01.4IB.50026A PowlVac® Electrically Operated Ground and Test Device

5kV & 15kV, up to 50kA per ConEd Specification EO-2022-15 for ConEd CUSTOMER

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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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 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® Electrically Operated 15kV Ground & Test Device:

- PV-E 60600G98 - 1200, 2000, & 3000A
- PV-E 60600G99 - 1200, 2000, & 3000A

The information in this instruction bulletin is intended to provide information required to properly operate and maintain the PowlVac Ground & Test Device 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 ground & test device
3. Instructions for installation and placing the ground & test device into service
4. Instructions for part replacement
5. Information for ordering renewal parts
6. Illustrations, photographs, and description of the ground and test device

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

All illustrations are shown using deenergized equipment.

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**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.

B. 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 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 uncrating the ground and test device.

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 ground and test devices 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 ground and test devices.

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® Electrically Operated Ground and Test Device.
C. General

1. Only supervised and qualified personnel trained in the usage, installation, operation, and maintenance of the ground and test device 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 ground and test devices' reliability and safety.

3. Service conditions and ground and test device applications shall also be considered in the development of safety programs. Variables include ambient temperature; humidity; number of operations; and any adverse local conditions including excessive dust, ash, corrosive atmosphere, vermin and insect infestations.

D. Specific

When operating the ground and test device safety precaution must be observed. Improper use can result in death, serious personal injury, or damage to the equipment. It is important for the user to develop specific and safe operating procedures to be observed when using the ground and test device.

The following specific safety precautions must be observed:

1. Do not close the grounding switch on an energized circuit. The circuit to be grounded should always be treated as energized until proven otherwise.

2. Use great care when opening the test port shutters to gain access to the test receptacles. The test receptacles should always be treated as energized circuits until proven otherwise.

3. Any test device plugged into the test receptacles must be properly rated for the circuit voltage being tested and all connections must be properly insulated.

4. Use only the test probes furnished with the device to plug anything into the test ports. Use of other plugs may damage the test port or may result in a poor connection which could be dangerous to the operator and/or damaging to the equipment.

5. Even though insulated, the test probes must not be inserted or extracted from energized test ports. The test probe insulation is only one part of a complete line-to-ground insulation system and the surface of the test probe may be energized at a voltage above ground potential when connection to an energized test port.

6. Do not attempt to force or bypass any interlocks. The interlocks are furnished for the safety of the operator and the protection of the equipment being tested and the test device. Forcing or bypassing the interlocks can result in a condition dangerous to the operator and/or damaging to the equipment.

7. Do not attempt to service the device while it is installed in a switchgear compartment or on a lift truck. For service, the device must be located either on the floor or on a sturdy, level work bench, and blocked from rolling.
8. For service, the device must be in the OPEN position and all operating springs must be discharged. These conditions should be verified before removing any covers or attempting any service.

9. Store the electrically operated ground and test device in a clean, dry area free from dust, dirt, moisture, caustic atmosphere, and vermin.

10. Keep all insulating surfaces, which include primary support insulation and insulation barriers, clean and dry.

11. Check all primary circuit connections to make certain that they are clean and tight.

12. Take extreme care while using this device to avoid contacting “live” or “hot” (energized) terminals.

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 ground and test device is handled, operated, or maintained.

NOTICE

Warning and Caution labels are located in various places in and on the switchgear and on the ground and test device. Always observe these warnings and caution labels. Do NOT remove or deface any of these warning/caution labels.
Ch 3 Equipment Description

A. General

The PowlVac® Electrically Operated Ground & Test Device is a drawout element that can be inserted into the circuit breaker compartment in the same manner as a PowlVac circuit breaker.

The PowlVac Electrically Operated Ground & Test Device provides a means for obtaining access to the primary disconnecting devices of the switchgear compartment for purposes of grounding the primary circuits or conducting certain high voltage test procedures such as conducting high voltage withstand (hipot) tests.

The grounding switch is operated by a stored energy mechanism. It is capable of applying the ground against a live circuit if operational errors have not cleared the circuit. However, in such a case, the relaying at the source of power is expected to cause the source interrupter to clear the circuit.

B. Rating

The ground and test device has ratings similar to a power circuit breaker, with two very important exceptions: it has no continuous current rating, and it has no interrupting rating. This device has no continuous current rating because it cannot be used to carry a continuous current. It has no interrupting rating (or any of the ratings associated with the interrupting rating, such as interrupting time, etc.) because it is not designed to interrupt current.

In general, the ratings applied to any ground and test device are the same as those applied to the power circuit breaker it is designed to temporarily replace for grounding and testing purposes. The rating nameplate (Figure 1, i) on the front of the device will give the ratings applicable to any individual device.

C. Primary Disconnect Stabs

The ground and test device has three (3) primary disconnect stabs consisting of an upper or lower device (Figure 2a, f & Figure 2b, a) similar in design to those on the PowlVac circuit breaker. These three disconnects will connect the three stationary primary disconnect stabs in the switchgear compartment when the ground and test device is racked into the connected position. They are mounted on the rear of a heavy insulated barrier near the rear of the ground and test device.

D. Ground Making Switch

A three-pole, single-throw ground making switch is mounted on the front of the insulating barrier on which the selector switch hinges are mounted. The three stationary contacts of the grounding switch (Figure 3, a) are connected to the three primary disconnect stabs so that the ground making switch can be connected to the primary disconnect stabs, allowing the selected circuit of the switchgear compartment to be grounded.

The moving contacts and blades of the ground making switch (Figure 3, b) are operated by a high-speed stored energy mechanism. The ground making switch contact structure is specially designed for the close-and-latch and short-time current carrying duties to which it can be subjected. These contacts are not designed for continuous current carrying duty or for interrupting duty. The position of the ground making contacts can be observed when the device is in the switchgear compartment through transparent viewing panels (Figure 1, f) in front of the contacts.
The hinges of the three grounding contacts are connected together by a ground bus (Figure 3, d), which is in turn connected to a heavy duty ground connection located on the rear of the ground and test device frame between the center and right phases. This ground connection duplicates the ground connection on the PowlVac® circuit breaker and connects to the ground bus in the switchgear compartment, providing a path to ground from the ground making switch.

E. STORED ENERGY MECHANISM

The lower front cover has cutouts and apertures giving access to various operating and levering-in mechanism indicating and operating functions. Removal of the holding screws allows the removal of the upper portion of the front cover and the test port shutter assembly, giving access to the mechanism and its interlocks (Figure 3), auxiliary switches (Figure 3, c), charging motor (Figure 4, a), and motor cutoff switch (Figure 4, c).

The ground making switch is closed and opened by a stored energy mechanism (Figure 3) in which a gear motor is used to compress a closing spring. During a closing operation, the energy stored in the spring is used to close the ground making switch contacts, charge the opening springs and overcome friction forces. When the ground making switch is opened, the energy stored in the opening spring and the kickoff springs will open the contacts. Since the ground making switch has no interrupting rating, contact speed while opening is not important. The motor, located on the inside of the lower front cover at the left (Figure 4, a) is supported from the lower front cover. Its output shaft is screwed to a coupler which insert into the eccentric drive shaft. This shaft is supported in the needle bearings in the mechanism frame side sheets and transmits the motor torque from the left to the right side of the mechanism.

When the motor is energized, the eccentric shaft rotates and causes the driving arm links to pivot about the cam shaft (Figure 3, l). The drive pawl located on the links engages with the ratchet wheel and rotates it. The ratchet wheel is prevented from rotating backwards by a holding pawl, which is supported on links which project upwards from the cam shaft.

To ensure correct synchronization of the drive and hold pawls, the hold pawl links are located by a threaded shaft which passes through the lower front cover to the right of the mechanism. The position of the holding pawls is adjusted by a nut on the outer end of this shaft.

As the ratchet wheel is rotated, projections from its side faces will engage drive plates attached to the cam shaft and the cam shaft will rotate. Attached to the ends of the cam shaft are crank arms and pointing outward from these are crank pins. These engage with the front ends of the connecting rods (Figure 4, d), the rear ends of which engage in pins projecting from the spring compression plate which straddles the main closing spring. As the cam shaft rotates, the connecting rods pull the spring compression plate forward, compressing the closing spring.

The ratchet wheel will drive the cam shaft so that the connecting rods go forward as far as possible and then start to move to the rear. At a certain point, the spring force will overcome friction and resistance and start to rotate the cam shaft. At the same time, the pawls are uncoupled from the ratchet wheel and the motor cutoff switch is operated.
Figure 1  Ground & Test Device with Probes

a. Test Probes (shown with test leads attached)
b. Key Lock K5
c. Racking Assembly
d. Levering In Shutter
e. Key Lock K3
f. View Window
g. Power Receptacle
h. Control Selector Switch
i. Nameplate
j. Key Lock K4
k. Key Lock K1
l. Key Lock K2
m. Close Coil
n. Manual Push to Trip Paddle
Figure 2a  Ground & Test Device Right View with Lower Primaries

- a. Crank Arm Roller
- b. Racking Gear
- c. Racking Crank Arm
- d. Worm Gear
- e. Levering-In Shutter Interlock
- f. Lower Primary Disconnecting Device
- g. Ground Connection
- h. Anti-Rollout Latch
- i. Wheel

Figure 2b  Ground & Test Device Right View with Upper Primaries

- a. Upper Primary Disconnecting Device
- b. Crank Arm Roller
- c. Racking Gear
- d. Racking Crank Arm
- e. Worm Gear
- f. Levering-In Shutter Interlock
- g. Ground Connection
- h. Anti-Rollout Latch
- i. Wheel
When the close latch is released by the closing solenoid, the closing spring pulls the cam shaft around and the main closing cam moves the main linkage into the closed position. The main linkage rotates the drive levers of the jack shaft, which is supported by the mechanism side sheets, where it is clamped by hook plates and by the ground and test device side panels. The jack shaft has three (3) upward-pointing levers to which the operating rods are attached. The operating rods, approximately horizontal, are moved to the rear of the device by the rotation of the jack shaft.

