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Three-Phase, Pad-Mounted Distribution Transformers

for Underground Service

Introduction

The equipment covered by these instructions should be operated and serviced only by competent technicians familiar with good safety practices. These instructions are written for such personnel and are not intended as a substitute for adequate training and experience in safe operating procedures for this type of equipment.

The pad-mounted transformer is designed for underground service and for outdoor mounting on a concrete pad. It is the responsibility of the installer and user to ensure that the interface between the pad and transformer, including the cable compartment, is properly sealed so that foreign objects can not be inserted inside the cable compartment. The primary and secondary cables enter the transformer from below, through openings in the concrete pad.

The pad-mounted transformer is furnished with separate high- and low-voltage compartments equipped with hinged doors. The high-voltage compartment is not accessible until the low-voltage compartment door is opened. The low-voltage compartment door has a provision for a user-installed padlock. All live parts are completely enclosed in locked compartments with adequate baffling for safety. A hood over the tank handhold, accessible through the cabinet, provides protection against tampering and the environment.

GEI–79025M

WARNINGS, CAUTIONS, AND NOTES AS USED IN THIS PUBLICATION

WARNINGS

Warning notices are used in this publication to emphasize that hazardous voltages, currents, or other conditions that could cause personal injury or death are present in this equipment or may be associated with its use.

Warning notices are also used for situations in which inattention or lack of equipment knowledge could cause either personal injury or damage to equipment.

CAUTIONS

Caution notices are used for situations in which equipment might be damaged if care is not taken.

NOTES

Notes call attention to information that is especially significant to understanding and operating the equipment.

This document is based on information available at the time of its publication. While efforts have been made to ensure accuracy, the information contained herein does not cover all details or variations in hardware and software, nor does it provide for every possible contingency in connection with installation, operation, and maintenance. Features may be described herein that are not present in all hardware and software systems. GE Industrial Systems assumes no obligation of notice to holders of this document with respect to changes subsequently made.

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The following warning notes apply to the operation of this equipment. Failure to comply with these warnings may result in serious personal injury or damage to the equipment.

Tank Ground

 ***WARNING:*** The first electrical connection made must be to ground the transformer tank. This connection is made from the tank ground pad to a permanent low-impedance ground. The tank ground must also be connected to the system ground. Failure to comply may result in serious personal injury or damage to the equipment.

External Electrical Connections

 ***WARNING:*** Make only the connections and operate only at the voltages authorized by the diagrams and information on the transformer name plate. The available transformer neutrals should be connected to the system neutrals. Each lead and connection not in use should be insulated from ground and from all other leads and connections. Failure to comply may result in serious personal injury or damage to the equipment.

Tap Changer

 ***WARNING:*** The tap changer must not be operated while the transformer is energized. Failure to comply may result in serious personal injury or damage to the equipment.

Dual-Voltage Switch

 ***WARNING*:** The dual-voltage switch must not be operated while the transformer is energized. Check the name plate and the switch position for the correct voltage before placing the unit in service. Failure to comply may result in serious personal injury or damage to the equipment.

Low-Voltage Circuit Breaker

 ***CAUTION:*** With the secondary circuit breaker open there may be sufficient coupling to the windings for a shock hazard to exist at the secondary terminals. Ground the open secondary terminals before working on the secondary service.

Lifting

 ***WARNING:*** Use all the lifting lugs when lifting the transformer. Use proper spreaders to obtain a vertical lift. Do not use the radiators for lifting or jacking. Failure to comply may result in serious personal injury or damage to the equipment.

Venting

 ***WARNING:*** Always release any possible pressure in the tank by carefully venting the pressure-relief valve before attempting to remove handhole covers or similar covers, including relief diaphragms and shipping covers (when used). Failure to comply may result in serious personal injury or damage to the equipment.

Bayonet Fusing

 ***CAUTION:*** Read the instructions supplied with the bayonet cutout before operating.

Dry-Well Nonloadbreak Fuse Holder

 ***WARNING:*** Deenergize transformer before removing or installing fuse holder cap assembly. Failure to comply may result in serious personal injury or damage to the equipment.

Dry-Well Loadbreak Fuse Holder

 ***WARNING:*** Do not exceed the fuse holder rating. Failure to comply may result in serious personal injury or damage to the equipment.

Oil Level

WARNING: Oil must be at the proper level before voltage is applied to the transformer. Failure to comply may result in serious personal injury or damage to the equipment.

Internal Fuses

WARNING: Deenergize the transformer before attempting to remove internal fuses. Failure to comply may result in serious personal injury or damage to the equipment.

Air Switches

WARNING: The fuse or switch may be energized in the OPEN position. Read the switch manufacturer's instructions before operating. Failure to comply may result in serious personal injury or damage to the equipment.

S&C Air Switch

WARNING: Use the S&C Loadbuster tool to operate the switch or fused disconnect. Failure to comply may result in serious personal injury or damage to the equipment.

Internal Loadbreak Switches

WARNING: These switches are designed to interrupt load current only. They are not suitable for interrupting fault currents. Do note exceed the switch rating. Failure to comply may result in serious personal injury or damage to the equipment.

Mounting Pad

WARNING: There must be no gaps between the cabinet and the pad, otherwise the tamper resistance of the transformer is compromised. Failure to comply may result in serious personal injury or damage to the equipment.

Bushings

CAUTION: Remove all dirt and foreign material from all bushings before placing the unit in service. Follow manufacturer's instructions for installing separable-insulated high-voltage connectors. Do not operate beyond the manufacturer's rating.

2–1 Receiving

Immediately upon receipt of the equipment, and before putting it into service, inspect the transformer for any damage that may have occurred during shipment or storage. If rough handling is evident, file a damage claim with the transport company immediately and notify the nearest General Electric Sales Office promptly. Tighten any parts that may have loosened during shipment.

2–2 Handling

WARNING: Use all the lifting lugs when lifting the transformer. Use proper spreaders to obtain a vertical lift. Do not use the radiators for lifting or jacking. Failure to comply may result in serious personal injury or damage to the equipment.

Lifting lugs are provided for lifting the complete transformer. Jacking space is provided in the base of the transformer to facilitate lifting with jacks. The transformer must never be moved or lifted by placing jacks or tackle on the radiators, the high-voltage and low-voltage compartments, or other attachments. When using a fork lift to move the transformer, lift from the tank rear with the shipping skid in place.

