G&W ELECTRIC CO.

INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

PUFFER VACUUM INTERRUPTER

Linear Puffer

Vault and Pad mount Style

GWI 527-35
Rev. 5
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Supersedes
Rev. 4
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SECTION 1 INTRODUCTION

1.1 General

This document is intended to provide the user with necessary information to properly receive, inspect, test, install, operate and maintain G&W SF_6 switches. If after reviewing the information contained herein, you should have any questions, please contact your G&W representative or call our customer service number.

Read these Instructions	**Read and understand the contents of this document and follow all locally approved procedures and safety practices before installing, operating or maintaining this equipment. Be sure to read and understand the Safety Information in Section 2.**	
Keep these Instructions	**This document is a permanent part of your G&W switch. Keep it in a safe location where it can be readily available and referred to as necessary.**	
How to Contact G&W	**By Phone:**	**708-388-5010, Monday through Friday, 8:00 AM to 5:00 PM Central Time**
	By Fax:	**708-388-0755**
	E-Mail:	**webmail@gwelec.com**
	Mail:	**3500 W. 127th Street, Blue Island, Illinois 60406, USA**
	Internet:	**To find your local G&W Representative visit our Web site: www.gwelec.com**

1.2 Qualified Persons

⚠ WARNING

The equipment covered by this document is intended to be installed, operated and maintained by qualified persons who are trained in the installation, operation and maintenance of electric power distribution equipment along with the associated hazards. A qualified person has been trained and is competent:

- To de-energize, clear and tag circuits and equipment in accordance with established safety procedures.
- To distinguish between live parts from non-live parts of the equipment.
- In the proper use of insulated tools, wears protective equipment such as rubber gloves, hard hat, safety glasses, flash-clothes, etc. in accordance with established safety practices and is trained in the care of such equipment.
- As in certified in rendering first aid, especially in the technique of removing a person in contact with a live circuit and in applying cardiopulmonary respiration.

These instructions are intended only for qualified persons and are not intended as a substitute for adequate training and experience in safety procedures for this type of equipment.

1.3 Shipment Inspection

Examine the crated equipment carefully for any damage that may have occurred in transit. If damage is found, a claim must be filed at once with the transportation company. Uncrate and remove packing as soon as possible after receiving the equipment. Examine the equipment carefully for any hidden damage that may have occurred in transit and was previously undetected. If damage is found, a claim should be filed at once with the transportation company.

Check the pressure gauge and insure that the pressure corresponds to the values on the table located near the pressure gauge or in Table1, Section 6.2 of this instruction. If the pressure is below the recommended level, contact your G&W representative or contact G&W customer service before placing the equipment in service.

1.4 Storage

Switches that will not be installed immediately should be suitable stored in a clean, dry location. Possible replacement of crating material should be investigated. Make certain switches are protected from potential damage**.**

1.5 Switch Duty

Switch Module	Abbreviations	Load Break	Fault Interrupting
Rotary Puffer	RP, XRP, 3PRP	X	
Rotary Blade	MR	X	
Linear Puffer	PI	X	
Vacuum Interrupter	VI, FI, NI	X	X

1.6 Switch Type Identification

Switch Type	Load Break 2- Position	Load Break 3 - Position	Fault Interrupting
Pole Top	ORA		OVI
Vault / Subsurface	RA, VRA, RAM, VRAM, RP	GRA, GRAM, RAC, RAD, RAJ	VI,VPVI(1), FI, VPFI(1), VTVI(2), VTFI(2)
Pad Mount	PPI, SPRAM, LPRAM	GRAM	PVI(1), RPVI(1), PFI(1), GRPVI(2), GRPFI(2), PNI, TVI(2), TFI(2)

Notes: (1) has 2-Position load break source switch(es)
(2) has 3-Position load break source switch(es)

1.7 Standards

Some or all of these standards are applicable to this switch:

Type of Switch						
	Each switch is characterized by a "Type" (i.e. Pole Top, a Pad Mount or a Subsurface [Vault] switch) and a "Duty" (i.e. Load Break, Fault Interrupting or both Load Break and Fault Interrupting.) To determine which standards apply to your particular switch select those indicated with a X.	**POLE TOP**	**PAD MOUNT**	**SUBSURFACE**	**LOAD BREAK**	**FAULT INT.**
Standards						
ANSI C57.12.28 1996. Switchgear and Transformers, Padmounted Equipment, Enclosure Integrity.			X			
ANSI/IEEE 4 - 1995. Standard Techniques for High-Voltage Testing.					X	X
ANSI/IEEE 386 - 1995. Separable Insulated Connectors for Power Distribution Systems Above 600 V.		X	X	X	X	X
ANSI/IEEE 454 - latest revision. Recommended Practice for the Detection and Measurement of Partial Discharge (Corona) During Dielectric Tests.					X	
ANSI/IEEE C37.09 - 1979. Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.						X
ANSI/IEEE C37.60 - 1981. Automatic Circuit Reclosers and Fault Interrupters for Alternating Current Systems.						X
ANSI/IEEE C37.71 - 1984. Three phase, Manually Operated Subsurface Load Interrupting Switches for Alternating Current Systems.				X		
ANSI C37.72 - 1987. Manually Operated, Deadfront, Padmounted Switchgear with Load Interrupting Switches and Separable Connectors for Alternating Current Systems.			X			
ANSI C37.85 - 1989. Interrupters used in Power Switchgear, X-radiation Limits for AC High-Voltage Power Vacuum.						X
ANSI/IEEE C37.100 - 1992. Definitions for Power Switchgear		X	X	X	X	X
IEC 60265-1 1998. International Standard for High-Voltage Switches		X	X	X	X	

SECTION 2. SAFETY INFORMATION & PRECAUTIONS

2.1 Safety Alert Messages

The following is important safety information. For safe installation and operation, be sure to read and understand all danger, warning and caution information. The various types of safety alert messages are described below:

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

CAUTION - Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. May also be used to alert against unsafe practices.