The end of the operating rods remote from the jack shaft levers is connected to the movable contacts of the ground making switch. The stationary contacts of the ground making switch are mounted on the center insulating barrier. Directly beneath the stationary contacts are the movable contact kickoff springs. When the moving contacts of the ground making switch make contact with the stationary contacts, the springs are loaded by a force sufficient to assist their separation during opening of the ground making switch.

In the linkage position shown in Figure 5, the kickoff springs and the main opening spring are both acting to compress the three (3) main mechanism links (Figure 5). The linkage is restrained from movement by the secondary trip prop acting on the primary trip prop roller. The component of force tends to make the primary trip prop move downward, but it is restrained by the secondary trip prop face acting on the primary trip prop roller. The clearance between the primary trip prop roller and the secondary trip prop is controlled by the primary trip prop adjusting screw. When the trip shaft is rotated by the action of the manual trip plate or the optional electric trip solenoid (when furnished), the secondary trip prop moves forward and permits the primary trip prop to move down, thus permitting the main linkage to move down and the jack shaft to rotate, opening the ground making switch. The left hand of the jack shaft has a connection for the opening spring. A projection of the left hand operating lever also operates the auxiliary switch (Figure 3, c).

With the standard electrical control scheme (Figure 9), the closing spring is not charged until a closing operation is called for by an external signal. As soon as the spring is fully charged, the tripped linkage can reset under the action of the reset spring (Figure 5, l) and the primary and secondary trip props can fall into the reset position. The reset spring stretches between an extension on the main cam roller pin and a spring support pin located on the right mechanism side sheet. The trip latch check switch operated by a lever on the trip shaft will now close. This allows the closing solenoid to energize, closing the ground making switch. The closing spring remains discharged after a closing operation.
Figure 3  Mechanism - Top View

a. Grounding Switch Stationary Contacts
b. Grounding Switch Moveable Contacts
c. Auxiliary Switch
d. Ground Bus
e. Control Relay
f. Stored Energy Mechanism
g. Pawl Return Spring Weldment
h. Ratchet Wheel
i. Pawl Support Arm
j. Eccentric Roller
k. Crank Arm
l. Cam Shaft
Figure 4   Mechanism - Left View

a. Charging Motor
b. Shunt Trip Coil (when furnished)
c. Motor Cutoff Switch
d. Connecting Rod
e. Close Latch Adjusting Screw
Figure 5    Mechanism and Trip Linkages

a. Center Phase Operating Lever
b. Jack Shaft
c. Primary Trip Prop Adjusting Screw
d. Main Cam Roller
e. Primary Trip Prop
f. Main Drive Cam
g. Primary Trip Prop Roller
h. Secondary Linkage Roller
i. Cam Shaft
j. Trip Bar
k. Secondary Trip Latch
l. Reset Spring
m. Secondary Trip Prop Adjusting Screw
**Figure 6** Cam and Fundamental Link Positions

A. Device Open - Springs Charged - Links Reset

B. Device Closed - Springs Discharged

C. Device Open - Springs Discharged
F. **Test Ports**

The ground and test device is equipped with three (3) high voltage test ports (Figure 7, a), mounted on a third insulation panel on the upper front of the device. These test ports are covered with insulating shutters (Figure 7, b) which can be interlocked to control access to the test ports.

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**CAUTION**

*The interlocking provided on the PV-E 60600G13 electrically operated ground and test device is of rugged construction and is designed to deter incorrect operation but any interlock mechanism can be damaged or rendered inoperative by deliberately bypassing or removing it, by force or by careless abuse. Interlock mechanisms should not be tampered with or abused. They exist for the safety of the operator and the protection of the equipment.*

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The upper set of three (3) test ports is connected to the primary disconnecting devices.

A set of three (3) test probes (Figure 7, c) is supplied with each ground and test device. These probes are specially made to connect to the test ports of the device and should be used for all connections to the test ports. Grooves around the circumference of the test probes allow them to be held captive in the test ports by slots in the shutters which cover the test ports. This feature can be used with interlocks to control the sequence of test operation.

G. **Levering-In Device**

The ground and test device is moved between the disconnected and connected positions by the levering-in device. This consists of a shaft which is supported by the device side sheets and which has a crank arm at each end (Figure 2a, c). Rollers (Figure 2a, a) attached to the crank arms engage vertical slots in plates attached to the cell and rotation of the shaft causes the device to move in and out of the breaker housing. The levering-in shaft supports a racking gear at its right end just outside the right device side sheet. The racking gear is rotated by a worm gear on a shaft which is terminated in a hexagon drive nut attached with a shear pin. This shaft points in a direction from the front to the back of the ground and test device. This shaft has a threaded portion carrying a threaded plate. As the worm shaft is rotated, the threaded plate moves along the shaft until it encounters either a front or a back sleeve attached to the shaft and further rotation of the worm shaft is prevented. At this point, the ground and test device is either fully inserted into the breaker compartment or is in the fully disconnected position.
H. INTERLOCKING

The ground and test device is provided with numerous interlocks as standard features, and many more can be added if required by a specific user. The standard interlocks include:

1. The levering-in mechanism cannot be operated unless the grounding switch is in the open position. The window in the front cover which gives access to the levering-in shaft is covered by a shutter (Figure 1, d). When the manual trip paddle (Figure 1, n) is in its normal position, a pin in this shutter rests on a shutter interlock arm (Figure 2a, e). Pushing in on the trip paddle opens the grounding switch. This action also causes the shutter interlock arm to swing forward, allowing the levering-in shutter to drop, exposing the levering-in shaft. When the shutter is down, the pin drops behind the shutter interlock arm, holding the trip paddle in its operated position and blocking closing of the grounding switch. This ensures that the device cannot be inserted into or withdrawn from a switchgear cell unless the grounding switch is open.

2. The levering-in shutter and the trip paddle are further interlocked to block closing of the grounding switch in any position of the ground and test device other than fully inserted into or fully withdrawn from the compartment. The levering-in shaft has a cam plate attached to it next to the racking gear. This cam has two notches in it. The back end of the shutter arm has another pin, which must drop into one of these notches in order to raise the shutter and release the trip paddle. The two notches are positioned so that the pin on the shutter will enter one notch when the ground and test device is in the fully inserted position and the other notch when the device is in the fully withdrawn position. In all other positions of the ground and test device, the pin on the shutter rides on the surface of the cam and blocks closing of the shutter which in turn blocks closing of the grounding switch.

3. The manual trip paddle (Figure 1, m) may be padlocked in the operated position, ensuring that the grounding switch remains open, or it may be padlocked in the non-operated position, preventing the opening of the grounding switch.

4. The shutters covering the test receptacles may be padlocked or they may be interlocked using key interlocks (Figure 1, b).

I. SHUTTERS

In addition to moving the ground and test device in and out of the connected position, the crank arm rollers sliding in the slots in the plates on the switchgear compartment operate the shutters over the primary disconnects in the compartment. Downward movement of the rollers in the slots move the shutters before there is any movement of the ground and test device toward the connected position.

J. OPERATING COILS

1) Closing Coil

The closing coil (Figure 1, m) is located just inside the lower front cover of the ground and test device. It is attached to the lower front cover by two screws, accessible from the front of the ground and test device.

2) Shunt Trip Coil

When supplied, the shunt trip coil (Figure 4, b) is located to the left of the mechanism to the rear of the ground and test device.
K. **Control Relay**

The control relay is mounted on the left hand mechanism enclosure side sheet, near the top (Figure 3, e).

L. **Trip Paddle Interlock Switch**

The trip paddle interlock switch is mounted just above the floor pan of the ground and test device, at the rear of the trip paddle mechanism. The switch is opened whenever the trip paddle is pushed. The switch opens the electrical closing circuit, blocking electrical closing of the grounding switch when the trip paddle is pushed.

M. **Remote Control Box**

The ground and test device draws its operating power through a control box connected to the ground and test device. The control box (Figure 8) contains a line fuse and a close push button. The control box is connected to the ground and test device by a 20 foot, four-conductor power cord. The cord is permanently attached to the control box, with a four-conductor twist-lock type receptacle at the ground and test device end.

N. **Key Locks**

The PowlVac® PV-E 60600G13 is provided with numerous key lock interlocks and include:

1) **Key Lock “K1” (Keys KCF and KB)**

The key lock “K1” interlock is a two cylinder lock used to electrically enable or disable the ground & test device.