2–3 Storage

Transformers should be stored with the tank sealed and filled with oil to the proper level. Compartment doors should be closed to prevent damage to bushings and accessories. The storage area should be a flat, dry surface and the transformer should be protected from mechanical damage.

3–1 Foundation

WARNING: There must be no gaps between the cabinet and the pad, otherwise the tamper resistance of the transformer is compromised. Failure to comply may result in serious personal injury or damage to the equipment.

The foundation necessary for the installation of a pad-mounted distribution transformer should have footings deep enough to prevent settling and heaving in areas where the ground freezes. The surface of the concrete pad should be level to ensure that there are no gaps between the compartment and the concrete pad.

Brackets are provided on the transformer base for bolting the transformer to the pad. Carefully lower the transformer to the pad with the unit level to avoid damage to the cabinet.

3–2 Inspection

The transformer covered by this instruction is shipped ready for installation and will not require drying unless moisture has been allowed to accidentally enter during transit. It has been filled with oil at the factory to the 25° C liquid level and sealed. Check the level by one of the following methods:

- Read the liquid level gauge.
- Vent the pressure-relief valve and then carefully remove the pipe plug located in the low-voltage compartment for this purpose. Reseal after use.

WARNING: Oil must be at the proper level before voltage is applied to the transformer. Failure to comply may result in serious personal injury or damage to the equipment.

3–3 External Electrical Connections

WARNING: The first electrical connection made must be to ground the transformer tank. This connection is made from the tank ground pad to a permanent low-impedance ground. The tank ground must also be connected to the system ground. Failure to comply may result in serious personal injury or damage to the equipment.

WARNING: Make only the connections and operate only at the voltages authorized by the diagrams and information on the transformer name plate. The available transformer neutrals should be connected to the system neutrals. Each lead and connection not in use should be insulated from ground and from all other leads and connections. Failure to comply may result in serious personal injury or damage to the equipment.

Line connections must be made so that no undue strain is placed on the bushings. Refer to Table 1 for recommended minimum electrical clearances.

3–4 Cabinet Closing

Before leaving the unit, close the cabinet and lock it with the user-installed padlock provision and any other auxiliary locking means that may be supplied. The padlock shackle should provide a snug fit in its opening.

Rated Line–Line kV (max)	Bil kV	Test kV	Clearance Line–Ground (in.)	Clearance Line–Line (in.)	Barrier* Thickness (max in.)
1.2	30	10	1.24	1.24	none
5	60	19	2.00 2.50	2.50 3.00	0.156 none
8.6	75	26	3.20 3.50	3.50 4.00	0.156 none
15.5	95	34	3.20 5.00	4.00 5.50	0.156 none
25	125	40	4.20 5.70	4.70 6.00	0.156 none
35	125	40	5.50 7.00	6.50 7.50	0.188 none
25 or 35	150	50	9.00 7.50	10.00 8.50	none 0.250

* Barrier must be high-quality nonhygroscopic and track-resistant material.

Table 1. Recommended electrical clearances.

The transformer should be vented to the atmosphere before it is placed in service if it has been pressurized for leak tests or storage.

WARNING: Always release any pressure in the tank by carefully venting the pressure-relief valve before attempting to remove handhole covers or similar covers, including relief diaphragms and shipping covers (when used). Failure to comply may result in serious personal injury.

4–1 Operation above 3000 Feet

If a transformer is to be operated at 3000 feet or higher above sea level, the internal and external pressures must be equalized before the transformer is put into operation. To equalize pressures, carefully open the pressure-relief valve at approximately 25° C. Release the valve immediately.

Refer to ANSI C57.12.00.4 for information on how elevations above 3000 feet affect transformer ratings.

5–1 Service Conditions

Table 2 is a list of the normal operating conditions for the transformers covered by this guide. Refer to ANSI C57.12.00.4 for detailed information on operation in different service conditions.

Parameter	Operating Range
Weather temperature	–20° to 40 ° C
Maximum daily average temperature	35° C
Elevation	1000 m and below
Humidity	Daily average not to exceed 95%
Gage pressure	7 psig

Table 2. Operating conditions.

5–2 Load Operation

For continuous loading in standard ambient temperature, the total balanced load on a transformer should not exceed the name plate rating. Prolonged overloading may result in shortened transformer life (see ANSI C57.91). Voltage should be applied only to transformers filled to the correct level with insulating liquid.

5–3 Low-Voltage Accessories

Current Transformer

General Electric Type JAB-0 and JKY-0 current transformers are designed to fit the low-voltage bushings. Other styles and potential transformers are available for mounting inside the low-voltage compartment.

Thermometers (1/2 NPT)

A dial-type thermometer accessory, when supplied, is located under oil in the low-voltage compartment. The thermometer dial, shown in Figure 1, reads from 0–160° C.

Liquid-Level Gage

A liquid-level gage accessory, when supplied, is located in the low-voltage compartment. The gage dial, shown in Figure 2, reads over the range LO–25 C–HI.

Figure 1. Thermometer accessory.

Figure 2. Liquid-level gage accessory.

Pressure Vacuum Gage (1/4 NPT)

A pressure gage accessory, when supplied, is located in the low-voltage compartment above the bushings in the air space. The gage dial, shown in Figure 3, reads from –10 psig to +10 psig.

Figure 3. Pressure vacuum gage accessory.

Pressure-Relief Device (1/4 NPT)

The pressure-relief device is located in the low-voltage compartment near the top of the tank. The automatic pressure-relief device relieves excessive internal tank pressure in the tank air space. The device opens at 8–12 psig and reseals at a positive pressure.

Low-Voltage Molded-Case Circuit Breakers

General Electric molded-case circuit breakers, when supplied, are located in the low-voltage compartment. Contact the nearest GE Sales Office for application data.

5–4 High-Voltage Accessories

Internal Oil-Immersed Fuses

A pad-mounted transformer may be provided with internal fuses in series with the high-voltage winding. Their function is to remove the transformer from the line in case of an internal failure. When supplied with a low-voltage circuit breaker, the fuse will carry high-voltage circuit currents in excess of those allowed by the breaker.

Access to the fuses is provided by a handhole in the transformer cover.

WARNING: Deenergize the transformer before attempting to remove internal fuses. Failure to comply may result in severe personal injury or death.