2.2 Following Safety Instructions

Carefully read all safety messages in this manual and on your equipment. Keep safety signs in good condition. Replace missing or damaged safety signs.

Keep your equipment in proper working condition. Unauthorized modifications to the equipment may impair the function and/or safety and effect equipment life.

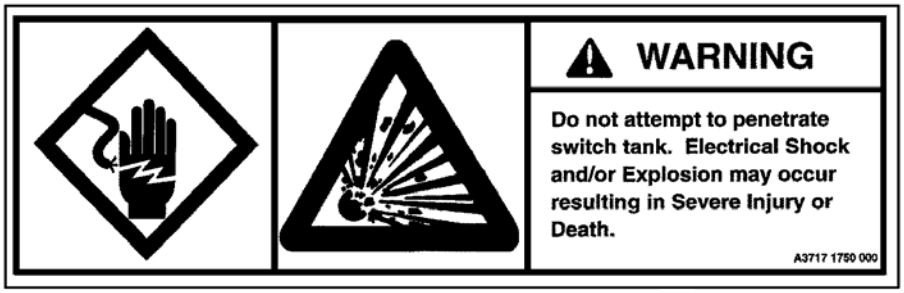
If you do not understand any part of these safety instructions and need assistance, contact your G&W representative or G&W Customer Service.

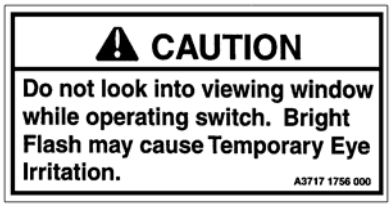
2.3 Replacement Instruction and Labels

Replacement instructions and safety labels are available from G&W. To obtain them, please contact Customer Service**.**

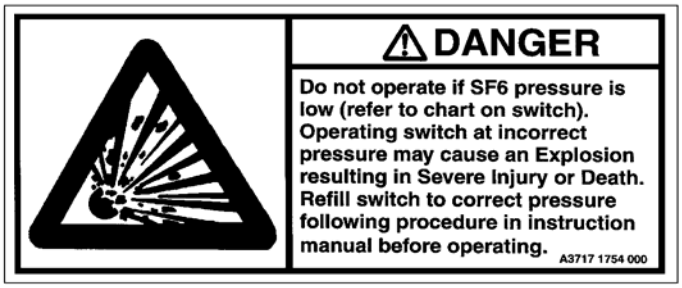
2.4 List and Location of Safety Labels

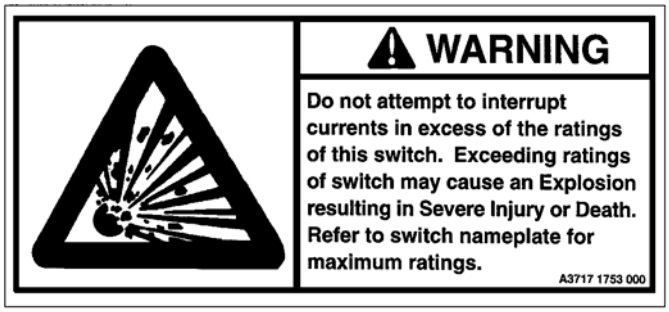
The following are typical safety labels which must be followed. Refer to customer drawing in Section 10.1 for approximate location of the labels on the switch. The drawings represent typical configurations and may vary.


WARNING
Do not attempt to penetrate switch tank. Electrical Shock and/or Explosion may occur resulting in Severe Injury or Death.
A3717 1750 000


CAUTION
Do not look into viewing window while operating switch. Bright Flash may cause Temporary Eye Irritation.
A3717 1756 000

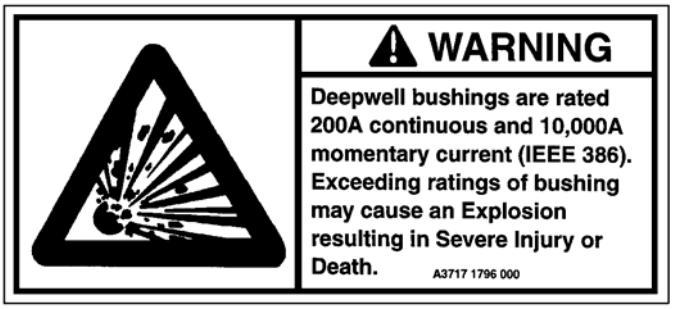

DANGER
Hazardous Voltage. May Shock, Burn, or Cause Death. Remote operation of switch is recommended. Switch is to be operated by Qualified Personnel in strict accordance with instruction manual.
A3717 1751 000


DANGER
Do not operate if SF6 pressure is low (refer to chart on switch). Operating switch at incorrect pressure may cause an Explosion resulting in Severe Injury or Death. Refill switch to correct pressure following procedure in instruction manual before operating.
A3717 1754 000

