuators

Verify alignment of the push-to-trip actuator on the door to the mating actuator on the circuit breaker floor pan. Verify that there is no damage to the sliding actuator on the floor pan and that it slides freely. Lubricate with a small amount of A-grease if needed.
C. **Abnormal Conditions**

Local conditions such as high ambient temperature, high humidity, salt-laden atmosphere, corrosive gases, heavy dust, ash, severe circuit operating conditions, vermin, or insect problems are considered to be abnormal, and will require more frequent inspections.

A series of inspections should be made at quarterly intervals, until the local conditions can be analyzed to determine a schedule that will maintain the switchgear in satisfactory condition.

In some locations, local conditions may be so bad that the frequency of maintenance will interfere with operating and production schedules. In such cases, consideration should be given to the possibility of enclosing the switchgear lineup in a relatively tight room, and to use filtered air handling units to supply a sufficient quantity of clean air to maintain conditions, maintenance schedules may then be established on a more normal basis. Such an arrangement might also provide for cooling the air, where the ambient temperature is relatively high, thus further improving operating conditions. To add another level of reliability, chemical filtration may be used in addition to mechanical filtration.
Ch 7  Recommended Renewal Parts and Replacement Procedures

A. Ordering Instructions

1. To order replacement parts from Powell, visit the website at www.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.
4. Standard hardware such as screws, bolts, nuts, washers, etc., should be purchased locally. Hardware used in bolted joints of conductors must be SAE Grade 5 or better to ensure proper clamping torque and to prevent the joints from overheating. The hardware should be plated to deter corrosion.

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, lists the recommended spare parts to be carried in stock by the user with 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 PowlVac-AR™ switchgear. Refer to the Qualified Persons section in the front of this instruction bulletin.
<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Recommended Quantity</th>
<th>Illustration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary Disconnect Override</td>
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01.4IB.65201 PowlVac 38-AR™
Arc Resistant Metal-Clad Switchgear

Equipped with CDS Circuit Breakers
38kV, 3000A, 40kA

June 2014