

IB-20204A Low Voltage Metal-Enclosed Switchgear

Equipped with GE WavePro® Circuit Breakers

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Signal Words

As stated in ANSI Z535.4-2002, § 4.13-4.13.3 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”**, and **“Caution”**. 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 indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

Not stated in ANSI Z535.4-2002, § 4.13-4.13.3 as a signal word but used in this manual is **“IMPORTANT”**. This is defined as:



IMPORTANT

IMPORTANT indicates a section of the manual covering a non hazardous situation, but one where Powell feels proper attention is warranted.

Qualified Person

For the purposes of this manual, a qualified person, as stated in NFPA 70®, is one familiar with the construction and operation of the equipment and the hazards involved.

In addition to the above qualifications, one must also be:

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

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Ch 1 General Information



WARNING

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

The equipment is designed for use, installation, and maintenance by qualified 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.



IMPORTANT

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.



IMPORTANT

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 Powell low voltage metal-enclosed switchgear assemblies equipped with GE WavePro® Low Voltage Power Circuit Breakers. The equipment described is indoor type switchgear for applications up to and including 635 Volts.

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

B. PURPOSE

The information in this instruction bulletin is intended to provide information required to properly operate and maintain the low voltage metal-enclosed switchgear equipped with GE WavePro circuit breakers.

This instruction bulletin provides:

1. Safety guidelines
2. General descriptions of the operation and maintenance of the low voltage metal-enclosed switchgear
3. Instructions for installation of the switchgear
4. Information for ordering renewal parts
5. Illustrations, photographs, and description of the switchgear. See the GE WavePro instruction manual for circuit breaker information.

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

All illustrations are shown using deenergized equipment.



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

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



Ch 2 Safety

A. SAFE WORK CONDITION

The information in Section A is quoted from *NFPA 70E 2004 - 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.

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

B. SAFETY GUIDELINES

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

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

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

The safety rules in this instruction bulletin are not intended to be a complete safety program. The rules are intended to cover only some of the important aspects of personnel safety related to Powell low voltage metal-enclosed switchgear.

C. GENERAL

1. Only 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, the applicable GE WavePro® instruction book, 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.

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 each spring load in a controlled manner. Detailed information regarding these mechanisms is found in the GE WavePro circuit breaker instruction bulletin.

4. **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.
5. **ALL COMPONENTS SHALL BE DISCONNECTED BY MEANS OF A VISIBLE BREAK AND SECURELY GROUNDED FOR SAFETY OF PERSONNEL PERFORMING MAINTENANCE OPERATIONS ON THE SWITCHGEAR.**



E. SAFETY LABELS

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



IMPORTANT

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

Powell Low Voltage Metal-Enclosed Switchgear described in this bulletin is designed to comply with IEEE Standard C37.20.1 (Standard for Metal-Enclosed Low Voltage Power Circuit Breaker Switchgear). The metal-enclosed switchgear is a lineup of one or more switchgear vertical sections, which are enclosed on all sides, top, and bottom except for the ventilation openings, lower unit cable penetrations, and view windows. The switchgear sections consist of full depth structural frames and components providing separate compartments for circuit breakers, buses, cable and auxiliary components.

The section main bus and intersection bus is isolated from the cable compartments. An overhead breaker lifting device (Figure 2, a) is provided as an option.

Powell low voltage, metal-enclosed switchgear for GE WavePro® circuit breakers consists of multiple sections, fastened together as a single group (Figure 1). It is completely operational when installed and connected directly to the customers' power supply. Circuit breaker compartments (Figure 2, f) are provided with hinged access doors for installing or removing the circuit breakers. Auxiliary compartments (Figure 2, d) are provided with hinged access doors for mounting and maintenance of instruments, relays, and wiring.

The equipment has been designed to operate within the customers' specifications with regard to circuit capacity.

B. RATINGS

Table A Powell Low Voltage Metal-Enclosed Switchgear Ratings

Maximum Voltage (volts)	Short Time Current		Short Circuit Current	
	Main Bus (kA)	Riser Bus (kA)	Main Bus (kA)	Riser Bus (kA)
635	85	85	150	100

Table B Fused Circuit Breaker Ratings (Max 600VAC, 50/60Hz)

Fuse Rating (Amperes) ¹		Breaker Type	Continuous Current Rating (Amperes)	Interrupting Rating rms Symmetrical kA
Minimum	Maximum			
300	1600	WPF-08	800	200
450	2500	WPF-16	1600	200
2000	2500	WPS-20 ²	2000	200
2000	4000	WPS-32 ²	3200	200
2000	5000	WPS-40 ²	4000	200
2000	5000	WPS-50 ²	5000	200

Note: 1. The maximum fuse rating is the largest fuse that tests show will result in proper performance of the breaker and fuse in combination under short circuit conditions.