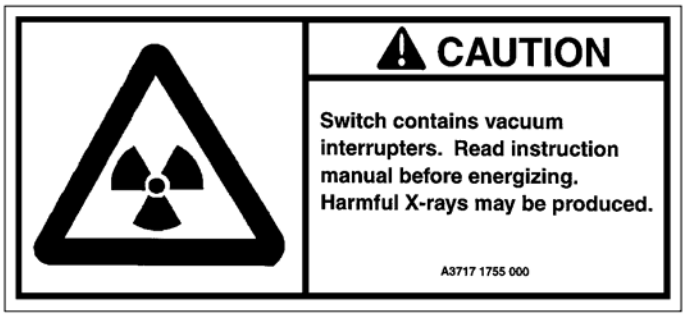

WARNING
Do not attempt to interrupt currents in excess of the ratings of this switch. Exceeding ratings of switch may cause an Explosion resulting in Severe Injury or Death. Refer to switch nameplate for maximum ratings.
A3717 1753 000


WARNING
Do not operate switch if a short circuit is suspected. Exceeding ratings of switch may cause an Explosion resulting in Severe Injury or Death. Refer to switch nameplate for maximum ratings.
A3717 1752 000


WARNING
SF6 Gas is heavier than air and may cause Suffocation. Do not exhaust SF6 into an Unventilated Area.
A3717 1757 000


WARNING
Deepwell bushings are rated 200A continuous and 10,000A momentary current (IEEE 386). Exceeding ratings of bushing may cause an Explosion resulting in Severe Injury or Death.
A3717 1796 000


WARNING
Hazardous voltage inside.
Can shock, burn, or cause death.
Keep out.
If open or unlocked, immediately call electric power and light company.


CAUTION
Switch contains vacuum interrupters. Read instruction manual before energizing. Harmful X-rays may be produced.
A3717 1755 000

2.5 X- Radiation Limits (if applicable)

G&W Vacuum Interrupters and Fault Interrupters are designed and tested in accordance with applicable sections of ANSI/IEEE C37.60-1981 and C37.85-1972, which include the following information. Reference the above standards for more detailed information.

The known United States manufacturers of vacuum interrupters initiated a test program during July of 1968 (as a Task Force of the NEMA Switchgear Section) to determine the present levels of X-radiation, if any, being emitted from high-voltage power vacuum interrupters, and to suggest permissible levels of radiation from such interrupters on the basis of their recognized application.

Each manufacturer conducted a series of tests on new vacuum interrupters taken from stock and recorded the X-radiation levels, if any, under the following conditions:

1. Dielectric withstand test voltage applied to new interrupters
2. Fault current interruption (where applicable)
3. Load current interruption
4. Dielectric withstand test voltages after fault current interruption
5. Dielectric withstand test voltages after load current interruption

As a result of evaluating the results of the aforementioned tests, the manufacturers concluded that neither the general public nor users will be subjected to harmful X-radiation due to normal application and operation of 15.5kV rated vacuum interrupter devices when applied within their assigned ratings and when the voltage applied across the open contacts of the interrupters is 15.5kV or less.

The manufacturers also concluded that at the permissible user dielectric withstand test voltage of 37.5kV radiation levels are negligible for vacuum interrupters rated 15.5kV. Normal electrical safety precautions will require the user to be at a safe distance from the interrupters, which will provide sufficient protection.

Precautions: If distances normally required for electrical safety are maintained, the exposure to test personnel will generally not exceed established dose limits. It is nevertheless recommended that adequate precautions such as shielding or distance be used to protect test personnel against possible higher X-radiation occurrences due, for example, to incorrect contact spacing or to the application of voltages in excess of those specified in column of Chart 1.

CHART 1

Test Voltage and X-Radiation Limits at One Meter Distance (Note 1)
Maximum X-Radiation Averaged Over an Area Not Greater than 100 cm^2 (mR/h)

Rated Max Voltage (kV RMS) (note 2) (Col 1)	**Low-Frequency Insulation Level Withstand Test (kV RMS) (Col 2)**	**At Rated Max Voltage (Col 3)**	**At Low Frequency Insulation Withstand Test Voltage (Col 4)**
15.5	37.5	0.5	15 (Note 3)

Notes:
(1) Chart 1 will be expanded as additional ratings become available
(2) This rating is the maximum line-to-line system voltage on which the vacuum interrupter is normally applied, whether the interrupter is rated on a single-phase or on a three-phase basis, using one interrupter per pole.
(3) See Appendix A of ANSI C37.85-1972 for derivation of this value**.**

SECTION 3 SWITCH DESCRIPTION

3.1 General

G&W manufactures a complete line of SF6 switches for either load break, fault interrupting or a combination of load and fault interrupting switching. Padmount, vault and overhead configurations are available. Switches are connected to cable systems using industry standard bushings and connectors. Switches can be operated either manually using a variety of operating handles or remotely using a motor actuator. A variety of electronic controls are available for local or remote operation.

Refer to the outline drawing attached for identification and location of switch components for your particular switch style.

SECTION 4 INSTALLATION

This switch has been shipped factory filled with the proper amount of SF_6. If the switch has not maintained the proper pressure (refer to the table on the switch, located near the pressure gauge or Table 1, Section 6.2), do not install the switch. Follow the filling procedure in Section 6.3.

4.1 Handling

⚠ WARNING

Do not lift or handle switch by the bushings. Doing so may result in damage to the switch and possible injury or death to personnel.