The K1 lock is a two cylinder lock equipped with an electrical switch element. The switch is closed when the KB key is retained. When the switch is open, the ground and test device is electrically disabled and the KCF key is retained.

*Note: When multiple ground and test devices are supplied for an installation, the customer feeder ground and test devices are normally supplied with similar interlock functions as that of the ConEd specification. In these cases, the KCF key is not present, but is instead supplied with a KU (utility) key for ConEd use. The KCF key and the KU key are not interchangeable.*
Figure 9  Control Scheme

Contact Table:

<table>
<thead>
<tr>
<th>Contacts</th>
<th>Handle</th>
<th>End</th>
</tr>
</thead>
<tbody>
<tr>
<td>Odd</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Trip</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Trip</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Similar to 10AA041
Except Engrave
Trip-Off-Close

120V/15A 3 Prong Plug

#14 5/C SO Cord (B, W, G)

Optional

#14 4/C W X Y Z
2) **Key Lock “K2” (Keys KB and KC)**

The key lock “K2” interlock is a two cylinder lock used to mechanically lock the ground and test device ground-making switch in the “OPEN” position.

The K2 interlock cannot be operated until the manual trip operator is fully depressed. When the manual trip operator is fully depressed, the ground-making switch operating mechanism is held in the open and trip-free condition.

The key lock “K2” interlock is operable only when key “KB” is inserted and the manual trip operator is depressed. When the K2 interlock is operated with the locking bolt extended, the ground-making switch is open, the KB key is retained and the KC key is released.

3) **Key Lock “K3” (Key KC)**

The key lock “K3” interlock is a single cylinder lock. When the K3 interlock is locked, the ground and test device is prevented from being inserted into or removed from the connected position of the circuit breaker compartment.

When the ground and test device is in the disconnected position, the K3 interlock prevents access to the ground and test-mounted racking device input shaft, thereby preventing the insertion of the ground and test device into the connected position in the circuit breaker compartment.

When the ground and test device is in the connected position, the K3 interlock prevents access to the ground and test-mounted racking device input shaft. This action prevents the removal of the ground and test device from the connected position.

With the KC key inserted and the locking bolt retracted to enable racking of the ground and test device in or out of the connected position, the KC key is retained.

4) **Key Lock “K4” (Keys KB and KD)**

The K4 interlock consists of a two cylinder lock used to mechanically lock the ground and test device ground-making switch in the “CLOSED” position.

In the PowlVac ground and test design, the locking bolt of the K4 interlock cannot be extended unless the ground-making switch is in the closed position, the manual trip operator is in the fully outward position and the manual trip operator is blocked from operation.

The K4 interlock is operable only when the KB key is inserted, the ground making switch is closed, the manual trip operator is in the fully outward position and the manual trip blocking lever is fully depressed. When the K4 interlock is operated with the locking bolt extended, the manual tripping function is mechanically disabled, the KB key is retained and the KD key is released.
5) **Key Lock “K5” (Key KD)**

The K5 interlock is a single cylinder lock and is used to open and lock the test port shutters.

The KD key, which normally resides in the K4 interlock, is available only when the ground making switch is in the closed and locked position. The KD key is then inserted into interlock K5. With the locking bolt retracted and the test port shutters are unlocked, the KD key is retained. Key KD is removable only when the locking bolt is extended in either of two positions. One position is with the test port shutters closed, and the other position is with the test probes installed in the test ports and the shutter moved to the probe locking position.

---

**Q. Interchangeability**

PowlVac ground and test devices are not interchangeable between the Con Edison and Customer compartments. The rating rejection interlocks (coding plates) will allow a ground and test device labeled “Con Edison” into only Con Edison incoming feeder compartments. Additionally, a ground and test device labeled “Customer” can be inserted into only customer feeder compartments.

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**O. Control Selector Switch**

A control selector switch (Figure 1, h) is mounted on the front of the ground and test device. This selector switch enables and disables the closing and tripping function of the ground and test device.

The selector switch is a three position rotary switch that operates in association with the remote OPEN/CLOSE push button control box. The snap action positions are OPEN, OFF, and CLOSE. The selector switch is padlockable in the OFF position.

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**P. Padlockable Cover**

PowlVac ground and test devices are equipped with a padlockable cover that covers the manual trip push button.
Ch 4 Installation

A. RECEIVING

When the ground and test device is received check for any sign of damage. If damage is found or suspected, file all claims immediately with the transportation company and notify the nearest Powell representative.

Estimated size and weight for shipping a PowlVac® on a pallet:

- Size: 42” width x 42” depth x 47” height
- Weight: 500 lbs.

Figure 10 shows the ground and test device enclosed in the carton used for shipment. The carton is attached to the shipping pallet by two metal bands. Remove these bands and lift the carton from the pallet so that the ground and test device is visible. The ground and test device is attached to the pallet by two metal bands. When these are removed the ground and test device may be removed from the shipping pallet. Refer to Ch 4 Installation, B. HANDLING, for more information.

B. HANDLING

After the ground and test device has been removed from its shipping pallet it may be rolled on its own wheels on a level surface. This is the preferred way of handling the ground and test device. When rolling the ground and test device it should be pushed and steered by the steel frame or the front cover.

![CAUTION]

Do not handle or move the ground and test device by the primary disconnecting devices, as damage may occur.

If necessary, the ground and test device can be moved by a fork lift truck or an overhead crane. When using a fork lift truck take care to avoid components located under the ground and test device. The forks on the truck should be set for a dimension over the forks of 28 inches. The forks should then ride under the wheel axles.

C. 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 contaminants 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.

D. Electrical Operation Check

In order to check the basic electrical operation of the ground and test device, the device must be placed near a circuit breaker test cabinet.

1) Test the Closing Operation of the Ground and Test Device

Perform the following to test the closing operation of the ground and test device:

a. Verify that the Control Selector Switch on the front of the ground and test device is in the “Off” (center) position (Figure 16).

b. Connect the umbilical cord of the remote control box to the ground and test device (Figure 17). Ensure the cord is locked into the connected position by turning the plug clockwise.

c. Move to control selector switch from “OFF” position to “Close” position (Figure 18).

d. From a safe distance, connect the ground and test device remote control box to a 120VAC, 15 ampere power supply.

e. Depress the “Close” push button switch on the control box (Figure 19) to close the ground and test device ground making switch.

f. Unplug the remote control box from the 120V power supply.

g. Move the control selector switch from the “Close” position to the “Off” position.
2) Test the Opening Operation of the Ground and Test Device

Note: Only applicable when the optional shunt trip coil is supplied.

Perform the following to test the opening operation of the ground and test device:

a. Perform steps a through g of Test Closing Operation of the Ground and Test Device
b. Move the control selector switch to the OPEN position
c. Turn the remote control box to the ON position and depress the OPEN push button to open the ground and test device
d. Move the control selector switch to the OFF position and turn the test cabinet power OFF
e. Disconnect the remote control box from the ground and test device

When the electrical checks are completed disconnect the secondary disconnect of the test cabinet from the ground and test device.

E. INSERTING GROUND AND TEST DEVICE INTO SWITCHGEAR EQUIPMENT

Refer to IB-51000B for information and cautions before attempting to insert a ground and test device into the metal-clad switchgear equipment. The information and cautions found in IB-51000B also apply to the ground and test device. Ensure that the levering-in crank arms at the sides of the device point in the direction of the main disconnects.

Each ground and test device and each compartment is provided, when required, with a coding plate designed to ensure that no device with less than the required voltage or momentary current rating is placed in any compartment. If attempting to insert an improperly rated device into the switchgear, these coding plates will interfere with each other and deter the insertion of the device. The interference occurs before the device reaches the “DISCONNECT” position.

CAUTION
Do not force the device past the interference or remove the coding plate from the compartment or the ground and test device.

1) Inserting Ground & Test Device Into Upper Compartment

Refer to IB-51000B for detailed procedures for this operation. The same instructions apply for the ground and test device.

2) Racking Ground & Test Device to the Connected Position

CAUTION
Verify the correct ground & test device is being inserted in the compartment of the feeder to be grounded. Also, verify all associated incoming and tie breakers are open before inserting the ground & test device. Failure to do so may result in damage to equipment and/or injury to personnel.

Perform the following to rack the ground and test device to the “CONNECTED” position:

a. Verify that the control selector switch is in the “OFF” position.
b. Push the manual push to trip paddle on the lower portion of the front of the device (Figure 1, n). The levering-in shutter will open automatically and the trip paddle will be held captive in the “TRIP” position.

3) Moving the Ground and Test Device from the Connected Position to the Disconnected Position

Perform the following to rack the ground and test device from the “CONNECTED” position to the “DISCONNECTED” position:

a. Ensure the grounding switch is in the Open position.

b. Push the manual push to trip paddle in and insert the racking handle.

c. Rotate the handle counter-clockwise until a positive stop is reached. The racking handle is equipped with an input torque limiter that will indicate limit to the operator by a mechanical ratcheting mechanism for positive operator feedback.

Do NOT attempt to rotate the handle counter-clockwise any further or damage to the mechanism may occur.

d. Once the device has reached the “DISCONNECTED” position, remove the racking handle and pull up on the levering-in shutter, returning it to its normal closed position. The manual push to trip paddle will be released by this action and will return to its normal position.