2. Fuses are mounted on separate fuse roll-out element and are ordered and shipped separately.


Table C GE WavePro® Circuit Breaker Ratings

Nominal Voltage Rating (max)	Breaker Type	Continuous Current Rating (Amperes)	Short Circuit RMS Symmetrical (kA)		
			Short Time Withstand	With Instantaneous Trip	Without Instantaneous Trip
600 (635)	WPS-08	800	30	30	30
	WPH-08	800	42	42	42
	WPX-08	800	50	50	50
	WPS-16	1600	42	42	42
	WPH-16	1600	65	65	65
	WPS-20	2000	65	65	65
	WPS-32	3200	65	65	65
	WPH-32	3200	85	85	85
	WPX-32	3200	85	85	85
	WPS-40	4000	85	85	85
	WPX-40	4000	85	85	85
	WPS-50	5000	85	85	85
WPX-50	5000	85	85	85	
480 (508)	WPS-08	800	30	30	30
	WPH-08	800	42	42	42
	WPX-08	800	65	65	65
	WPS-16	1600	50	50	50
	WPH-16	1600	65	65	65
	WPS-20	2000	65	65	65
	WPS-32	3200	65	65	65
	WPH-32	3200	85	85	85
	WPX-32	3200	100	100	100
	WPS-40	4000	85	85	85
	WPX-40	4000	100	100	100
	WPS-50	5000	85	85	85
WPX-50	5000	100	100	100	
240 (254)	WPS-08	800	30	42	30
	WPH-08	800	42	50	42
	WPX-08	800	65	65	65
	WPS-16	1600	50	65	50
	WPH-16	1600	65	65	65
	WPS-20	2000	65	65	65
	WPS-32	3200	65	85	65
	WPH-32	3200	85	130	85
	WPX-32	3200	100	130	100
	WPS-40	4000	85	130	85
	WPX-40	4000	100	130	100
	WPS-50	5000	85	130	85
WPX-50	5000	100	130	100	

Figure 1 Powell Low Voltage Metal-Enclosed Switchgear with GE WavePro® Circuit Breakers





Figure 2 *Removing the Circuit Breaker from the Switchgear*



- a. *Powell Overhead Lifting Device*
- b. *Overhead Lifting Device Handle*
- c. *Overhead Lifting Cable*
- d. *Auxiliary Compartment*
- e. *Lifting Device Yoke*
- f. *Circuit Breaker Compartment*
- g. *Circuit Breaker*

Ch 4 Installation

A. RECEIVING

Powell low voltage metal-enclosed switchgear is fabricated in rigid, floor-mounted, self-supporting steel vertical sections. The switchgear vertical sections are shipped in an upright position and when received should be kept upright.

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

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

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

B. HANDLING

Powell recommends the switchgear be handled or moved by means of an overhead crane. If an overhead crane is not available the switchgear may be moved on an even surface by the use of rollers or heavy duty pipes placed under the switchgear. The use of a forklift is not recommended, since the forks may damage the compartments or interior parts of the switchgear vertical sections. If no other method of handling is available, the forks must go completely under the switchgear base to avoid damage to the switchgear.

The switchgear is shipped with the circuit breakers installed unless other instructions are given. If the circuit breakers are shipped installed, they are done so in the open and fully connected position. Refer to the GE WavePro® circuit breaker instruction bulletin for removal of the circuit breakers. See Figure 2 for use of the Powell Overhead Lifting Device.

1) Lifting the Switchgear

The maximum shipping section width is 102 inches. The equipment should be lifted using an appropriately rated overhead crane. It should be assumed that each section of equipment weighs a minimum of 4000 lbs with the circuit breakers installed. The equipment should be lifted a single shipping section at a time. Lifting rings are permanently attached at the front and rear corners of the center compartment of each section. Four lift points shall always be used when lifting the switchgear. It is important to note that when a spreader bar is not being used that each lift chain/cable when loaded maintain at least a 45° angle from the horizontal plane. See Figure 3 for proper lifting instructions.

Note: *At 45° the force on each lifting chain/cable is equal to the total load divided by four divided by 0.707 making each less efficient. Angles less than 45° can damage the switchgear.*