The switch is equipped with lifting eyes or other lifting provisions. Use proper equipment to obtain a vertical lift without damaging the unit. See switch drawing in Section 10.1 for approximate weight and lifting provision details**.**

4.2 Mounting

For vault and pad mount applications, provisions should be made for ample cable training space. All switches have provisions for mounting. See switch drawing in Section 10.1 for mounting details. Check that the switch, in its installed position, is secured and that mountings are adequate to support the weight of the switch. For applications that may be subject to flooding, the mountings must be capable of withstanding buoyant tendencies**.**

4.3 Grounding (earthing)

Ground bosses are located on the switch tank. To ensure a good ground connection, the top surface of each boss must be sanded to expose bare metal before making a ground connection. The switch tank must be attached to a suitable ground as required by local practice. Ensure that all cable terminations for shielded cable have been properly grounded to the switch tank during installation.

4.4 Cable Connections

Each entrance must be properly terminated. Entrances must be terminated following instructions supplied by the termination manufacturer.

⚠ WARNING

Switch entrances are designed to accept cable accessories constructed in accordance with IEEE 386 or a termination means specifically approved by G&W Electric Co. The use of any other cable termination means can present an electrical hazard or cause failure resulting in serious injury or death.

⚠ DANGER

End caps constructed in accordance with IEEE 386 or a termination means specifically approved by G&W Electric Co. must be used to cover any terminal connections that are not terminated to a cable. The shipping caps will not provide proper electrical insulation for an energized terminal. Energizing a non-terminated connection can present an electrical hazard or cause failure resulting in serious injury or death.

4.5 Installation Testing

High potential testing on switches and cable systems may be conducted. Refer to Section 7, Testing.

4.6 Fault Indicators (if applicable)

Refer to separate instructions.

4.7 Interrupter Relays (if applicable)

Refer to separate instructions.

4.8 Voltage sensors (if applicable)

Refer to separate instructions.

4.9 Actuators (if applicable)

Refer to separate instructions.

4.10 Enclosure (if applicable)

If supplied, pad mount enclosures provide tamper resistant construction. Penta-head bolts require a special wrench to open and are located on each access door behind the door handle. Door handles conceal Penta-head bolt when pushed flush against the door and are supplied with a provision for padlocking. Wind stops are supplied for each door panel. Some enclosures are supplied with a flip-up top section that is locked in place behind the main access doors.

SECTION 5 OPERATION

5.1 General

Switches are assigned ratings by the manufacturer and have been designed and tested using levels established by ANSI and/or IEC standards. Design and production tests are conducted to demonstrate that the equipment will perform within the ratings on the nameplate and customer drawing. See section 9.1 and Customer Drawing in Section 10.1.

⚠ WARNING

Equipment in service will perform to established ratings only if properly installed, operated and maintained. Power switchgear is characterized by high voltage and high continuous and short circuit currents. It should be installed, operated and maintained by Qualified Personnel. Failure to properly install, operate or maintain the equipment may result in damage to the switch and possible injury or death.

For further information on operation and maintenance of equipment see ANSI C2 standards.

⚠ WARNING

Do not attempt to close into fault in excess of the switch ratings or to interrupt currents in excess of interrupting ratings. Either may result in damage to the switch and possible injury or death.

At least once per year and before each operation, check the SF_6 pressure by comparing the pressure gauge to the table on the switch or in Section 6.2. Re-pressurize, if required, in accordance with Section 6.3.

⚠ WARNING

Do not operate an energized switch if the SF_6 gas pressure varies by more than 2 psig (14 kPa) from the Table 1, Section 6.2. Check gauge pressure before operating the switch. Improper SF_6 gas pressure may cause the switch not to operate as designed, resulting in damage to the switch and possible injury or death.

5.2 Operation of the Puffer Source Switch Operators

Switches may be provided with different style operating handles. Review and follow the appropriate steps for your particular switch style.

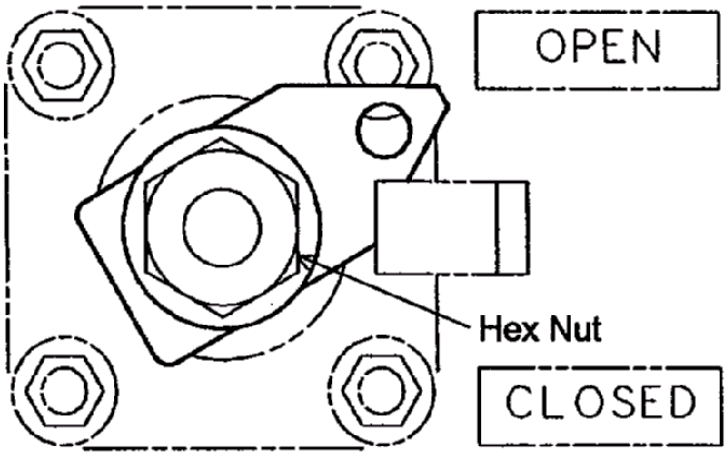
A. For removable style operating handles (see Figure 1).

5.2.1. The removable operating handle is rotated clockwise to close and counterclockwise to open. When the spring operator is unarmed, the pointer indicates the switch contact position. Hooks are provided on the switch for handle storage when not in use.

5.2.2. The handle may be positioned on the hex nut to give the best mechanical advantage for a particular switching sequence. To operate the switch, mount the handle on the hex nut so that the handle is rigid in the direction of operation. The handle will collapse and not operate the switch in the opposite direction. This breakaway action is a safety feature and prevents rapid reversal of the switch contacts. Because a load interrupting switch is not designed or rated to interrupt fault current, the breakaway handle eliminates the possibility of immediately reopening the contacts after closing into a fault. This provides time for line side circuit protective devices to operate. To return the switch to its original position, the handle must be removed, turned around and reset.