4) Removing the Ground and Test Device from the Upper Switchgear Compartment

Refer to IB-51000B for the detailed procedure for removing a circuit breaker from the upper compartment and follow the same procedures to remove a ground and test device.
Ch 5 Operating Procedures

The PowlVac® Electrically Operated Ground and Test Device is designed to provide access to the stationary primary disconnecting devices of metal-clad switchgear compartments to ground those terminals or to perform tests on either energized or deenergized circuits. Because this device gives access to switchgear components that are normally energized with dangerous voltages, great care must be exercised when using this device. All primary circuits should be considered to be energized until proven otherwise.

The operational instructions given in this instruction bulletin cover the basic operations required to use the ground and test device. In addition, many users will have operational and interlocking procedures of their own that must be followed. The operator must be knowledgeable of any procedures required by the user of the equipment and should also examine the drawings furnished with the particular switchgear equipment being grounded or tested, as these drawings may include additional information or instructions.

A. Applying Ground

Although the PowlVac Electrically Operated Ground & Test Device is designed and rated to close against a short circuit current within its rating, it should not be used to deliberately apply a ground to an energized line or bus. The operator should ensure that the circuit to be grounded is deenergized before closing the grounding switch.

Because the two-high construction of PowlVac metal-clad switchgear requires the bus connections to be located on the upper disconnect stabs of some compartments and the lower disconnect stabs of other compartments, it is vital that the operator be sure which set of disconnect stabs is to be grounded before inserting the device into the switchgear compartment. Determine the circuit to be grounded and carefully examine the drawings provided with the switchgear equipment to determine in which compartment this circuit is located and whether it is connected to the upper or lower disconnect stabs. Once this is known, perform the following:

1. With the ground and test device out of the breaker compartment, verify the correct compartment compatibility of the ground and test device. The ground and test devices supplied per installation are prominently marked “CUSTOMER” across the front for ease of identification.
2. Obtain the KCF (Key Customer Feeder) through proper customer control procedures.
3. Insert the KCF key into key lock K1 (Figure 11) and rotate the key. The switch associated with K1 opens. The “Close” control circuit of the ground and test device is now electrically disabled. The KCF key is now captive and has electrically locked the ground and test device in the “open” position. The KB key is now removable.

Figure 11 Inserting KCF Key into Key Lock K1
4. Transfer key KB to key lock K2. Fully depress the manual trip operator and rotate key KB (Figure 12). The ground and test device is now mechanically locked in the “Open” position. The KB key is now captive and the KC key is removable.

Figure 12  Key KB into Key Lock K2 and Depressing Manual Trip Push Button

5. Insert the ground and test device into the correct compartment. The ground and test device is rolled into the compartment, in the same manner as the circuit breaker it temporarily replaces, until the ground and test device racking rollers engage the racking slots on the compartment and a positive “stop” is encountered.

6. Transfer key KC to key lock K3 and rotate the key (Figure 13). The KC key is now captive. Pull the racking access shutter fully down. The ground and test device racking shaft is now accessible. Key lock K3 is blocked from operation with the racking access shutter in the down position.

7. Install the racking handle and rotate the handle clockwise to move the ground and test device into the “Connected” position. The connected position is indicated by the mechanical position indicator on the front of the ground and test device. The racking handle is also equipped with an input torque limiter that will indicate limit to the operator by a mechanical ratcheting mechanism for positive operator feedback. Remove the racking handle.

8. Rotate key KC to lock the ground and test device in the connected position. The KC key is now released.

9. Transfer key KC to key lock K2 (Figure 14). Fully depress the manual trip operator and rotate key KC. Release the manual trip operator. The key KC is now captive and the KB key is released.

Figure 13  Inserting Key KC into Key Lock K3

Figure 14  Transfer Key KC to Key Lock K2
10. Transfer key KB to key lock K1 (Figure 15). Rotate key KB. The ground and test device control circuit is now enabled. The KB key is now captive and the KCF key is released.

Figure 15 Transfer Key KB to Key Lock K1

11. Verify that the Control Selector Switch on the front of the ground and test device is in the “Off” (center) position (Figure 16).

Figure 16 Selector Switch in Off Position

12. Connect the umbilical cord of the remote control box to the ground and test device (Figure 17). Ensure the cord is locked into the connected position by turning the plug clockwise.

Figure 17 Connecting Control Box to Device

13. Move to control selector switch from “OFF” position to “Close” position (Figure 18).

Figure 18 Selector Switch in Closed Position

14. From a safe distance, connect the ground and test device remote control box to a 120VAC, 15 ampere power supply.

15. Depress the “Close” push button switch on the control box (Figure 19) to close the ground and test device ground making switch.
16. Unplug the remote control box from the 120V power supply.
17. Move the control selector switch from the “Close” position to the “Off” position.
18. Disconnect the control box umbilical cord from the ground and test device.
19. Rotate key KCF in key lock K1. Remove key KB from key lock K1.
20. Ground and test device can no longer be operated.
21. Secure key KB in lock box on premises.

**B. REMOVING GROUND**

1. Obtain key KB from lock box on premises.
2. Transfer key KB to key lock K1 (Figure 20) and rotate key. Key KB is now captive and key KCF is released (Figure 21). The control circuit for the ground and test device is now enabled.

3. Verify that the control selector switch on the front of the ground and test device is in the “Off” (center) position (Figure 16).
4. Connect the umbilical cord of the remote control box to the ground and test device (Figure 17). Ensure the cord is locked into the connected position by turning the plug clockwise.
5. Move the selector switch from the “Off” position to the “Open” position.
6. From a safe distance, connect the ground and test device remote control box to a 120VAC, 15 ampere power supply.
7. Depress the “Open” push button switch on the control box (Figure 22) to open the ground and test device ground making switch.
8. Unplug the remote control box from the 120V power supply.
9. Move the control selector switch from “Open” to the “Off” position.
10. Disconnect the remote control box umbilical cord from the ground and test device.
11. Rotate key KCF in key lock K1. The switch associated with K1 opens. The “Close” control circuit of the ground and test device now electrically disabled. The KCF key is now captive and has electrically locked the ground and test device in the “Open” position. Key KB is now removable.
12. Transfer key KB to key lock K2. Fully depress the manual trip operator and rotate key KB (Figure 12). The ground and test device is now mechanically locked in the “Open” position. Key KB is now captive and key KC is now removable.
13. Transfer key KC to key lock K3 and rotate. The key KC is now captive. Pull the racking access shutter fully down. The ground and test device racking input shaft is now accessible. Key lock K3 is block from operation with the racking access shutter in the down position.
14. Install the racking handle, and rotate the handle counterclockwise to move the ground and test device into the “disconnected” position. The disconnected position is indicated by the racking mechanism encountering a positive stop. The racking handle is also equipped with an input torque limiter that will indicate limit to the operator by a mechanical ratcheting mechanism for positive operator feedback. Remove the racking handle.
15. Rotate key KC to lock the ground and test device in the disconnected position. Key KC is now released.
16. Transfer key KC to key lock K2. Fully depress the manual trip operator and rotate key KC. Release the manual trip operator. The key KC is now captive and key KB is released.
17. Transfer key KB to key lock K1 (Figure 20) and rotate. The ground and test device control circuit is now enabled. Key KB is now captive and key KCF is now released.
18. Remove the ground and test device from the compartment.
19. Remove key KCF from key lock K1 (Figure 21).
20. Secure key KCF in lock box on premises.

C. Procedure for Testing Feeder

Perform steps 1 through 10 of Ch 5 Operating Procedures, A. Applying Ground prior to the following:

1. Verify that the control selector switch on the front of the ground and test device is in the “Off” (center) position (Figure 16).
2. Connect the umbilical cord of the remote control box to the ground and test device (Figure 17). Ensure the cord is locked into the connected position by turning the plug clockwise.
3. Move the control selector switch from the “Off” position to the “Close” position.
4. From a safe distance, connect the ground and test device remote control box to a 120VAC, 15 ampere power supply.
5. Depress the “Close” push button switch on the control box (Figure 19) to close the ground and test device ground making switch.
6. Unplug the remote control box from the 120V power supply.
7. Move the control selector switch from the “Close” position to the “Off” position.
8. Disconnect the control box umbilical cord from the ground and test device.
9. Rotate key KCF in key lock K1 to electrically lock the ground and test device in the “Closed” position.
10. Transfer key KB to key lock K4. Depress the manual trip blocking lever. Rotate key KB. The KB key is now captive and key KD is released.
11. Transfer key KD key to key lock K5. Rotate key KD to unlock the test port shutters.
12. Open the test port shutters using the slide handle. With the test ports fully open, the key lock K5 interlock is blocked from operating and the key remains captive (Figure 23).

**Figure 23  Key KD in Key Lock K5 with Shutters Unlocked**

13. Install test probes into the test ports (Figure 24). Move the test port shutter to the left to capture the test probes in the test probe shutter.