Note: *The customer is responsible for providing the spreader bar.*



Figure 3 Chain/Cable Sling Installation

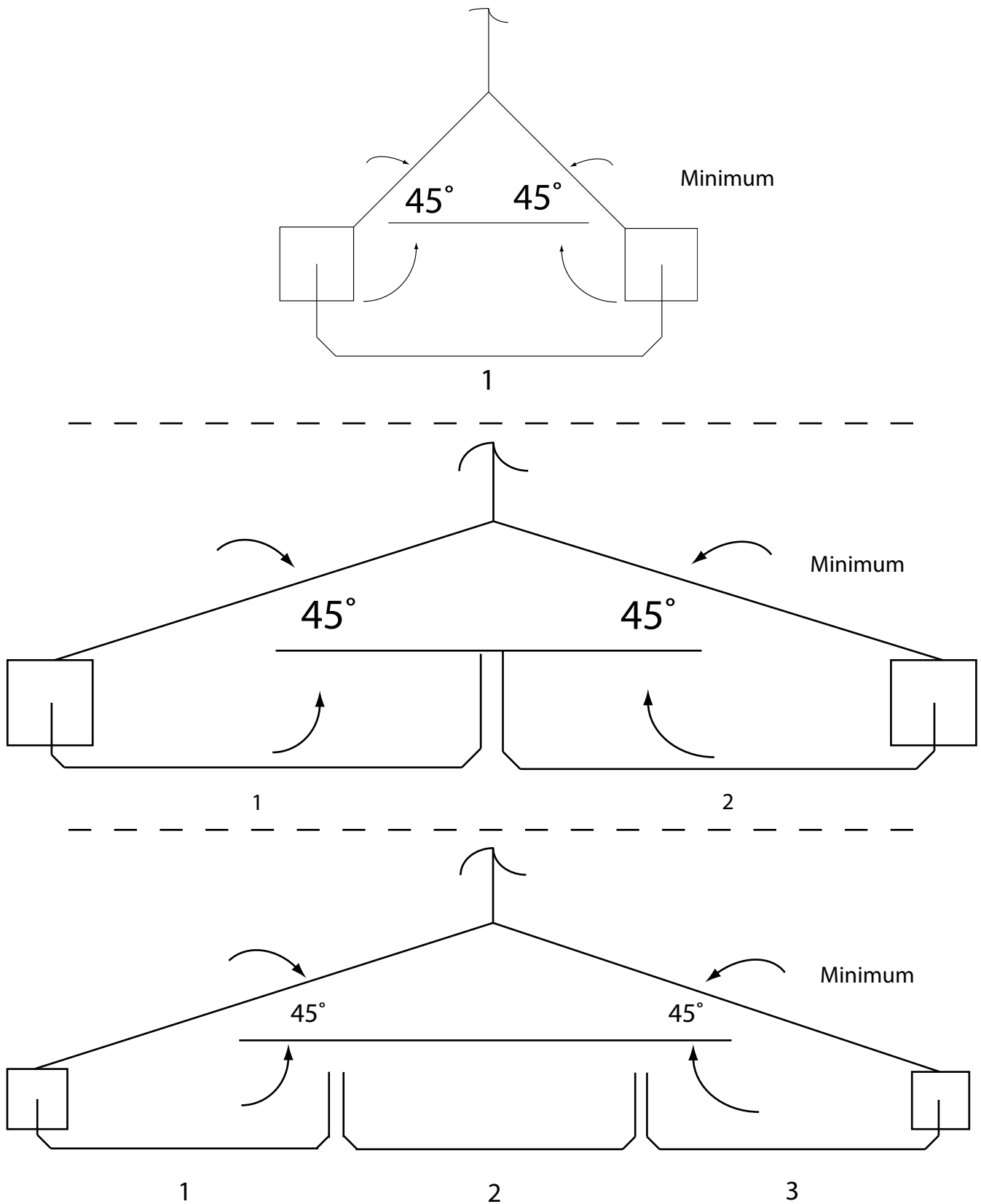
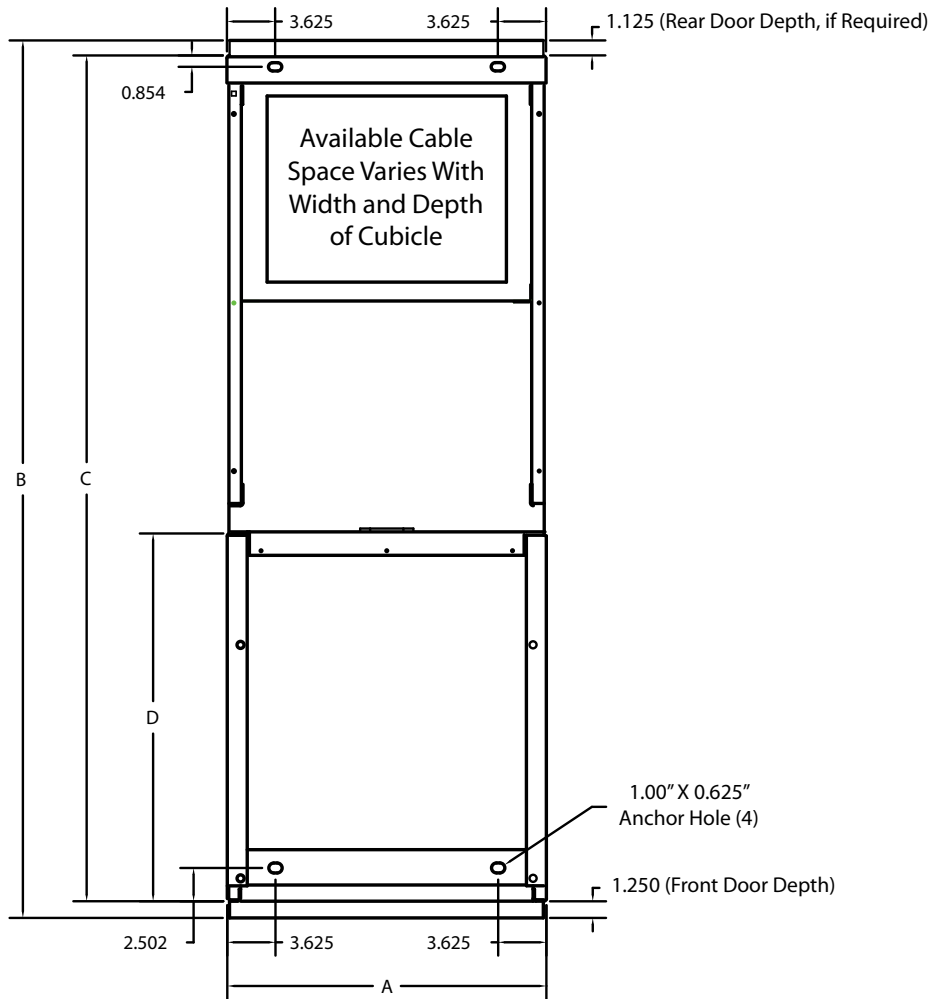