5.2.3. The two-position operator travels 60 degrees from open to closed. The operating handle will travel approximately 60 degrees before the spring mechanism inside the switch tank is fully charged and unlatching occurs. At that point the switch contacts move rapidly from one position to the next. Whether the operating handle is moved fast or slow is unimportant. The switch contacts will remain latched until released by action of the spring mechanism. Contacts will latch in the new position when the switching action is completed. Avoid excessive force when manually operating.

Figure 1: Removable style handle



For safety, the mechanism provides positive position indication. The operating handle and indicator will return to its original position, signifying an incomplete operation if the switch contacts fail to move.

5.2.4. For remote/manual operation either a hookstick or a rope may be used. A pulley arrangement may be needed for rope operation to provide training to the desired location and to maintain proper mechanical advantage. To operate the switch remotely, attach the rope or hookstick to the eye at the end of the handle. By operating the switch slowly, the transfer, occurring when the handle reaches the limit of its travel, will be felt, indicating a complete operation. Motor operators are also available for electrical remote or SCADA control.

5.2.5. The indicator/handle assembly is equipped with provisions for padlocking in all positions.

B. For fixed style operating handles (see Figure 2).

Each switch way is equipped with an internal spring mechanism to assure positive operation. Indicators show the position of the switch and padlocking positions are included for locking in each position. The following steps are for switches utilizing a fixed style-operating handle (see Figure 2).

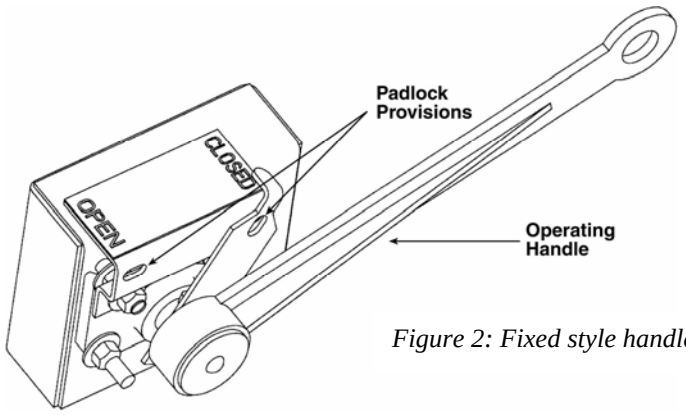


Figure 2: Fixed style handle

5.2.6 To operate the switch open or close, first check the present position of the switch. Rotate the operating handle toward the desired position. The handle will travel approximately 60^{o} before the spring mechanism inside the switch tank is fully charged and unlatching occurs. At that point the switch contacts move rapidly from one position to the next. Whether the operating handle is moved fast or slow is unimportant. The switch contacts will remain latched until released by action of the spring mechanism. Contacts will latch in the new position when the switching action is complete. Avoid excessive force when manually operating.

NOTE: The handle may over travel the 60^{o} specified above by 15^{o} in either direction. This is normal for the operation and does not effect contact position. For safety, the mechanism provides positive position indication. The operating handle and indicator will return to its original position, signifying an incomplete operation if the switch contacts fail to move.

5.2.7. For remote/manual operation either a hookstick or a rope may be used. A pulley arrangement may be needed for rope operation to provide training to the desired location and to maintain proper mechanical advantage. To operate the switch remotely, attach the rope or hookstick to the eye at the end of the handle. By operating the switch slowly, the transfer, occurring when the handle reaches the limit of its travel, will be felt, indicating a complete operation. Motor operators are also available for electrical remote or SCADA control.

5.2.8. The indicator/handle assembly is equipped with provisions for padlocking in all positions.

5.3 OPERATION OF THE VACUUM INTERRUPTERS

G&W PVI switches are furnished standard with one operating handle per each vacuum interrupter for single-phase operation. Three-phase operation can also be accomplished using a single center handle and linkage connecting the three interrupters together. The vacuum interrupter mechanism is spring activated. Therefore, it is the travel distance of the handle which is important, not the speed or force of movement.

⚠ CAUTION

The position of the vacuum interrupter operating handle DOES NOT indicate switch contact position. Contact position is ONLY verified by the OPEN-CLOSED indicator visible through the viewing window adjacent to each interrupter operating handle.

A. For Single Phase Operation

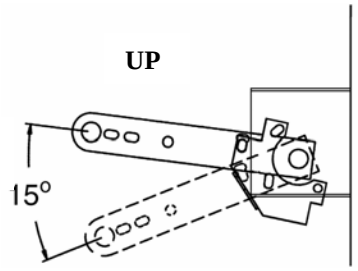
5.3.1. Make certain proper insulating tools and safety equipment are used.

5.3.2. Verify the proper SF_6 gas pressure of the switch by viewing the pressure gauge on the tank and cross-referencing the gas pressure/temperature Table 1, Section 4 of this instruction. The pressure/temperature chart is also located on the switch tank.

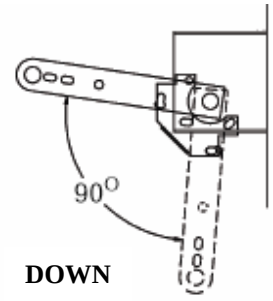
5.3.3. Verify interrupter contact position (OPEN or CLOSED) by looking through the viewing window adjacent to the operating handle.