Bayonet Oil-Fused Cutout

CAUTION: Read the instructions supplied with the bayonet cutout before operating.

Within the rating of this device, the transformer may be equipped with bayonet oil-fused cutouts, shown in Figure 4, to provide a load-break function. The oil-immersed expulsion fuses are externally replaceable. The fault-sensing fuse protects the line from transformer faults.

Figure 4. Bayonet fuses.

The load-sensing fuse provides secondary overload protection. The cutout is not recommended for closing on faults.

To replace a bayonet fuse, use the following procedure:

CAUTION: Use a hot stick to remove bayonet cutouts.

WARNING: Deenergize the transformer before attempting to remove internal fuses. Failure to comply may result in severe personal injury or death.

1. Vent the transformer to equalize the pressure with the supplied pressure-relief valve. Release the valve when the tank pressure is equalized.
2. Open the latch.
3. Rotate the cutout one-quarter turn.
4. Press down firmly to break the gasket seal.
5. Withdraw the cutout quickly and uniformly.

Instructions for replacing the bayonet fuse are packed with each replacement fuse or may be obtained from the fuse manufacturer.

Nonloadbreak Dry-Well, Current-Limiting Fuseholder

WARNING: Deenergize the transformer before attempting to remove or install a fuseholder cap assembly. Failure to comply may result in severe personal injury or death.

This accessory combines the high interrupting capability of general-purpose, full-range current-limiting fuses with dry-well fuseholders. These fuseholders are operable with a hot stick. The nonloadbreaking fuseholder assembly has an integral warning notice and an interlocked safety baffle, shown in Figure 5, to prevent removal of the fuse while the transformer is energized.

Nonloadbreaking fuseholders are mechanically interlocked with a loadbreak switch; be careful not to defeat this arrangement. When the transformer is deenergized by operation of the loadbreak switch, the safety baffle can be moved, permitting access to the fuses, as shown in Figure 6.

Nonloadbreaking fuseholders are available with maximum voltage ratings of 8.3 kV, 15.2 kV, and 21.1 kV and with impulse withstands of 95-kV BIL, 125-kV BIL, and 150 kV-BIL. Table 3 lists the complete ratings.

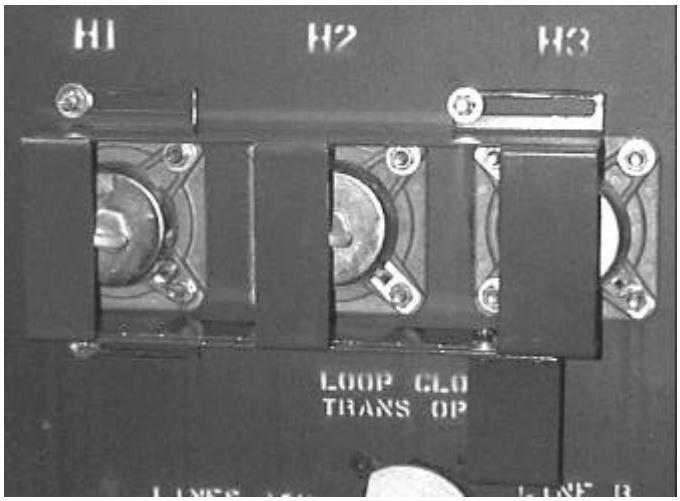

Figure 5. Safety baffle over the fuses.

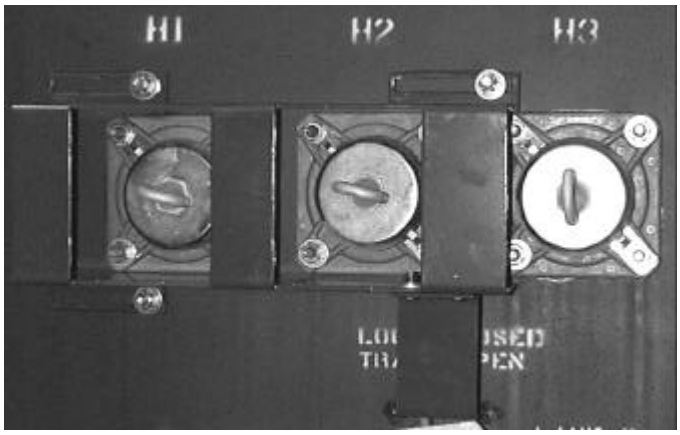

Figure 6. Safety baffle moved from over the fuses.

Maximum Voltage Rating, kV	8.3	15.2	21.1	21.1
BIL, kV	95	125	125	150
HIPOT, kV	34	40	50	50
Corona Extinction, kV	11	19	26	26
Continuous Current Rating, A (unfused)	160	160	160	160
Momentary Current Rating, A RMS symm. 10 cycles (unfused)	10,000	10,000	10,000	10,000
Acceptable Fuses* (must be ordered separately)	2.8 and 4.3 kV all sizes to 100 A; 5.5 kV all sizes to 75 A; 8.3 kV all sizes to 40 A	15.5 kV all sizes to 40 A	23 kV all sizes to 25 A	23 kV all sizes to 25 A

* GE Sureguard™ GP or Cooper Power Systems NX®

Table 3. Nonloadbreak fuseholder ratings.

Nonloadbreak Fuse Replacement

> ***WARNING:*** Deenergize the transformer before attempting to remove or install a fuseholder cap assembly. Failure to comply may result in severe personal injury or death.

To replace a fuse, use the following procedure:

1. ***Deenergize the transformer.*** Open the loadbreak switch to deenergize the transformer and allow the safety baffle to be released for access to the fuseholders, as shown in Figure 6.
2. Remove the draw-out assembly using a hot stick and the pulling eye on the cap assembly, as shown in Figure 7. Carefully withdraw the assembly to avoid damaging the contacts.
3. Replace the blown fuse with a fuse of the same rating. To replace the fuse, loosen the two set screws on the draw-out rod assembly and the two set screws on the contact assembly. Remove the fuse and install the new fuse. Tighten the two set screws on the contact assembly and the set screws on the draw-out rod assembly. Figure 8 shows the locations of the parts.
4. Replace the draw-out fuseholder assembly in the fuseholder tube, taking care to not damage the contents. Seat the assembly firmly within the fuseholder tube. Avoid the introduction of foreign matter into the fuse holder tube.
5. Move the safety baffle to cover the pulling eyes and engage the loadbreak switch to energize the transformer and interlock the baffle.