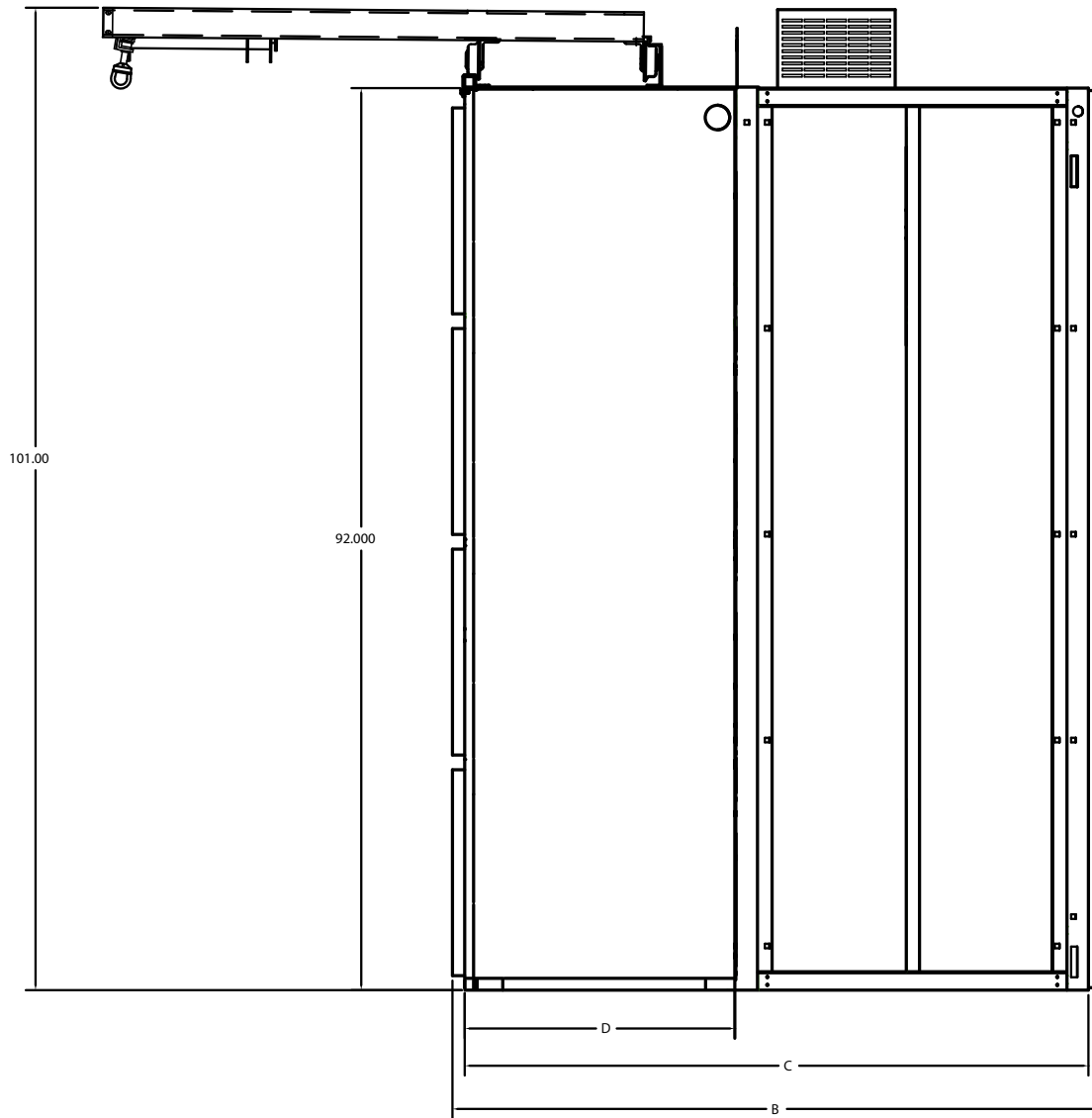
Figure 4 Base View

Table D Low Voltage Metal-Enclosed Switchgear Dimensions

Equipment Width (inches) (A)	Overall Equipment Depth (inches) (B)	Equipment Depth without Doors (inches) (C)	Front Compartment Depth (inches) (D)		Overall Height (inches)	
			Shallow Front	Deep Front	With Lift	Without Lift
24/32	60	57.625	27.625	34.625	101	92
	66	63.625	27.625	34.625		
	68	65.625	27.625	34.625		
	74	71.625	27.625	34.625		
	80	77.625		34.625		
	86	83.625		34.625		
40 ¹	74 ²	71.625	36.875	36.875		
	80	77.625	36.875	36.875		
	86	83.625	36.875	36.875		

Note: 1) 5000A Breaker Only
2) Cable Only (No Bus Duct)



Figure 5 Side View



See Table D for dimensions

C. STORAGE

If it is necessary to store the metal-enclosed switchgear and equipment for any length of time, the following precautions shall be taken to prevent corrosion.

- a. Uncrate the switchgear and equipment and check the shipment for condition and completeness.
- b. Store the switchgear and equipment in a clean, dry (maximum 50% humidity) area with a moderate temperature (-40° C to +70° C) and cover with a suitable canvas to prevent deposit of dirt or other foreign substances upon movable parts and electrical contact surfaces.
- c. If dampness or condensation may be present in the storage location, heaters shall be placed inside the units to prevent moisture damage. Approximately 500 watts of heater per unit will be required. Remove all cartons and other miscellaneous material packed inside the units before energizing any heaters.
- d. Removable elements such as circuit breakers should be prepared separately for storage. Refer to the applicable instruction bulletin for each element for instructions.
- e. Indoor switchgear equipment shall not be stored outdoors.

D. POSITIONING THE METAL-ENCLOSED SWITCHGEAR*1) Drawings and Diagrams*

Before any installation work is done, consult and study all drawings and Bill of Materials furnished by Powell for the particular order. The drawings include arrangement drawings and wiring and schematic diagrams.

The recommended aisle space for the front and at the rear of the metal-enclosed 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. The dimensions shown on the switchgear drawings are those required for proper operation of the switchgear.

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

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



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

**CAUTION**

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

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

Mats, railing, etc. that are external to metal-enclosed switchgear may be required to meet local code. These items must be provided by the purchaser.