**Figure 24  Test Probes Installed**

14. Rotate key KD to lock the test probes in the test ports. Key KD is now released.

15. Transfer key KD to key lock K4. Depress the manual trip blocking lever. Rotate key KD. Release the manual trip blocking lever to unlock the manual trip operator. Key KD is now captive and key KB is released.
16. Transfer key KB to key lock K1 (Figure 15). Rotate key KB. The ground and test device control circuit is now enabled. Key KB is now captive and key KCF is now released.
17. Verify that the control selector switch on the front of the ground and test device is in the “Off” (center) position (Figure 16).
18. Connect the umbilical cord of the remote control box to the ground and test device (Figure 17). Ensure the cord is locked into the connected position by turning the plug clockwise.
19. Move the control selector switch from the “Off” position to the “Open” position.
20. From a safe distance, connect the ground and test device remote control box to a 120VAC, 15 ampere power supply.
21. Depress the “Open” push button switch on the remote control box (Figure 22) to open the ground and test device ground making switch.
22. Unplug the remote control box from the 120V power supply.
23. Move the control selector switch from the “Open” position to the “Off” position.
24. Disconnect the remote control box umbilical cord from the ground and test device.
25. Rotate key KCF in key lock K1 to electrically lock the ground and test device in the “Open” position. Remove key KB from key lock K1.
26. Lock key KB in a lock box on premises.
27. The ground and test device is now prepared for testing.
D. **Testing Ports**

The three (3) test ports provided on the front of the ground and test device may be used to provide access to the primary disconnecting devices of the switchgear compartment for testing purposes. Three (3) test probes are provided for use in these test ports.

The test ports are covered with shutters, one shutter for the upper three test probes. The shutters and test probes are made so that the shutter will interlock with a groove around the circumference of the test probe when the test probe is fully inserted into the test port, holding the test probes captive in the ground and test device.

The test ports are connected to the primary disconnecting devices. Each test probe is provided with a threaded stud projecting from the outer end of the probe. This stud may be used for attaching leads to test apparatus. The thread is 3/8-16 UNC. Since the end of these studs is accessible when the test probes are inserted in the test receptacles, the stud will be energized if the ground and test device is connected to an energized circuit. It is imperative that the operator insulate the ends of these test probes before inserting them into the ground and test device.

The test probes are not high current devices. They are suitable for testing procedures such as high potential testing, phasing out circuits, phase rotation testing, and primary voltage measurements.

Since the test probes give access to primary circuits, it is essential that any test apparatus connected to the test probes be rated for the primary circuit voltage. Test leads used for these connections must also be rated for the primary circuit voltage.

Actual testing procedures are to be determined by the user, taking into account the safety practices and cautions given in this instruction bulletin.

E. **Removing Test Probes**

Perform the following steps to remove the test probes from the ground and test device:

1. Obtain key KB from the lock box on premises.
2. Transfer key KB to key lock K1 and rotate key. The ground and test device control circuit is now enabled. The KB key is now captive and key KCF is released.
3. Verify that the control selector switch on the front of the ground and test device is in the “Off” (center) position (Figure 16).
4. Connect the umbilical cord of the remote control box to the ground and test device (Figure 17). Ensure the cord is locked into the connected position by turning the plug clockwise.
5. Move to control selector switch from “OFF” position to “Close” position (Figure 18).
6. From a safe distance, connect the ground and test device remote control box to a 120VAC, 15 ampere power supply.
7. Depress the “Close” push button switch on the control box (Figure 19) to close the ground and test device ground making switch.

**CAUTION**

*Even when insulated, the test probes should not be handled when energized. The test probe insulation is only one part of a complete line-to-ground insulation system and the surface of the test probe may be energized at a voltage above ground potential.*
8. Unplug the remote control box from the 120V power supply.
9. Move the control selector switch from the “Close” position to the “Off” position.
10. Disconnect the control box umbilical cord from the ground and test device.
11. Rotate key KCF in key lock K1 to electrically lock the ground and test device in the “Closed” position. Key KCF is now captive and key KB is released.
12. Transfer key KB to key lock K4. Depress the manual trip blocking lever and rotate the key. Key KB is now captive and key KD is released.
13. Transfer key KD to key lock K5. Rotate the KD key to unlock the test port shutters. Key KD is now captive.
14. Open the test port shutters using the slide handle. With the test ports fully open, the K5 interlock is blocked from operating and the key remains captive.
15. Remove the test probes from the test ports. Close the test port shutters.
16. Rotate key KD to lock the test port shutter. Key KD is now released.
17. Transfer key KD to key lock K4. Depress the manual trip blocking lever and rotate the key. Release the manual trip blocking lever to unlock the manual trip operator. Key KD is now captive and key KB is released.
18. Transfer key KB to key lock K1 and rotate the key. The ground and test device control circuit is now enabled. Key KB is now captive.
19. Verify that the control selector switch on the front of the ground and test device is in the “Off” (center) position.
20. Connect the umbilical cord of the remote control box to the ground and test device (Figure 17). Ensure the cord is locked into the connected position by turning the plug clockwise.
21. Move the control selector switch from the “Off” position to the “Open” position.
22. From a safe distance, connect the ground and test device remote control box to a 120VAC, 15 ampere power supply.
23. Depress the “Open” push button switch on the remote control box (Figure 22) to open the ground and test device ground making switch.
24. Unplug the remote control box from the 120V power supply.
25. Move the control selector switch from the “Open” position to the “Off” position.
26. Disconnect the remote control box umbilical cord from the ground and test device.
27. Rotate key KCF in key lock K1. The switch associated with K1 opens. The “Close” control circuit of the ground and test device is now electrically disabled. The KCF key is now captive and has electrically locked the ground and test device in the “Open” position. Key KB is now removable.
28. Transfer key KB to key lock K2. Fully depress the manual trip operator and rotate key KB. The ground and test device is now mechanically locked in the “Open” position. The KB key is now captive and key KC is removable.
29. Transfer key KC to key lock K3 and rotate the key. Key KC is now captive. Pull the racking access shutter fully down. The ground and test device racking input shaft is now accessible. Key lock K3 is blocked from operation with the racking access shutter in the down position.
30. Install the racking handle and rotate the handle counterclockwise to move the ground and test device into the “Disconnected” position. The disconnected position is indicated by the racking mechanism encountering a positive stop. The racking handle is also equipped with an input torque limiter that will indicate limit to the operator by a mechanical ratcheting mechanism for positive operator feedback. Remove the racking handle.
31. Rotate key KC to lock the ground and test device in the “Connected” position. Key KC is now released.
32. Transfer key KC to key lock K2. Fully depress the manual trip operator and rotate key KC. Release the manual trip operator. Key KC is now captive and key KB is now released.
33. Transfer key KB to key lock K1. Rotate key KB. The ground and test device control circuit is now enabled. Key KB is now captive and the KCF key is released.
34. Remove the ground and test device from the compartment.
35. Remove key KCF from key lock K1.
36. Secure key KCF in a lock box on premises.
Ch 6  Maintenance

A. General Description

**CAUTION**

Prior to beginning any maintenance procedures, make certain that the control circuits are deenergized and the ground and test device is resting securely outside the circuit breaker compartment. Do not work on a closed ground and test device or a ground and test device with the main closing spring charged.

**NOTICE**

Before attempting any maintenance work, it is important to study and fully understand the safety practices outlined in Chapter 2 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.

1) Introduction

A regular maintenance schedule must be established to obtain the best service and reliability from the ground and test device. The ground and test device is designed to comply with industry standards requiring maintenance every 250 operations or once a year.

Actual inspection and maintenance will depend upon individual application conditions such as number of operations, time between uses, and storage conditions. If the ground and test device is used relatively infrequently, the interval between inspections may be longer than a year, but may include only a few operations. When the ground and test device has been in storage for an extended period of time, it is recommended that it be inspected and cleaned before being used. See Ch 4 Installation, C. Storage for storage recommendations. Follow those recommendations to minimize the need for maintenance before using the device after prolonged storage.

A permanent record of all maintenance work should be kept, the degree of detail depending 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, the condition of ground and test device, and any repairs or adjustments that were performed. This record should begin with tests performed at the time of installation and energization, and all data should be graphed as a function of time to ensure a proper maintenance cycle is being scheduled. The actual reading of the operations counter should be recorded when the device is first used and whenever any maintenance is performed.

2) Inspection and Cleaning

Visually check for loose or damaged parts. Tighten or replace loose or missing hardware. Any part damaged so as to interfere with the normal operation of the device should be replaced.

Clean the ground and test device, removing loose dust and dirt.
**CAUTION**

Do NOT use compressed air to clean the device. This may result in loose dirt or grit being blown into bearings or other critical parts and causing excessive wear.

Either use a vacuum cleaner or wipe with a dry lint-free cloth or industrial-type wiper.

Primary insulation, including the insulating support plates on which the selector switch and grounding switch contacts are mounted and the operating rods, should also be cleaned. Wipe clean with a dry lint-free cloth or an industrial-type wiper. If dirt adheres and will not come off by wiping, remove it with distilled water or a mild solvent such as denatured alcohol. Be sure that the ground and test device is dry before returning it to service. Do not use any type of detergent to wash the surface of the insulators, as the detergent may leave an electrical conducting residue on the surface as it dries.