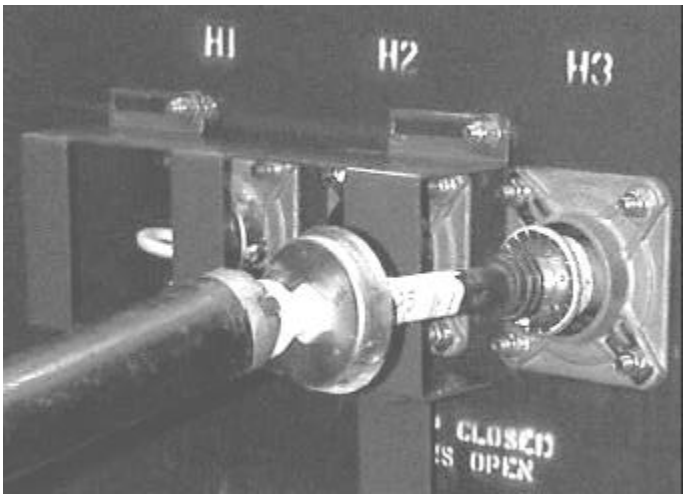

Figure 7. Fuse removal with a hot stick.

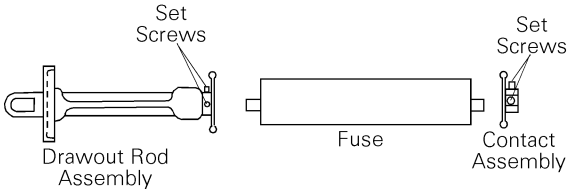

Figure 8. Nonloadbreak fuse replacement.

Loadbreak Dry-Well Fuseholder

> ***WARNING:*** Do not exceed the fuseholder rating. Failure to comply may result in serious personal injury or damage to the equipment.

This fuseholder is similar to the nonloadbreak model, with the addition of a loadbreak switching device. The switching device uses the rod and bore principle to accomplish loadbreak within the fuseholder.

Available ratings are 8.3 kV at 95 kV BIL and 15.2-kV at 125-kV BIL. Table 4 lists the complete ratings.

Loadbreak Fuse Replacement

Figure 9 shows loadbreak fuses. The details of the parts involved are illustrated in Figure 10.

Removal – Attach a hot stick to the pulling eye. Rapidly withdraw the draw-out assembly from the fuseholder housing.

Installation – With the fuse assembly attached to the hot stick, insert the draw-out assembly until the contact spring has just entered the fuse housing. Rapidly push the draw-out assembly into the housing until the cap is seated in the spring clips.

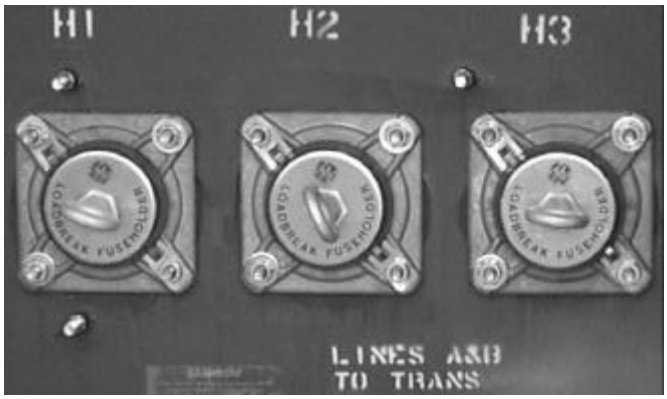

Figure 9. Loadbreak fuses.

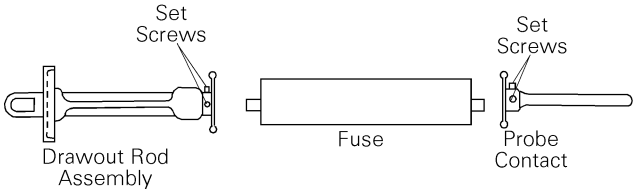

Figure 10. Loadbreak dry-well fuse replacement.

Oil-Submersible Protector

The oil-submersible protector (OSP) is a partial-range current-limiting fuse that is used in series with an expulsion fuse to provide full-range protection. The OSP is designed to clear high-current faults (up to 50,000 A symmetrical), while the expulsion link clears low-current faults. These fuses are located under oil beneath the transformer handhold. Either internal expulsion fuses or bayonet fuses are available as the series expulsion fuse.

The bayonet or internal expulsion fuse is available for replacement. Refer to the sections *Internal Oil-Immersed Fuses* and *Bayonet Oil-Fused Cutout* for instructions. Replacement of the OSP fuse requires removal of the main tank cover. Refer to the nearest GE-approved service shop for this type of repair.

Maximum Voltage Rating, kV	8.3	15.2**
BIL, kV	95	125
HIPOT, kV	34	40
Corona Extinction, kV	11	19
Continuous Current Rating, A (unfused)	160	160
Momentary Current Rating, A RMS sym 10 cycles (unfused)	10,000	10,000
Acceptable Fuses* (must be ordered separately)	2.8 and 4.3 kV all sizes to 100 A; 5.5 k V all sizes to 75 A; 8.3 kV all sizes to 40 A	15.5 kV all sizes to 40 A
Load Make and Break Rating, Three-Phase	20 operations at 100 A (8.3 kV L–G, 14.4 kV L–L)	20 operations at 100 A (15 kV L–L)
Fault Close In, A RMS sym (fused)	10,000	10,000

* GE Sureguard™ GP or Cooper Power Systems NX®.

** Fuseholder may be applied as a loadbreak device in three-phase applications where the line–line voltage will not exceed 15 kV.

Table 4. Loadbreak dry-well fuseholder ratings.

External Surge Arresters

CAUTION: If induced-voltage tests are made on a transformer with arresters, the arresters must be disconnected during the test and reconnected after the test is completed. Surge arresters should also be disconnected before cables are hi-potted or tested with high-current dc.

Specific recommendations for arrester applications may be obtained from the nearest GE Sales Office. When provided, arresters are mounted in the high-voltage compartment.

Arrester and tank-ground connections should be completed before the high-voltage line is connected. With the low-voltage neutral and the high-voltage arresters connected to the tank and ground, the arresters are placed in direct shunt relation to the transformer insulation, thus giving the most effective protection.