E. PREPARATION OF FLOOR ANCHORING FOR INDOOR METAL-ENCLOSED SWITCHGEAR

The station floor must be strong enough to remain rigid and not sag under the weight of the switchgear structure. The floor also must be able to withstand the impact stress caused by the opening of the circuit breakers under short circuit conditions. The short circuit impact load is approximately 1-½ times the static load weight of the switchgear.

The purchaser must provide suitable means for anchoring the switchgear to the floor. The

floor supporting the switchgear must be level in order to avoid distorting the switchgear structure and to align the switchgear properly. The switchgear must be correctly and completely aligned prior to applying final anchors. Level foundations are desirable since they automatically produce true, level, and plumb switchboard installations. However, the switchgear will operate satisfactorily on a true and flat foundation that has a uniform slope of no more than 1/8 inch in three feet. The switchgear units must be placed on the floor channels in such a manner that the base of each unit rests directly on each of the floor channels.

The floor channels should have a minimum web dimension of 4 inches. The required quantity and location of the floor channels is shown on the drawings furnished with the order. The spacing of the floor channels, including the center channel, must be as shown on the drawings. Even though the switchgear is not anchored to the center channel, its location is important to the proper support and alignment of the switchgear units. The floor channels must be level and straight with respect to each other. Brass shims should be placed under floor channels when leveling is needed.

Care should be taken to provide a smooth, hard and level floor underneath and in front of the sections to facilitate installation and removal of the circuit breaker.

When installing metal-enclosed switchgear on existing floors, it will usually be desirable to pour a newly finished floor with embedded channels, or to cut slots in the floor for embedding and leveling the supporting channels.

The recommended practice 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 should be painted to deter corrosion. If welding facilities are not available, the switchgear should be bolted to the floor channels.

F. REMOVABLE ELEMENT

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

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

G. GROUNDING

Before power connections can be made, the switchgear vertical sections must be grounded. A ground bus is furnished with lugs at each end for connection to the station grounding system.