### B. MECHANISM AREA

1) **Mechanical Operation**

Remove the upper portion of the front cover of the ground and test device. Make a careful visual inspection of the mechanism for loose, damaged or excessively worn parts. Operate the grounding switch several times. Operate the levering-in mechanism through one or two complete cycles and check for smoothness of operation.

2) **Lubrication**

Powell offers a complete lubrication kit (Powlube-104) which contains all the lubricants required for maintaining the ground and test devices. 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.

Lubricate the stored energy mechanism and other specified parts in accordance with Table A, Lubrication. See Figure 25 for labeled lubrication photographs.

*Table A, Lubrication* lists the location of all surfaces that should be lubricated, the type of lubricant to be used, and the method of applying the lubricant. The guiding rule in lubrication is to lubricate regularly, use lubricant sparingly and remove all excess lubricant. Tilting the ground and test device will enable the lubricant to cover the bearing surfaces.
### Table A Lubrication

<table>
<thead>
<tr>
<th>Location</th>
<th>Reference Figure</th>
<th>Lubricant</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Electrical Parts</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Main Primary Disconnect Fingers</td>
<td>Figure 25, a</td>
<td>B - Grease</td>
<td>Wipe clean. Apply lubricant only to actual contact surface.</td>
</tr>
<tr>
<td>Grounding Switch Hinges</td>
<td>Figure 25, b</td>
<td>B - Grease</td>
<td>With switch closed, wipe clean and apply as close to hinge as possible. Repeat with switch open.</td>
</tr>
<tr>
<td>Grounding Switch Contacts</td>
<td>Figure 25, c</td>
<td>B - Grease</td>
<td>With switch open, wipe clean and apply lube only to actual contact surfaces.</td>
</tr>
<tr>
<td><strong>Mechanical Parts</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Levering-In Device Worm and Wheel</td>
<td>Figure 25, d</td>
<td>A - Grease</td>
<td>Feed grease between worm and wheel while rotating worm shaft between disconnected and connected positions.</td>
</tr>
<tr>
<td>Worm Shaft Bearings</td>
<td>Figure 25, e</td>
<td>C - Oil</td>
<td></td>
</tr>
<tr>
<td>Levering-In Shaft Support Bearings</td>
<td>Figure 25, f</td>
<td>C - Oil</td>
<td></td>
</tr>
<tr>
<td>Levering-In Crank Arm Rollers</td>
<td>Figure 25, g</td>
<td>C - Oil</td>
<td>Tilt device sideways and rotate roller while oiling.</td>
</tr>
<tr>
<td>Spring Yoke Pins</td>
<td>Figure 25, h</td>
<td>C - Oil</td>
<td></td>
</tr>
<tr>
<td>Trip Shaft Support Bearings</td>
<td>Figure 25, i</td>
<td>C - Oil</td>
<td></td>
</tr>
<tr>
<td>Crank Pins</td>
<td>Figure 25, j</td>
<td>C - Oil</td>
<td></td>
</tr>
<tr>
<td>Motor Drive Shaft Roller Needle Bearings</td>
<td>Figure 25, k</td>
<td>C - Oil</td>
<td></td>
</tr>
<tr>
<td>Pawls</td>
<td>Figure 25, l</td>
<td>C - Oil</td>
<td></td>
</tr>
<tr>
<td>Close Latch Shaft Face</td>
<td>Figure 25, m</td>
<td>A - Grease</td>
<td>Apply a light coating of grease and remove all excess.</td>
</tr>
<tr>
<td>Ratchet Wheel</td>
<td>Figure 25, n</td>
<td>A - Grease</td>
<td></td>
</tr>
<tr>
<td>Jackshaft Lever Pins passing through Operating Rod Clevises</td>
<td>no image available</td>
<td>C - Oil</td>
<td>Apply to penetrate where pin passes through end link.</td>
</tr>
<tr>
<td>Fixed Link Pin</td>
<td>Figure 25, o</td>
<td>C - Oil</td>
<td></td>
</tr>
<tr>
<td>Main Closing Spring Guide Rod</td>
<td>Figure 25, p</td>
<td>C - Oil</td>
<td></td>
</tr>
<tr>
<td>Primary Trip Prop Shaft Support Bearings</td>
<td>Figure 25, q</td>
<td>C - Oil</td>
<td></td>
</tr>
<tr>
<td>Primary Trip Prop Shaft Roller</td>
<td>Figure 25, r</td>
<td>C - Oil</td>
<td></td>
</tr>
<tr>
<td>Open-Close Flag Drive Lever Pin at Jackshaft</td>
<td>Figure 25, s</td>
<td>C - Oil</td>
<td></td>
</tr>
<tr>
<td>Flag Support Pins</td>
<td>Figure 25, t</td>
<td>C - Oil</td>
<td></td>
</tr>
<tr>
<td>Jackshaft Supports at Mechanism</td>
<td>Figure 25, u</td>
<td>C - Oil</td>
<td></td>
</tr>
<tr>
<td>Wheel</td>
<td>Figure 25, v</td>
<td>C - Oil</td>
<td>Tilt device sideways and rotate wheels while oiling.</td>
</tr>
<tr>
<td>Motor Drive Shaft Support Bearings</td>
<td>Figure 25, w</td>
<td>C - Oil</td>
<td></td>
</tr>
<tr>
<td>Camshaft Needle Bearings</td>
<td>Figure 25, x</td>
<td>C - Oil</td>
<td></td>
</tr>
<tr>
<td>Close Shaft Support Bearing</td>
<td>no image available</td>
<td>C - Oil</td>
<td></td>
</tr>
<tr>
<td>Motor Cutoff Switch Cam</td>
<td>Figure 25, y</td>
<td>A - Grease</td>
<td>Apply to peripheral surface only.</td>
</tr>
<tr>
<td>Fundamental Link</td>
<td>Figure 25, z</td>
<td>C - Oil</td>
<td></td>
</tr>
<tr>
<td>Fundamental Link Cam</td>
<td>Figure 25, aa</td>
<td>A - Grease</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** 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 456. See Ch 6 Maintenance, B. MECHANISM AREA, 2) Lubrication for more details.
Figure 25  Mechanism for Lubrication Call Outs

- a) Main Primary Disconnect Fingers
- b) Grounding Switch Hinges
- c) Grounding Switch Contacts
- d) Levering-In Device Worm and Wheel
- e) Worm Shaft Bearings
- f) Levering-In Shaft Support Bearings
- g) Levering-In Crank Arm Rollers
- h) Spring Yoke Pins
- i) Trip Shaft Support Bearings
- j) Crank Pins
- k) Motor Drive Shaft Roller Needle Bearings
- l) Pawls
- m) Close Latch Shaft Face
- n) Ratchet Wheel
- o) Fixed Link Pin
- p) Main Closing Spring Guide Rod
- q) Primary Trip Prop Shaft Support Bearing
- r) Primary Trip Prop Shaft Roller
- s) Open-Close Flag Drive Lever Pin
- t) Flag Support Pins
- u) Jackshaft Supports
- v) Wheel
- w) Motor Drive Shaft Support Bearings
- x) Camshaft Needle Bearings
- y) Motor Cutoff Switch Cam
- z) Fundamental Link
- aa) Fundamental Linkage Cam
3) Mechanism Adjustments

There are several factory adjustments in the mechanism which are described below. No adjustment of these settings is required for routine maintenance, but they may need to be adjusted after major overhaul or removal of the mechanism. Do not adjust these settings unnecessarily.

a. Adjustment of Ratchet Wheel Holding Pawl

The ratchet wheel holding pawl is adjusted by a nut on the outer end of a threaded shaft. If the pawl is not properly adjusted, there will be a “knocking” noise when the ratcheting mechanism is operating, or the mechanism will not ratchet at all. To adjust the pawl, turn the nut while charging the spring using the charging motor. Bring the pawl into adjustment by turning the nut clockwise. Do not turn the nut counterclockwise.

b. Adjustment of Primary and Secondary Trip Props and Latch Check Switch

Adjust the secondary trip prop adjusting screw (Figure 5, m) so that the overlap of the secondary trip prop on the primary trip prop roller is approximately 0.125”. Adjust the primary trip prop adjusting screw (Figure 5, c) so that with the main linkage in the reset position the clearance between the primary trip prop roller and the secondary trip prop is 0.005” to 0.015”. With a 0.015” wire gauge between the trip bar lever and the secondary trip prop adjusting screw, the latch check switch should be open. With no gap between the lever and the screw, the latch check switch should be closed.

c. Adjustment of Close Latch

The close latch shaft passes through the side sheets of the mechanism frame at the front of and below the cam shaft. The right end of the shaft is shaped to make a latch face and interferes with the latch arm which is fixed to the cam shaft. The other end of the close shaft is on the left side of the mechanism and a small lever attached to it is positioned by an adjusting screw (Figure 4, e).

Adjustment of this latch must be made with the main closing spring charged. Since the control circuit of the ground and test device is designed to close the grounding switch immediately on completion of the charging cycle, it is necessary to unplug the closing coil from the wiring harness before adjusting the close latch. With the closing coil disconnected, plug the control cord into a power source of the
proper rating and press the “CLOSE” push button on the control box. The mechanism will charge the main closing spring and stop. Disconnect the control cord from the power source before proceeding.