5–5 High-Voltage Bushings

CAUTION: Remove all dirt and foreign material from all bushings before placing the unit in service. Follow the manufacturer's instructions for installing separable insulated voltage connectors. Do not operate beyond the manufacturer's ratings.

Porcelain Bushing Construction (ANSI C57.12.22)

The standard high-voltage bushing is made of porcelain and is provided with a clamp-type terminal up through 500 kVA, as shown in Figure 11, and a three-hole blade above 500 kVA, as shown in Figure 12.

The clamp-type terminals accommodate cables from #8 through 2/0. The high-voltage terminals are oriented for vertical take-off of primary cables entering the compartment from below.

Figure 11. Clamp-type live-front porcelain high-voltage bushing.

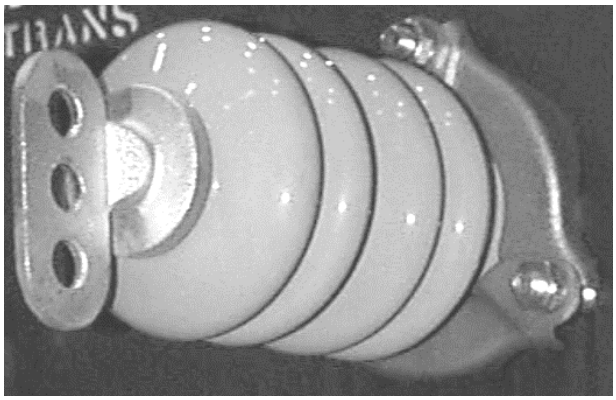

Figure 12. Blade-type live-front porcelain high-voltage bushing.

Separable Insulated Connectors (ANSI C57.12.26)

Separable insulated connector components may be universal bushing wells, integrated bushings, or bushing wells with inserts (switch modules) installed. See Figure 13 for typical bushing arrangements.

All separable connector components must be dry and clear of any contaminants before connections are made. Unused terminals must be capped before the unit is energized.

The separable insulated connectors may be either live-break or dead-break. Follow the manufacturer's instructions and warnings on the use of these terminations.

Figure 13. Separable insulated connectors (typical arrangement)..

WARNING: Read the manufacturer's instructions before installing separable insulated connectors. Do not operate beyond the manufacturer's rating. Failure to comply may result in serious personal injury or damage to the equipment.

5–6 Tap Changer Operation

The tap changer operating handle, shown in Figure 14, is generally located in the high-voltage compartment. The operating handle can be operated by hand or hot stick. A locking screw and/or padlock provision prevent inadvertent operation of the switch. The tap changer is shipped connected for the rated name plate voltage.

WARNING: Deenergize the transformer before operating the tap changer. Failure to comply may result in serious personal injury, death, or damage to the equipment.

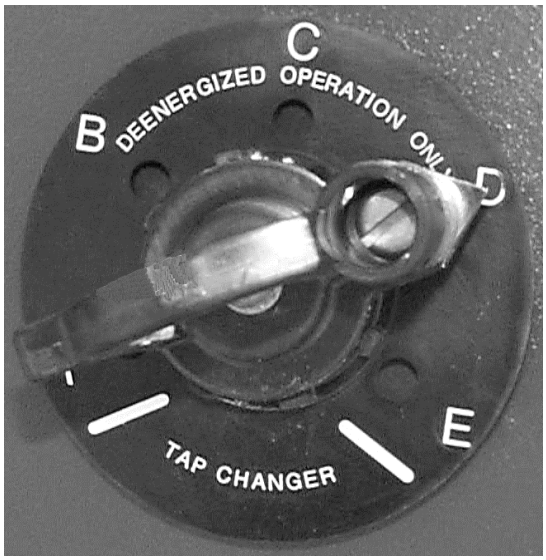

Figure 14. Tap changer.

To change taps, use the following procedure:

1. ***Deenergize the transformer***.
2. Open the high-voltage compartment.
3. See the name plate for the proper voltage adjustment.
4. Back out the locking screw.
5. Using a hot stick or hand, pull out the spring-loaded handle, turning it to the desired position.
6. Allow the pointer to drop into the slotted index plate, between the corresponding alphabetic sections on the index plate.
7. Engage the locking screw.
8. If padlock security is required, place a padlock through the operating handle.

5–7 Dual-Voltage Switch

> ***WARNING:*** Deenergize the transformer before operating the dual-voltage switch. Check the name plate and switch position for the correct voltage before placing the unit in service. Failure to comply may result in serious personal injury, death, or damage to the equipment.

The dual-voltage switch accessory, when supplied, has an external operating control generally located in the high-voltage compartment. The control handle can be padlocked, is operated with a hot stick, and is spring loaded, providing a positive indication of voltage switching. Two positions are marked 1 and 2, with the corresponding high-voltage values.

To operate the dual-voltage switch, shown in Figure 15, use the following procedure:

1. ***Deenergize the transformer***.
2. Open the high-voltage compartment.
3. See the name plate for the proper voltage adjustment.
4. Back out the locking screw.
5. Using a hot stick or hand, pull out the spring-loaded handle, turning it to the desired position.
6. Engage the locking screw.
7. If padlock security is required, place a padlock through the operating handle.

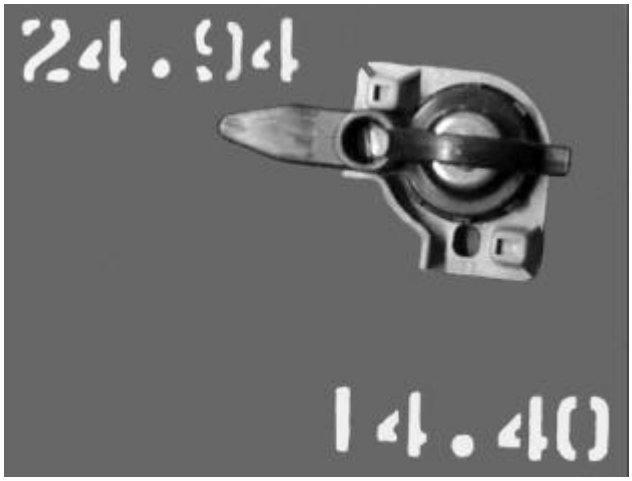

Figure 15. Dual-voltage switch.