The ground bus 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 (Figure 6). Assemble the ground bus joints as outlined under **Ch 4 Installation, H. CONNECTIONS**. Ground bus connections are made in the lower portion of the cable entrance compartment. 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 when short circuits or other abnormal occurrences take place and to ensure that all non-live parts of the equipment are 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 exists. 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 solutions. 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.



H. CONNECTIONS

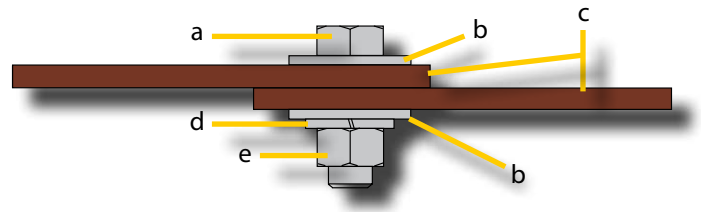
The main bus bars and other connection bars are copper. The connection surfaces are silver surfaced or equivalent. The silver plating used on bolted contact surfaces is approximately 0.0001" thick; plating on sliding contact surfaces is thicker. All fields assembled joints in primary conductors, regardless of method of insulation, 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 bus joint hardware is zinc-plated, dichromate treated, high strength steel. Cap screws are 1/2-13 SAE Grade 5. See Figure 6 for proper hardware assembly.

Figure 6 Ground Bus Splice Bolt Assembly

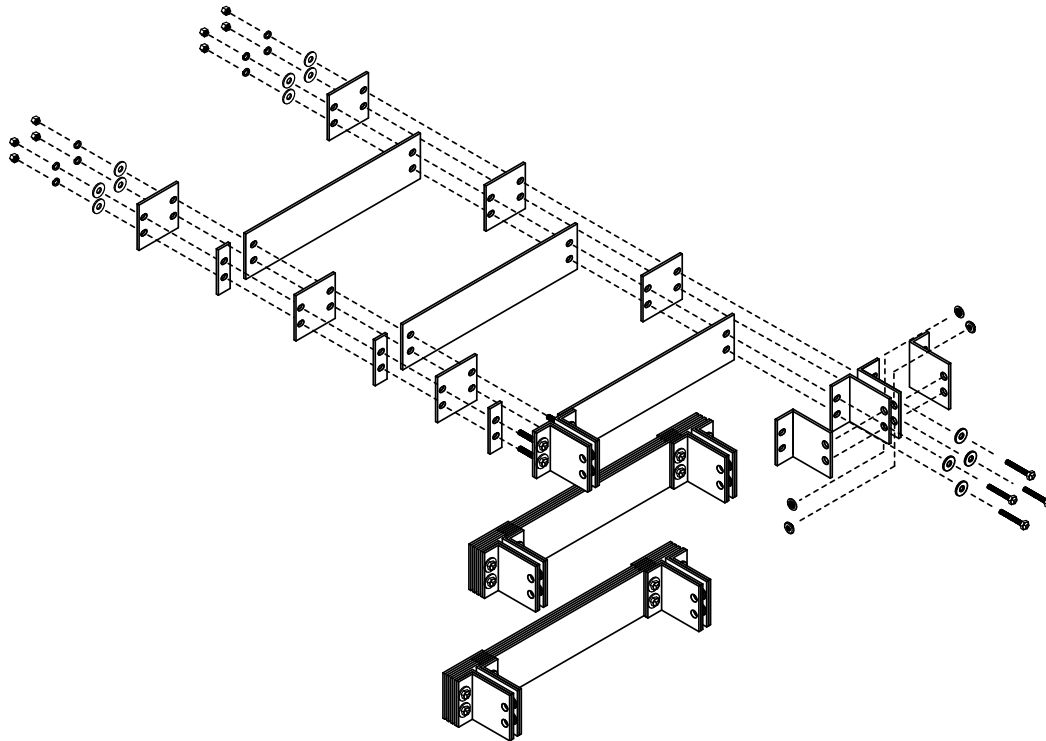


- a. Bolt
- b. Flat Washer
- c. Bus Bar
- d. Split Lock Washer
- e. Nut

3. In some cases, external connections are made to metal-enclosed switchgear bus by bars. The metal-enclosed switchgear bars are normally silver plated. Unplated bars, either copper or aluminum, should not be used to connect to plated bars.
4. All hardware must be tightened to the torque values listed in *Table E, Bolt Torque Values for Powell Low Voltage Metal-Enclosed Switchgear*.

Refer to Figure 7 for a typical main bus splice connection.

Figure 7 Main Bus Splice



CAUTION

The operating temperature of conductors in metal-enclosed switchgear may reach 105°C. Any insulating material used in the metal-enclosed switchgear must be suitable for this temperature.