With the main closing spring charged, turn the latch adjusting screw upwards until the latch is released and the grounding switch closes. Unscrew the adjustment screw 2½ turns and lock in position with the locking nut. The latch adjusting screw is accessible from beneath the ground and test device through a clearance hole in the base pan. The locking nut is accessible from above the base pan, on the left side of the main mechanism.

After completing the adjustment of the close latch, reconnect the closing coil.

4) Electrical Operation

After any necessary mechanical maintenance and lubrication is done, operate the ground and test device electrically several times to ensure that the electrical control system works properly. Refer to Ch 5 Operating Procedures.

C. Grounding Switch Area

1) Routine Maintenance

Lubricate the blades as shown in Table A. Examine the contact areas, both moving and stationary, for evidence of overheating, pitting, cracking or other damage. Any damaged parts should be replaced.

2) Moving Contact Adjustments

There are two factory adjustments of the moving contacts which are described in this section. No adjustment of these settings is required for routine maintenance, but they may need to be adjusted after major overhaul or replacement of contact parts. Do not adjust these settings unnecessarily.

a. Initial Kick-Off Spring Height Adjustment

The initial height setting of the kick-off springs is measured with the ground making switch open. The height from the back side of the impact snubber and the insulating support is 2 1/8”. This height is adjusted by grasping the impact snubber and turning the 1/4-20 hex head bolt. Turning the bolt clockwise will decrease the gap, and turning the bolt counterclockwise will increase the gap (Figure 27).
b. Kick-Off Spring Pressure Adjustment

With the ground making switch in the closed position, measure the gap between the back of the insulating barrier that supports the kick-off springs and the underside of the 1/4-20 hex head bolts that retain the springs. This gap should be between 1/4” and 5/16” (Figure 27). This measurement does not include the flat washer. To adjust the gap, open the ground making switch. Remove the pin connecting the operating rod clevis to the jackshaft arm. Loosen the locknut on the operating arm clevis and rotate the clevis one or more half turns to adjust the length of the operating rod. The clevis should be screwed into the operating arm cross member (turned clockwise) to decrease the gap between the bolt head and the mounting barrier and screwed out (turned counterclockwise) to increase the gap. Reconnect the clevis to the jackshaft arm and tighten the locking nut. Close the ground making switch and recheck the gap. Repeat as necessary to achieve optimum adjustment of the gap.

Figure 27 Ground Switch Contacts

c. Hinge Bolt

Disconnect the operating rod at the movable contact by removing the pin. With the movable contact not touching the stationary contacts, apply a force gauge to the outer end of the contacts. The hinge bolt should be tightened so that the force necessary to start the blades in motion is 9-12 lbs.

D. HIGH POTENTIAL TESTS

These tests are not ordinarily required for routine maintenance, but should be performed if the ground and test device has been in storage for an extended period of time, especially in a damp location or other adverse environment, or if the insulation of the device shows any signs of damage or deterioration.

1) High Voltage Insulation Integrity

With the grounding switch “OPEN” wire the three upper primary stabs of the device to a high potential test set and ground the three lower primary stabs and the frame of the ground and test device. Perform the one minute high voltage test prescribed in ANSI Standard C37.20.2, 5.5 and 4.2.3, at the voltage level appropriate for the equipment.

CAUTION

Remove all grounding conductors applied for this test before placing the ground and test device into service.
2) Control Voltage Insulation Integrity

If the user wishes to check the insulation integrity of the control circuit, it may be done with a 500V or 1000V insulation tester or with an AC high potential tester. The AC high potential test should be made at 1125V, 60Hz, for one minute. The charging motor must be disconnected at its connection plug prior to testing the control circuit. The motor itself may be similarly tested at a voltage not to exceed 675V, 60Hz. Be sure to remove any test jumpers and reconnect the charging motor when the tests are complete.
Ch 7  Recommended Renewal Parts and Replacement Procedures

A. Ordering Instructions

1. Order Renewal Parts from Powell at www.powellind.com or call 1.800.480.7273.

2. Always specify complete nameplate information, including:
   - Ground and Test Device Type
   - Serial Number
   - Rated Voltage
   - Rated Amps
   - Impulse Withstand
   - 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, a photo or simply submit a sketch showing the part needed.

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 replacements parts.

Since parts may be improved periodically, renewal parts may not be identical to the original parts. Table B lists the recommended spare parts to be carried in stock by the user. The recommended quantity is not specified. This must be determined by the user based on the application. It is recommended that one set of parts be stocked at all times.

Powell recommends that only qualified technicians perform maintenance on these units. Refer to the Qualified Person Section in the front of this instruction bulletin. If these ground and test devices are installed in a location where they are not maintained by a qualified technician, a spare ground and test device should be on site ready for replacement. The malfunctioning unit can then be returned to the factory for reconditioning.

Table B  Recommended Renewal Parts

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Description</th>
<th>Catalog Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Grounding Switch Moving Contact</td>
<td>60221P01</td>
</tr>
<tr>
<td>6</td>
<td>G.S. Stationary Contact Finger</td>
<td>60219P01</td>
</tr>
<tr>
<td>3</td>
<td>Test Probe</td>
<td>50577G02</td>
</tr>
<tr>
<td>1</td>
<td>Closing Coil, 120V 60Hz (1)</td>
<td>50026G01</td>
</tr>
<tr>
<td>1</td>
<td>Charging Motor, 120V 60Hz (1)</td>
<td>50960G04</td>
</tr>
<tr>
<td>1</td>
<td>Shunt Trip Coil, 120V 60Hz (1) (2)</td>
<td>50025G03</td>
</tr>
<tr>
<td>1</td>
<td>Motor Relay</td>
<td>GS187</td>
</tr>
<tr>
<td>1</td>
<td>Latch Check Switch</td>
<td>BA-2RV2-A2</td>
</tr>
<tr>
<td>1</td>
<td>Trip Paddle Interlock Switch</td>
<td>BA-2RV2-A2</td>
</tr>
<tr>
<td>1</td>
<td>Motor Cutoff Switch Assembly</td>
<td>50756G03</td>
</tr>
<tr>
<td>2</td>
<td>Auxiliary Switch</td>
<td>MT-4RV-A28</td>
</tr>
<tr>
<td>3</td>
<td>Primary Contact Spring Assembly</td>
<td>50740G02</td>
</tr>
<tr>
<td>2</td>
<td>Ground Shoe Finger Assembly</td>
<td>50952G02</td>
</tr>
</tbody>
</table>

Notes: 1) For other control voltages, contact factory.
2) When device is equipped with this optional feature.
C. Replacement Procedures

This section includes instructions for replacing the parts recommended as renewal parts. Before attempting any maintenance repair work, take note of the safety practices outlined in Ch 2 Safety of this instruction bulletin.

⚠️ CAUTION

Ensure that the control circuits are deenergized and the ground and test device is resting securely outside the switchgear housing. Do NOT start to work on a closed ground and test device or a device with the main closing spring charged. When any maintenance procedure requires the opening or closing of the ground and test device or the charging of any of the stored energy mechanism springs, exercise extreme caution to ensure that all personnel, tools, and other miscellaneous objects are kept clear of the moving parts of the charged springs.

1) Grounding Switch Movable Contact

The grounding switch movable contacts (Figure 3, b) are located at the top of the moving arms of the grounding switch, behind the windows in the front cover.

⚠️ CAUTION

Ensure that the control circuits are deenergized and the ground and test device is deenergized, disconnected by means of a visible break, and securely grounded. Do NOT start to work on a closed ground and test device or a ground and test device with the main closing spring charged.

Perform the following steps to replace the grounding switch movable contact:

a. Remove upper portion of ground and test device front cover.

b. With grounding switch in “OPEN” position, remove two 3/8” bolts holding movable contact to top of moving arm (Figure 27).

c. Bolt the new movable contact in place, using existing hardware. Torque 3/8” bolts to 20-30 lb/ft.

d. Close grounding switch and check the kick-off spring pressure as described in Ch 6 Maintenance, C. Grounding Switch Area, b. Kick-Off Spring Pressure Adjustment. If necessary, adjust the spring pressure.

e. Replace the front cover.

2) Grounding Switch Stationary Contacts

The grounding switch stationary contacts are located on the front of the middle insulating barrier of the ground and test device (Figure 3, a).

⚠️ CAUTION

Ensure that the control circuits are deenergized, disconnected by means of a visible break, and securely grounded. Do NOT start to work on a closed ground and test device or a ground and test device with the main closing spring charged.

Perform the following steps to replace the grounding switch stationary contacts:

a. Remove the upper portion of ground and test device front cover.

b. Remove six insulating tubes from the test port jacks.
c. Remove three ⁵/₁₆” bolts holding the stationary contact to the contact support bar. Bolt the new stationary contacts in place using the existing hardware. Torque the ⁵/₁₆” bolts to 15-20 lb/ft. No adjustment of the contacts is required.

b. Unplug the closing coil from the wiring harness.

c. Remove the two bolts holding the closing coil assembly to the lower front cover and withdraw the closing coil from the front of the ground and test device.

d. Insert new closing coil assembly into the device from the front, bolt it into place and plug it into the wiring harness. No adjustment is required.

e. Close the grounding switch electrically several times to ensure that the coil is working properly.

f. Replace the upper front cover.