5.3.4. If contact indicator reads CLOSED the operating handle will be in the up position. **To OPEN**, depress the handle down using a steady motion (approximately 15 degrees from its original position). Verify "OPEN" contacts by looking at the contact indicator through the viewing window.

TO OPEN



TO RESET



TO CLOSE

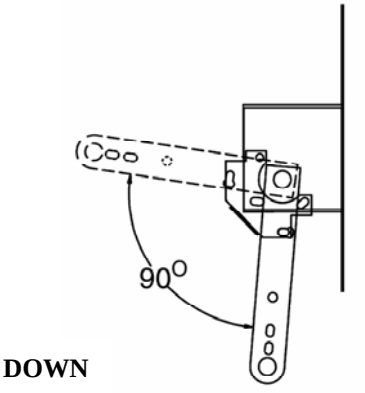
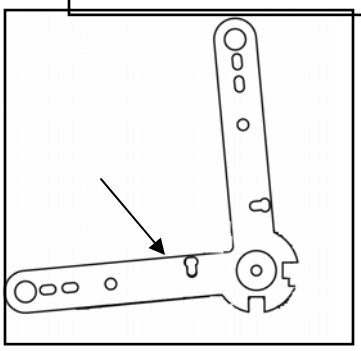


Figure 3: Fixed handle



For "L" shape fixed handles, the handle orientation above refers to the bottom leg of the L handle.

5.3.5. If the contact indicator reads OPEN the operating handle may be either in the up or down position.

If the handle is up it means that the vacuum interrupter has been electronically tripped either due to an overcurrent condition or because the push button was operated on the electronic control on the side of the switch.

To RESET a tripped phase, first verify that the cause of the fault or overload is corrected. Next, depress the handle down using a steady motion until the handle movement stops (approximately 90 degrees from its original position).

If the handle is down, it means that the vacuum interrupter has been manually opened.

To CLOSE, if 15 degrees down, depress the handle all the way down using a steady motion until the handle movement stops. Then raise the handle up until the handle stops (approximately 90 degrees). Verify "CLOSED" contacts by looking through the viewing window.

B. For Three-Phase Operation (Figure 4)

For three-phase operation, the operating handles of the three adjacent single-phase interrupters are linked together as in Figure 4. A removable extension rod is provided to aide in obtaining the required mechanical leverage when using a hookstick to move the center handle in a downward direction. The same procedures as for single-phase operation apply with the following exceptions.

⚠ CAUTION

When set for three phase trip, the electronic control of the vacuum interrupters is designed for simultaneous tripping of all three phases. The three phase operating handle used for manual operation mechanically links three independent single-phase operating mechanisms, and is adjusted to synchronize the opening and closing of all three mechanisms as closely as possible. However, when manually opening the vacuum interrupters, there is a chance that not all three phases may operate simultaneously. To minimize the difference in opening sequence make certain to use a quick steady motion of the three phase handle.

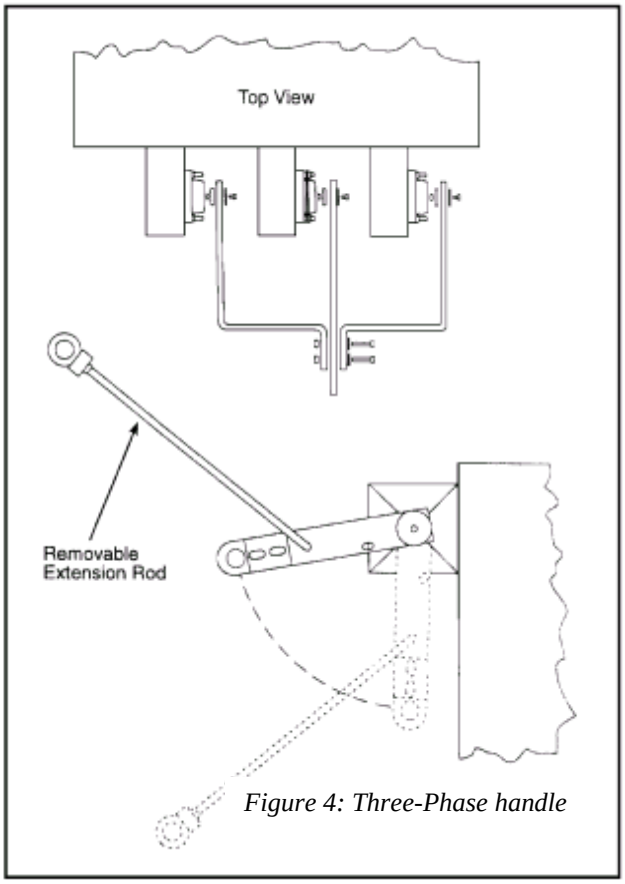


Figure 4: Three-Phase handle

5.3.6. When set for three-phase operation, what happens to any individual single-phase interrupter should happen to all three phases. Therefore, all contact indicators should read the same. If they read differently, verify that the electronic control is set for three-phase operation. If settings are proper, contact the factory for possible troubleshooting procedures.

5.3.7. When using the extension rod to operate in a downward position, position the curved end of the handle extension into the hole located directly behind the carriage bolt connections on the center phase operating handle. The extension rod should be resting on top of the operating linkage. **To open** all three phases, push the rod downward approximately 15 degrees or until the contact movement is heard. Verify by contact indicators through each viewing window.