When the pointer is in the 2 position, the primary coils are connected for operation at the series voltage of a series-multiple rated transformer or the wye voltage of a delta-wye rated transformer. When the pointer is in the 1 position, the primary coils are connected for operation at either the multiple or delta voltage. Unless otherwise specified, the dual-voltage switch is shipped in the 1 (multiple or delta) position.

5–8 Internal Loadbreak Switches

> ***WARNING:*** These switches are designed to interrupt load current only. They are not suitable for interrupting fault currents. Do not exceed the switch rating. Failure to comply may result in serious personal injury, death, or damage to the equipment.

> ***NOTE:*** Internal switching is not available with silicone fluid.

The internal loadbreak switch is a gang-operated and is located under oil. It is connected between the primary bushings and the transformer fuses and windings. This switch is designed for occasional load interruption and can be used to deenergize the transformer. The operating handles and the name plate indicating the switch positions are located in the high-voltage compartment. A 0.875-inch hole is provided in the control for operation with a hot stick. See Table 5 for rating and servicing information.

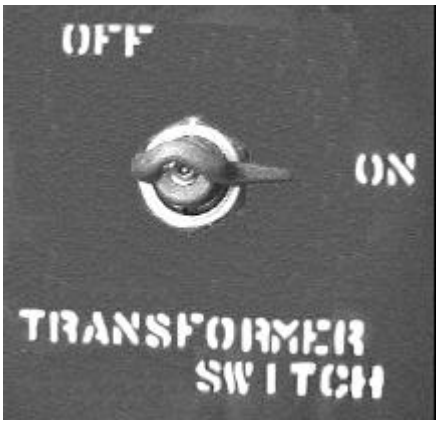

Figure 16. Radial-feed switch.

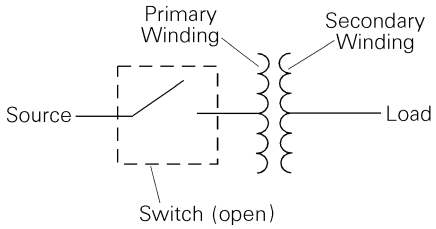

Figure 17. Schematic of the radial-feed switch.

Radial-Feed Switch

The radial-feed, two-position internal oil switch, shown in Figure 16, is a gang-operated loadbreak switch. It is operated by a hot stick and uses a manually charged overtoggle storage spring assembly that is independent of operator speed. The spring-loaded operating mechanism ensures quick load breaking and load making operation. It can be used to deenergize the transformer. The operating handle and name plate are located in the high-voltage compartment. Figure 17 is a schematic of this switch.

Loop-Feed Switches

The loop-feed switch arrangement, shown in Figure 18, consists of two two-position, gang-operated, internal oil switches. It may be used for sectionalizing and loop connections, such as selection of power sources in a loop-feed primary distribution system, isolating faulted cables or transformers, or isolating transformers for change out or maintenance. Six high-voltage bushings are furnished with a typical application. Three bushings are identified as A source and three as B source. Figure 19 is a schematic of this switch arrangement.

Parameter	Two-Position		T Blade	V Blade
Maximum Voltage, kV	38	15	25	35
BIL, kV	150	95	125	150
One-Minute Withstand, kV	70	34	40	50
Maximum Continuous and Loadbreak Current, A	300	600	300	200
Momentary and Fault Close, A RMS sym.	12,000	10,000	10,000	10,000
Momentary and Fault Close, A RMS asym.	19,000	10,000	10,000	10,000

Table 5. Internal loadbreak switch ratings.

Figure 18. Loop-feed switches.

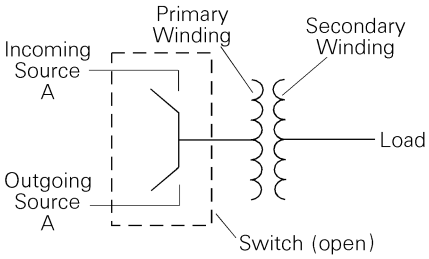

Figure 19. Schematic of the loop-feed switch.

The switch positions are as follows:

1. Both pointers CLOSED. This position permits loop feed for adjacent transformers with the transformer energized.
2. Left-hand pointer CLOSED, right-hand pointer OPEN. Only one side of the loop (A bushings) is connected to the transformer windings.
3. Left-hand pointer OPEN, right-hand pointer CLOSED. Only one side of the loop (B bushings) is connected to the transformer windings.
4. Both pointers OPEN. Both sides of the loop (A and B bushings) are disconnected, thus isolating and deenergizing the transformer windings from the loop-feed system.

Loop-Radial Switches

Two two-position loadbreak switches, shown in Figure 20, may be used to obtain a combination of the loop and radial switch functions. The combination consists of a transformer switch (line B) and a loop switch (line A). Figure 21 is the schematic for this arrangement.

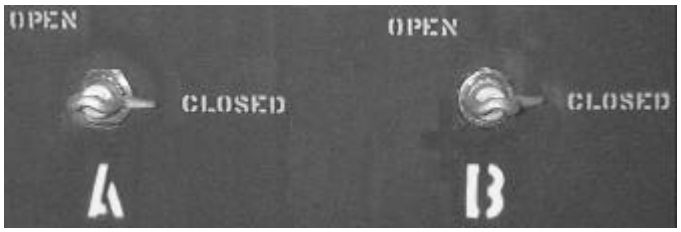

Figure 20. Loop-radial switches.

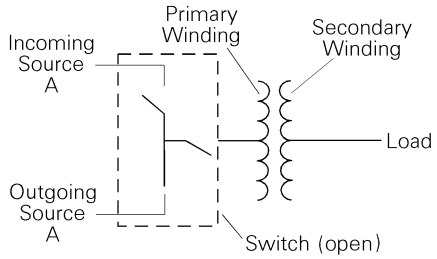

Figure 21. Schematic of the loop-radial switch.

The switch positions are as follows:

1. Both pointers CLOSED. The loop is closed by connecting line A to line B and the transformer is connected to the loop.
2. Left-hand pointer CLOSED, right-hand pointer OPEN. The transformer is disconnected from the loop and the loop is closed.
3. Left-hand OPEN, right-hand pointer CLOSED. The loop is open and the transformer is connected to source B.
4. Both pointers OPEN. The transformer is deenergized and the loop is open.