3) Closing Coil Assembly

The closing coil assembly is located in the lower center of the ground and test device, just behind the lower front cover (Figure 1, m).

4) Charging Motor Assembly

The charging motor assembly is located in the lower left of the ground and test device, just behind the lower front cover (Figure 4, a).

Ensure that the control circuits are deenergized and the ground and test device is deenergized, disconnected by means of a visible break, and securely grounded. Do NOT start to work on a closed ground and test device or a ground and test device with the main closing spring charged.

Perform these steps to replace the charging motor assembly:

a. Remove the upper portion of the ground and test device front cover.

b. Unplug the charging motor from the wiring harness.

c. Remove the two bolts holding the motor mounting bracket to the lower front cover and slide the motor to the left, disconnecting the motor shaft from the mechanism, and lift the motor out.

Perform these steps to replace the closing coil assembly:

a. Remove the upper portion of the ground and test device front cover.
d. Lubricate the end of the shaft of the new motor liberally with A - Grease.
e. Position the new motor assembly in the device, being sure that the pin on the end of the drive shaft engages the slot in the mechanism shaft.
f. Bolt the motor to the front cover and plug it into the wiring harness.
g. Close the grounding switch electrically several times to ensure that the motor operates smoothly.
h. Replace horizontal front cover.

5) Shunt Trip Coil

When supplied, the shunt trip coil is located to the left of the mechanism near the rear (Figure 4, b).

![CAUTION]

Ensure that the control circuits are deenergized and the ground and test device is deenergized, disconnected by means of a visible break, and securely grounded. Do NOT start to work on a closed ground and test device or a ground and test device with the main closing spring charged.

Perform these steps to replace the shunt trip coil:

a. Remove the upper portion of the ground and test device front cover.
b. Unplug the trip coil from the wiring harness.
c. Remove the two bolts holding the trip coil assembly to the mechanism frame and remove the assembly.
d. Insert the new trip coil assembly into the device, bolt it into place and plug it into the wiring harness.
e. With the mechanism in the reset position, check the gap between the trip coil armature and the trip lever extending from the trip shaft. This gap should be between ¼” and ⁵/₁₆”. If necessary, bend the trip lever slightly to achieve this setting.
f. Close and trip the grounding switch electrically several times to ensure that the coil is working properly.
g. Replace the upper front cover.

6) Control Relay

The control relay is mounted on the left side of the mechanism on the lower front cover (Figure 3, e).

![CAUTION]

Ensure that the control circuits are deenergized and the ground and test device is deenergized, disconnected by means of a visible break, and securely grounded. Do NOT start to work on a closed ground and test device or a ground and test device with the main closing spring charged.

Perform these steps to replace the control relay:

a. Remove the upper portion of the ground and test device front cover.
b. Disconnect leads from the control relay, being careful to note which wires go to which terminals.
c. Loosen lower mounting screw of relay.
d. Remove upper mounting screw and lift relay off lower screw.
e. Place new relay over lower screw, reinstall upper screw, and tighten both screws.
f. Reconnect all wires to the proper terminals of the relay.
g. Close the grounding switch electrically
several times to ensure that the relay is working properly.

h. Replace the upper front cover.

7) **Latch Check Switch**

The latch check switch is located on the right side of the mechanism near the rear (Figure 26, a).

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**CAUTION**

Ensure that the control circuits are deenergized and the ground and test device is deenergized, disconnected by means of a visible break, and securely grounded. Do NOT start to work on a closed ground and test device or a ground and test device with the main closing spring charged.

Perform these steps to replace the latch check switch:

a. Remove the upper portion of the ground and test device front cover.

b. Remove two screw holding switch to mechanism. Do not lose nut plate into which these screws are threaded.

c. Disconnect wires from switch.

d. Connect wires to new switch and fasten switch in place with screws and nut plate previously removed.

e. Adjust switch per instructions in **Ch 6 Maintenance, B. MECHANISM AREA, 3) Mechanism Adjustments, b. Adjustment of Primary and Secondary Trip Latches and Latch Check Switch** in this instruction bulletin.

f. Close the grounding switch electrically several times to ensure that the mechanism is working properly.

g. Replace the upper front cover.

8) **Trip Paddle Interlock Switch**

The trip paddle interlock switch is located on the right side of the mechanism just above the floor pan (Figure 26, d). It is accessible from the rear of the ground and test device.

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**CAUTION**

Perform these steps to replace the trip paddle interlock switch:

a. Remove two screws holding switch to mechanism. Do not lose nut plate into which these screws are threaded.

b. Disconnect wires from switch.

c. Connect wires to new switch and fasten switch in place with screws and nut plate previously removed.

d. Adjust switch so that its contact is closed when the trip paddle is in its normal position (fully forward) and is open when the trip paddle is depressed far enough to get a padlock in front of the trip paddle and into the hole in the trip paddle interlock bracket. This may require bending the arm of the switch.

e. Check to be sure the mechanism will not charge when the trip paddle is padlocked in the depressed position.

f. Replace the upper front cover.
9) Motor Cutoff Switch Assembly

The motor cutoff switch assembly is located in the lower left of the ground and test device, just behind the lower front cover (Figure 4, c).

⚠️ CAUTION

Ensure that the control circuits are deenergized and the ground and test device is deenergized, disconnected by means of a visible break, and securely grounded. Do NOT start to work on a closed ground and test device or a ground and test device with the main closing spring charged.

Perform these steps to replace the motor cutoff switch:

a. Remove the upper portion of ground and test device front cover.
b. Disconnect leads from switch, being careful to note which wires came from which terminals.
c. Remove the two bolts holding the switch mounting bracket to the lower front cover and remove the assembly.
d. Install new motor cutoff switch assembly, bolt it to the front cover and reconnect the wiring harness.
e. Close the grounding switch electrically several times to ensure that the mechanism operates smoothly.
f. Replace the upper front cover.

10) Auxiliary Switch

The auxiliary switch is located on the left hand side panel of the ground and test device (Figure 3, c).

⚠️ CAUTION

Ensure that the control circuits are deenergized and the ground and test device is deenergized, disconnected by means of a visible break, and securely grounded. Do NOT start to work on a closed ground and test device or a ground and test device with the main closing spring charged.

Perform these steps to replace the auxiliary switch:

a. Remove the upper portion of the ground and test device front cover.
b. Remove two screws holding switch to the side panel. Do not lose nut plate into which these screws are threaded.
c. Disconnect leads, being careful to note which leads are connected to which terminals.
d. Reconnect all leads to proper terminals of new switch.
e. Locate new switch on side panel and reinstall two mounting screws. Do not tighten screws.
f. Adjust by rotating the switch about the lower mounting hole. The upper hole is enlarged to allow rotation. The switch is properly adjusted when there is continuity between the terminals marked “Common” and “Normally Open” with the ground and test device in the open position. Check both switches that make up the assembly. It may be required to bend the arm on one or the other of the switches in order to accomplish this adjustment.
g. Close the grounding switch electrically several times to ensure that the auxiliary switch operates smoothly.
h. Replace the upper front cover.

11) Primary Contact Spring Assembly

These springs are located at the outer end of the primary contact stabs (Figure 2a, f).

![CAUTION]

Ensure that the control circuits are deenergized and the ground and test device is deenergized, disconnected by means of a visible break, and securely grounded. Do NOT start to work on a closed ground and test device or a ground and test device with the main closing spring charged.

Perform these steps to replace the primary contact spring assembly:

a. Depress spring support sufficiently to allow keeper to be removed.
b. Remove slotted washer, spring support, and spring.
c. Slide new spring onto spring support and place spring support in slot between fingers.
d. Place slotted washer over spring support on other side of spring from fingers.
e. Depress head of spring support and install keeper in end of spring support.
f. Release spring slowly, allowing keeper to seat properly.

Note: Springs are to be installed in every other slot in fingers; top, center, and bottom. The second and fourth slots are empty.

12) Ground Shoe Finger Assembly

The ground shoe assembly is located at the rear edge of the ground and test device floor pan, between the center and right poles (Figure 2a, g).

![CAUTION]

Ensure that the control circuits are deenergized and the ground and test device is deenergized, disconnected by means of a visible break, and securely grounded. Do NOT start to work on a closed ground and test device or a ground and test device with the main closing spring charged.

Perform these steps to replace the ground shoe finger assembly:

a. Elevate the ground ant test device so that there is at least 6” of clear space below the bottom pan of the device.
b. Remove the bolts holding the two ground shoe mounting brackets to the ground bar, and remove the two brackets.
c. Press down on finger assembly and remove it from the bottom of the ground and test device.
d. Remove four socket head screws holding two side finger assemblies to two red spacer tubes.
e. Assemble new side finger assemblies to red spacer tubes.
f. Wipe old lubricant off ground bars on ground and test device and apply a thin coat of contact lubricant B - Grease to ground bars.
g. Insert new finger assembly from below the floor pan and press up until the upper lobe of the fingers snaps into place on the ground bus.
h. Reinstall the two mounting brackets.
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PowlVac® Electrically Operated
Ground & Test Device

5kV & 15kV, 50kA
per ConEd Specification EO-2022-15
for ConEd CUSTOMER

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