IMPORTANT: Prior to the next step make certain to position the extension rod at the best angle to allow the maximum distance between operating rod and cable entrance connectors.

To close or recharge the switch after an electronic trip, leave the extension rod in the same position and continue pushing downward as far as the handle will go. This charges the internal spring mechanism. Pull the handle upward approximately 90 degrees with a firm steady motion until the contacts close. Verify by contact indicators through each viewing window.

NOTE*:* Movement of the three phase operating handle will take some exertion. Avoid excessive force. Force required to operate mechanism may exceed 30 lbs.

5.4 OPERATION OF THE INTERRUPTER RELAYS

The electronic relay monitors the current and activates a trip solenoid, which opens the vacuum interrupter to interrupt overcurrents. The relay is housed within a NEMA enclosure and are powered by current transformers mounted inside the switch tank. The relays are factory set for the current response curves if specified by the customer.

Reference switch outline drawing and separate instructions on Vacuum Interrupter Relays for location and style of the relays supplied. Review the instructions for more detailed information.

5.5 Locking in a position

Padlock provisions are provided.

5.6 Operation by actuator (if applicable)

See supplemental instructions provided.

5.7 Automatic operation (if applicable)

See supplemental instructions provided.

5.8 Fuses (if applicable)

Some switches are equipped with dry well fuse holders for use with NX, ELX, CX or GP type current limiting fuses. Fuses are installed at the factory when they are ordered with the switch. The fuse holders are hook stick operable and can be mechanically interlocked with the switch to prevent access to the fuses when the switch is in the closed position.

⚠ DANGER

Fuse holders are not rated for load break or load make operation. Do not attempt to override the mechanical interlock to remove or replace fuses with the switch in the closed position. Always replace the fuse draw out rod and return the interlock to its closed and locked position prior to closing the switch. Fuse holders can contain energized parts even with the switch in the open position. Do not attempt to clean or probe inside of the fuse holders without completely de-energizing, grounding and isolating the switch in accordance with prescribed practices. Failure to follow these prescribed procedures can result in serious personal injury or death.

6.1 General

No internal maintenance is required. However, if the switch must be opened, personnel should be instructed to take certain precautions. During any internal maintenance, the switch must be de-energized. The SF_6 should be pumped from the switch through filters into a storage tank for reuse.

⚠ CAUTION

SF_6 removed from a switch should be pumped through a filter into a storage tank for reuse. SF_6 is heavier than air and will displace air (oxygen) in confined or low-lying areas. Make sure adequate ventilation is provided for enclosed or low-lying environments to prevent oxygen displacement and possible injury or death by asphyxiation.

SF_6 has been identified as a greenhouse gas and should not be released into the atmosphere. Emissions of SF_6 may contribute to global warming.

Occasional visual inspection of the switch is recommended and if possible, the switch(es) should be exercised periodically.

At least once per year and before each operation, check the SF_6 pressure by comparing the pressure gauge to the table on the switch located near the pressure gauge or in Section 6.2. Re-pressurize if required in accordance with Section 6.3. A fitting is provided on the tank for the addition of SF_6. If leak detection becomes necessary, detectors are readily available which are sensitive to SF_6.

6.2 Table 1, SF_6 Pressure/Temperature Chart

Ambient Temperature (1)	Filling Pressure	Ambient Temperature (1)	Filling Pressure
^oC	kPa	^oF	psig
-30	31	-20	4.7
-20	37	0	5.6
-10	43	20	6.5
0	49	40	7.5
10	55	60	8.4
20	61	80	9.3
30	66	100	10.2
40	72	120	11.2
50	78		

(1) For ambient temperatures less than -20^{o}F *(-30^{o}C)* or in excess of 120^{o}F *(50^{o}C)* consult factory.

⚠ WARNING

Do not operate an energized switch if the SF_6 gas pressure varies by more than 2 psig (14 kPa) from the table above. Check gauge pressure before operating the switch. Improper SF_6 gas pressure may cause the switch not to operate as designed, resulting in damage to the switch and possible injury or death to personnel.

⚠ CAUTION

Fresh SF_6 gas is nonflammable and non-toxic but is heavier than air. Oxygen may be displaced in low-lying or enclosed environments. Make sure adequate ventilation is provided to prevent oxygen displacement and possible asphyxiation.

6.3 SF_6 Filling Procedure

If it is suspected that the switch has lost some or all of its gas, follow this procedure to verify loss and properly refill the switch. Verify the switch pressure with a known gauge. This can be accomplished by connecting the known gauge to one end of a flexible hose suitable for pressure up to 15 psig or 103 kPa and connecting the other end to the switch fill valve.

Two different types of fill valves have been used on G&W switches. One has a 1/4" NPT male connection and the other has a 1/4" SAE male flare connection. The fill valve with the 1/4" NPT male fitting is distinguished by its separate shutoff handle. Valves with the 1/4" SAE male flare connection have internal shut-offs which are activated by the hose connection fitting. Be sure to use the proper fittings for connecting to the fill valve.

⚠ CAUTION

Use of improper fittings can cause gas leakage leading to a complete loss of gas pressure. Complete loss of gas pressure can lead to a switch explosion resulting in serious injury and/or death.

6.3.1 If the switch has lost some gas but has maintained a positive pressure, it need not be de-energized or vacuumed before re-pressurizing with SF_6. Proceed to 6.3.5

6.3.2 If the switch has not maintained a positive pressure de-energize immediately and follow the entire filling procedure beginning with 6.3.3, below.