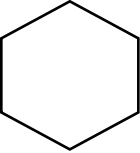
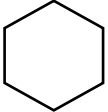


I. MAIN BUS ASSEMBLY INSULATION (OPTIONAL)

 **IMPORTANT**

If the equipment is insulated, follow the guidelines in Ch 4 Installation, I. Main Bus Assembly Insulation (Optional).

To insulate the main bus assembly follow these instructions:

1. Remove the compartment covers.
2. Bolt the splice plates and bus bars together using directions in **Ch 4 Installation, H. CONNECTIONS.**
3. Tighten the bolts properly. See *Table E, Bolt Torque Values for Powell Low Voltage Metal-Enclosed Switchgear.*

Table E Bolt Torque Values for Powell Low Voltage Metal-Enclosed Switchgear			
Bolt Dimensions (inches)	Bolt Head	Torque	
		<i>Ft-Lbs</i>	<i>Kg-M</i>
5/8		55-70	7.6-9.7
1/2		35-50	4.8-6.9
3/8		20-30	2.8-4.2
1/4		5-7	0.7-0.97

Note: Bolt heads in the table are not actual size.

1) *Applying PVC Boots*

- a. Prepare all joints as outlined under **Ch 4 Installation, H. CONNECTIONS.**
- b. Place the PVC boot over the joint. The boot should fit tightly around all conductors and flanges must contact each other in a smooth joint.
- c. Secure the boot with the furnished nylon wire ties. The joint insulation is now complete.
- d. Replace all covers previously removed.

2) *Cleaning Bus Insulation*

The main 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.

Vacuum and wipe dirt or other foreign matter from the insulation with a clean cloth saturated with only denatured or isopropyl alcohol.

 **CAUTION**

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

**CAUTION**

Do not use any commercial soap-based or detergent-based cleaner.

Do not use carbon tetrachloride.

Avoid prolonged exposure to solvent vapors.

Use solvents in a well ventilated area.

J. POWER CABLES

Access the primary cable connections in Powell low voltage metal-enclosed switchgear by opening the hinged rear 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 the motors will rotate in the proper directions and that the phase rotation is the same when interconnecting two different sources of power. If parallel cables are used it is imperative to confirm phasing of each cable by test. Normally compression terminals are used to terminate primary cables.

K. CONTROL CABLES

When control conduits enter the unit from below, the conduit should not extend more than 1 inch above the floor. The control cables may be pulled through the conduits before or after the switchgear is installed.

If the control conduits enter from above, drill the top cover of the front enclosure to suit the conduits, being careful not to damage existing wire bundles. Fasten the conduits to the cover with locknuts.

The cable from the control power source to the switchgear must be large enough to avoid excessive voltage drop when the circuit breakers are operated (see testing instructions that apply to a particular device). Where units have been split for shipment, any control or other secondary leads that 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 time will be required for reconnecting them.

L. INSERTING AND REMOVING THE CIRCUIT BREAKER FROM THE CIRCUIT BREAKER COMPARTMENT

Refer to the instruction bulletin furnished with the circuit breaker for all installation and removal procedures.

M. INSPECTION AND TESTING

For assistance with testing and inspection contact the Powell Service Division at 1.800.480.7273 or email at info@powellservice.com.

After the equipment has been installed and all connections made, it shall 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 the equipment has been properly installed. The primary equipment should be completely deenergized while the tests are in progress.

The directions for testing devices such as relays, instruments, and meters are given in the instruction bulletin furnished for each device. General instruction bulletins are furnished for complicated automatic equipment, describing the sequence of operation for the devices required to perform the desired function.



1) *Inspection*

The following checks need to be made during inspection:

- a. Power and secondary wiring connections are properly made
- b. Ground connections are properly made
- c. Circuit breakers prepared per GE WavePro® Instruction Manual
- d. All vent areas are clean and free of shipping or construction materials
- e. All tools are removed from the equipment and the area is free from debris

2) *Testing*

The following tests shall be completed before placing the switchgear into operation:

- a. An Insulation Resistance test shall be made to ensure all connections made in the field are free of undesirable grounds
- b. A dielectric test shall be made on the low voltage primary power circuit for one minute at the appropriate test voltage. (Voltage transformers, CPT's, and surge arresters must be disconnected during this test).
- c. For Start Up and Commissioning refer to TP1000 Major Electrical Equipment Start Up and Commissioning Guidelines Specification located at www.powellservice.com.

Ch 5 Maintenance

Note: Contact Powell Service Division for assistance in performing maintenance or setting up a maintenance program either by phone 1.800.480.7273, by email info@powellservice.com, or by visiting our website at www.powellind.com.



IMPORTANT

Before attempting any maintenance work, it is important to study and fully understand the safety practices outlined in Ch 2 Safety of this instruction bulletin. If there is any reason to believe there are any discrepancies in the descriptions contained in this instruction bulletin, or if they are deemed to be confusing and/or not fully understood, contact Powell immediately.