Interlocked Alternate-Source Switch

The alternate-source switch is used for the selection of either of two voltage sources to energize the transformer. An interlock on the switch handle allows the transformer to be energized from only one source at a time. Figure 22 is a schematic for this switch.

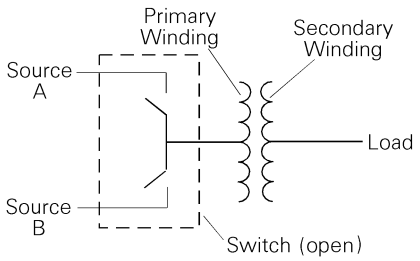

Figure 22. Schematic of the interlocked alternate-source switch.

Loop Switch with ON-OFF Radial Switch

This combination, shown in Figure 23, provides the functions of the loop and radial switches, allowing the transformer to be deenergized and either loop to be deenergized. Figure 24 is a schematic for this switch.

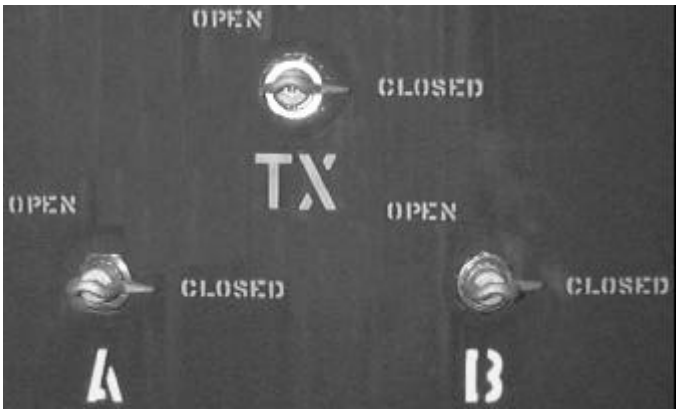

Figure 23. Loop switch with ON-OFF radial switch.

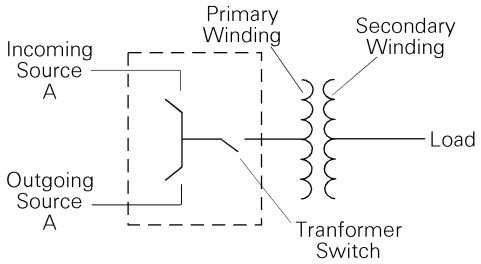

Figure 24. Schematic of the loop switch with ON-OFF radial switch.

T-Blade Sectionalizing Switch

The T-blade sectionalizing switch, shown in Figure 25, rotates 360° in either direction for alternate-source selection. It is operated with a hot stick. A spring-loaded mechanism ensures quick load breaking and positive contact engagement in all positions. Switching can be accomplished in one-third to one-half of a cycle, which minimizes power outages. The T-blade switch allows the loop to be energized while the transformer is deenergized. Figure 27 is a diagram of T-blade switch function.

NOTE: Internal switching is not available with silicone fluid.

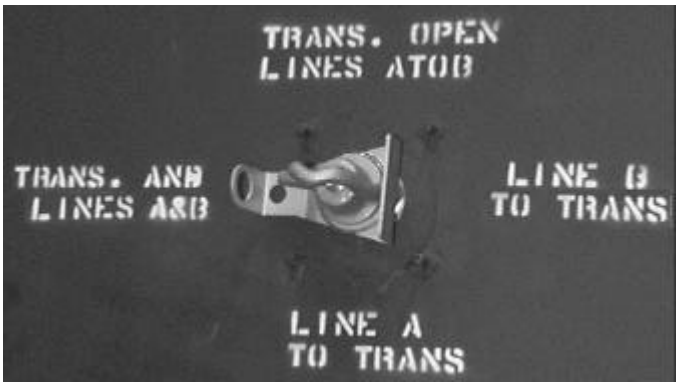

Figure 25. T-blade sectionalizing switch.

V-Blade Switch

The V-blade switch, shown in Figure 26, allows the loop and the transformer to be deenergized at the same time. Figure 28 is a diagram of V-blade switch function.

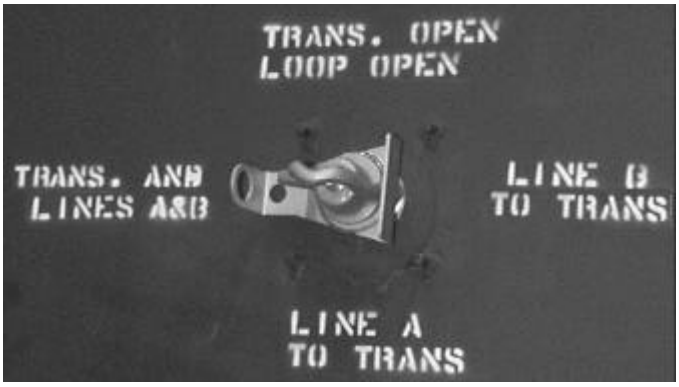

Figure 26. V-blade switch.

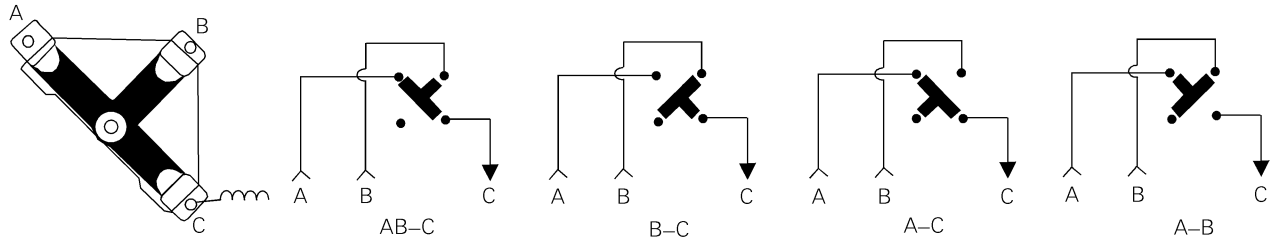

Figure 27. T-blade switch function.

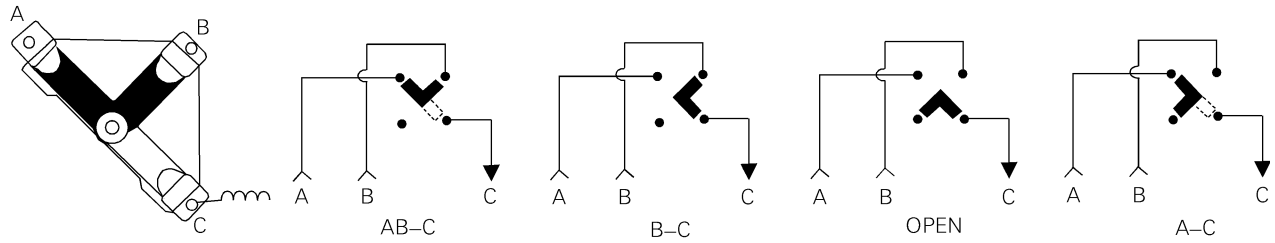

Figure 28. V-blade switch function.

Cooper Power Systems Arc Strangler® Switch

Transformers may be equipped with either radial or loop-feed Arc Strangler switches mounted in the high-voltage compartment. These switches are equipped with current-limiting fuses. The Arc Strangler must be cocked before a switch or fuse assembly can be closed. Follow the Cooper Power Systems instructions for operating these devices. The load-break function is provided by either fuses or blades.

S&C Pad-Mounted Gear

When S&C air switches or fused disconnects are used, follow the manufacturer's instructions for operation. When operated with the S&C loadbuster tool, these disconnects function as loadbreak switches.

WARNING: Use the S&C loadbuster tool to operate the switch or fused disconnect. Failure to comply may result in serious personal injury or death.

The transformer was thoroughly dried at the factory and filled with insulating oil to the correct level before shipping. Three-phase pad-mounted transformers are available with oil, R-TEMP®, and silicone insulating fluids. Oil is generally the standard choice for outdoor applications where flash and fire points are not an issue. For applications requiring less-flammable liquids, R-TEMP and silicone insulating fluids are generally specified. Internal switching is not available in GE silicone-filled transformers. R-TEMP is the standard choice when switching is required.

The approximate flash and fire points of the three choices of insulating fluids are listed in Table 6.

Parameter	Oil	R-TEMP®	Silicone
Flash Point, °C	149	284	300
Fire Point, °C	—	312	340

Table 6. Flash and fire points for choices of insulating fluids.

The correct level for the fluid at approximately 25° C is at the liquid-level plug or the 25° C mark on the liquid-level gauge. When it is necessary to add to or refill the tank, the work should be done in a clean, dry room. The transformer should be filled with the same type of insulating fluid as originally installed at the factory. A fill provision is located on the front plate in the low-voltage compartment and a drain is located in one of the compartments.

7–1 Internal Inspection

WARNING: Deenergize the transformer before attempting any internal inspection. Failure to comply may result in serious personal injury or death.

WARNING: Always release any pressure in the tank by carefully venting the pressure-relief valve before attempting to remove handhole covers or similar covers, including diaphragms and shipping covers (when used). Failure to comply may result in serious personal injury or death.

If the transformer must be opened for internal inspection or fuse replacement, take proper precautions to prevent the entrance of moisture and other foreign matter into the transformer. Remove the hood and clean off the tank cover.

For access, remove the handhole cover. Place the handhole gasket nuts and washers in storage for reuse. Examine the underside of the cover for signs of moisture. Look inside the transformer for blown fuses, broken leads, and loose parts. If fuses are blown, replace them. If any bushings are damaged, repair or replace them through the handhole, as described below.

If internal damage is suspected, the following procedure is recommended.

1. Remove the tank cover, lower the liquid to the top of the core, and carefully inspect the interior to note if any damage has occurred.
2. Take an oil sample from the bottom of the tank. If moisture is found inside the tank, arrangements should be made to dry the transformer.
3. After inspection and any repairs, refill the unit with dry insulating liquid to the 25° C level. Fill very slowly in a vacuum chamber. Hold a partial vacuum on the unit (up to –3 psig) for four hours after refilling. Do not use the tank as a vacuum chamber.
   a. If the unit cannot be filled under vacuum, fill it through the handhole, directing the flow of oil so that aeration of the liquid is prevented. For instance, direct a slow flow of the liquid against the upper tank wall.
   b. If a vacuum is not available, the unit should be allowed to sit for at least 24 hours before it is tested or energized.
   c. Tilt the unit during filling to prevent entrapment of air in the coils and insulation.

7–2 Bushing Maintenance

WARNING: Deenergize the transformer before attempting bushing maintenance. Failure to comply may result in serious personal injury or death.

Lower the liquid level before removing bushings. In most cases, the high-voltage bushings may be changed by removing the external clamp hardware and carefully pulling the bushing out. Access to the internal lead allows it to be disconnected. Replace the bushing and carefully insert it back in its hole on the tank.

Low-voltage bushings may be changed externally or through the main tank cover handhole. Where the leads are fastened internally with nuts, first loosen the 10-32 screws. Where split blocks are used, loosen the hardware in the block itself. Where neither of the above is used, the bushing may be replaced externally by removing the clamps and pulling the bushing out of its hole. The lead hardware may be removed and the bushing changed. Be sure to reinstall the hardware in the original sequence.

The gasket must be located so that it will seal properly and not be damaged during repair to the unit. The gasket and bushings may be reused if they are undamaged. After repairs have been completed, refill the unit with dry insulating liquid to the 25° C level.

7–3 External Finish Maintenance

The condition of the transformer finish should be examined at regular intervals. If the finish is weathered, clean it thoroughly and refinish with a good grade of durable paint, as recommended by GE.

Complete instructions for sampling, testing, and drying oil and drying transformers, along with operating data and recommendations, can be obtained upon request to the nearest GE Sales Office.

8–1 When You Need Service

If you need service on products manufactured by GE Industrial Systems, a world-wide service organization is ready to serve you. Warranty administration, site-testing services, installation, system studies, maintenance, trouble-shooting, site repairs, and training seminars are provided by GE and the GE Factory Authorized Service Team. Shop repairs, reconditioning, or rebuilding of electrical apparatus are provided by members of the GE Factory Authorized Service Team in their shop or on your premises. Contact your GE Sales Office or a Factory Authorized Service Team member for full information about these services.

8–2 Renewal Parts

Orders for renewal parts may be placed by describing the part and giving the rating and serial number appearing on the name plate of the transformer.

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