A. GENERAL DESCRIPTION

1) Introduction

Periodic inspections and maintenance are essential. When Powell low voltage metal-enclosed switchgear is operated under "Usual Service Conditions" per IEEE C37.20.1, maintenance and lubrication are recommended at five year intervals. "Usual Service Conditions" are defined as environments which the equipment is not subjected to excessive dust, acid fumes, damaging chemicals, salt air, rapid or frequent temperature changes, vibration, high humidity, and extreme temperatures. Generally, it is best to adjust the maintenance schedule based on experience and service environment.



IMPORTANT

A periodic maintenance program is not intended to cover reconditioning or major repair, but should be used to determine if such service is required.



IMPORTANT

If optional shutters are included with the equipment, refer to the applicable section in the GE WavePro Circuit Breaker Instruction Bulletin to verify shutter operation.

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



CAUTION

Prior to performing any maintenance on the switchgear, make sure all circuits are deenergized and the circuit breakers are withdrawn to the disconnected position and locked out.



 **CAUTION**

If work is to be done on remote equipment connected to a section of the switchgear, the circuit breaker must be placed in the disconnected position. The remote equipment should also be isolated from any other power sources.

 **CAUTION**

Exercise extreme caution to ensure that all personnel, tools, and other miscellaneous objects are free from the insulation air gap. Failure to do so may result in personnel injury and/or serious damage to the equipment.

2) *Cleaning*

Primary insulation and supports should be cleaned. Wipe the insulation clean with a dry, lint-free cloth or an industrial type wiper. If dirt adheres and cannot be removed by wiping, remove it with a mild solvent such as denatured alcohol. Do not use any type of detergent to wash the surface of the insulators because detergent may leave an electrically conducting residue on the surface as it dries.

B. MAINTENANCE PROCEDURES

 **CAUTION**

Prior to beginning any maintenance procedures, make certain that the equipment is completely deenergized and grounded.

1) *Switchgear Condition*

Thoroughly clean the equipment, removing all dust and other accumulations. Wipe clean the buses and supports. Inspect the buses and connections carefully for evidence of overheating or weakening of the insulation.

2) *Mechanisms and Wear Points*

Clean mechanisms and lubricate wear points. The application of lubricants should be held to a minimum to reduce the accumulation of dust and dirt.

For lubrication instructions refer to the GE WavePro® Instruction Bulletin.

3) *Abnormal Wear*

Check primary disconnecting device contacts for signs of abnormal wear or overheating. Discoloration of the silver surfaces is not ordinarily harmful unless atmospheric conditions cause deposits, such as sulfides on the contacts. Apply a thin coat of contact lubricant to the main contacts per the GE WavePro Instruction Bulletin before replacing the circuit breaker.

4) Other Disconnecting Contacts

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

5) Control Contacts

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

6) Secondary Wiring

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

7) Mechanical Parts

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

8) Ventilation

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

9) Battery and Charging Equipment

Special attention should be given to the control battery because it is an important item for switchgear operation. To provide long life and reliable service for the battery, perform frequent inspections and tests recommended in the battery supplier's instructions. At the same time the battery is checked, inspect the battery charger and remove accumulations of dust and dirt.

10) Anchor Bolts

Check to see that all anchor bolts and bolts in the structure are tight.

11) Heaters

If the switchgear is equipped with heaters, check to see that all heaters are energized and operating.



12) Records

The condition of each switchgear unit at the time of inspection should be listed in a permanent record to become a guide for anticipating the need for replacements or for special attention between the regularly maintenance periods. Insulation resistance tests are suggested for checking the insulation. A series of these tests will indicate any tendency toward a reduction in dielectric strength of the insulation. Insulation resistance readings should be taken before and after cleaning the equipment and, insofar as possible, under similar conditions at successive periods. Records should include the insulation resistance reading, the temperature, and the humidity, either by definite reading or description. Acceptable limits vary with the extent and design of the bus structure. In contrast to a small installation, the longer switchgear assemblies have a more extensive bus structure with a greater number of insulators. Therefore, there are a larger number of parallel insulation resistance paths to ground, which tends to decrease insulation resistance readings. This variation in insulation resistance between different switchgear assemblies emphasizes the value of a series of readings which can be charted to establish a normal insulation level so that progressive weakening of the insulation can be recognized.

13) Abnormal Conditions

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

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

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

Ch 6 Replacement Parts

A. ORDERING INSTRUCTIONS

1. To order Replacements 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. REPLACEMENT PARTS

Table F Miscellaneous Parts	
Part Name	Part Number
Overhead Lift Cable Assembly	
Cable	1468452123 (10ft)
Swage Ball	47024P01
Clevis	MS-664-C8
Overhead Lift Hand Crank	47009P03

Note: The numbers in the () indicate the number of pieces or the length of cable included.



IB-20204A Low Voltage Metal-Enclosed Switchgear

Equipped with GE WavePro® Circuit Breakers

October 2010