6.3.3 If the switch tank has not maintained a positive pressure of at least 2 psig (14 kPa) or has otherwise been opened to ambient air, the switch tank should be purged**.**

⚠ CAUTION

Do not purge the switch while energized. Complete loss of SF_6 gas can lead to a switch explosion resulting in serious injury and/or death.

The molecular sieve is located inside the switch tank in a plastic mesh. The switch tank may have to be cut open to replace the molecular sieve. Plastic gloves should be worn to prevent white power by-products from coming in contact with skin as it may cause irritation. One end of the plastic mesh may be unfastened to allow removal of the bags. It is important to minimize exposure of the molecular sieve to moist atmospheric conditions.

The molecular sieve is not listed in the U.S. EPA's Resource Conservation and Recover Act (RCRA) Hazardous Waste Management Regulations and does not possess any of the four identifying characteristics of hazardous waste. Dispose of the sieve and container in an environmentally acceptable manner, in full compliance with all applicable government regulations.

6.3.4 Remove the cap covering the valve, connect the vacuum pump, open the tank valve and evacuate the switch to between 29 and 30 inches of mercury at 60°F (98-101 kPa at 15.6°C). Disconnect vacuum pump.

Fill switch to 10 psig (79 kPa) with dry nitrogen having a dew point of less than -45°C (-49°F).

⚠ CAUTION

Do not pressurize the switch beyond 103 kPa or 15 psig. The tank has a maximum operating pressure of 103 kPa or 15 psig. Exceeding 15 psig or 103 kPa can lead to a switch explosion resulting in serious injury and/or death.

After completing the fill, vent and re-vacuum to between 29 and 30 inches of mercury at 60°F (98-101 kPa at 15.6°C). Disconnect vacuum pump. The switch is now purged.

6.3.5 Adjust the gas regulator to 20 psig (140 kPa) and allow a small volume of SF_6 to flow, purging air from the supply line prior to connecting the supply line to the switch.

⚠ CAUTION

Do not pressurize the switch beyond 103kPa or 15 psig. The tank has a maximum operating pressure of 103 kPa or 15 psig. Exceeding 15 psig or 103 kPa can lead to a switch explosion resulting in serious injury and/or death.

6.3.6 Remove the valve cap and make the connection to the switch. Re-pressurize the switch according to Table 1, Section 6.2.

⚠ CAUTION

Do not pressurize the switch beyond 103kPa or 15 psig. The tank has a maximum operating pressure of 103 kPa or 15 psig. Exceeding 15 psig or 103 kPa can lead to a switch explosion resulting in serious injury and/or death.

6.3.7 Once the switch is filled, stop the flow of SF_6, remove the filling line and replace the cap.

6.4 Handling of G&W SF_6 Switches

6.4.1 Overview

The following information is for reference as a general guideline when operating, performing maintenance or disposing of G&W Electric Sulfur Hexaflouride (SF_6) gas insulated switchgear. This information is compiled in accordance with existing industry papers on the subject *(see reference section).* It is difficult to anticipate all possible situations that may occur. Any questions on how to handle a specific situation should be forwarded to the local G&W Electric representative. State and local regulations should always be considered.

⚠ CAUTION

SF_6 gas venting from a switch should be pumped through a filter into a storage tank for reuse. SF_6 heavier than air and will displace air in confined or low-lying areas. Make sure adequate ventilation is provided for low-lying or enclosed environments to prevent oxygen displacement and possible asphyxiation.

6.4.2 General Information

SF_6 gas has been used for many years in transmission cable systems and circuit breakers. The application versatility of the gas soon led to its use in distribution voltage (15.5-38kV) equipment. Although it is used as an insulating medium in both applications, there are some very important differences to consider. Primary considerations are the amount of SF_6 gas used in the equipment, typical operating pressures and the fault or load break energy associated with interruption.

6.4.2.1 Amount of Gas

High voltage circuit breakers use large amount of gas, up to 2000 lbs. (800 kg) in some applications. G&W SF_6 switches use between 8-20 lbs. of gas**.**

6.4.2.2 Operating Pressure

The pressure of SF_6 gas in any contained vessel will vary with temperature. G&W SF_6 switches require an operating pressure of approximately 8.5 psig at 60^{o}F (55 kPa at 10 ^{o}C).

6.4.2.3 Fault or Load Break Energy

High voltage circuit breakers re designed to interrupt typically high energy fault current within the SF_6 environment. G&W SF_6 load break switches are designed for typically 630 Amp load break operation. In accordance with industry standards, the switches also have a momentary and fault close rating typically in the 20-40 kA asym. (32-64 kA peak) range. Arc interruption in SF_6 is therefore only a load break or low energy function, as opposed to a fault interrupting or high energy function. G&W switches designed for fault interrupting duty incorporate vacuum bottles or air insulated canister style fuses for these applications. All fault interruption is performed without the aid of SF_6 gas.

Sulfur hexaflouride gas, in its virgin state, is a non-toxic, nonflammable, odorless and colorless gas. It combines excellent electrical, chemical and thermal properties making it an ideal dielectric. Included in these properties are high dielectric strength, excellent arc quenching capability, excellent chemical stability and good thermal conductivity. Although the gas has many advantages, there are certain precautions which should be considered when dealing with this dielectric.

6.4.3 Safety Precautions & By-products

Sulfur hexaflouride has been described as a "physiologically inert gas". Laboratory rats have been exposed to a mixture of 80% SF_6 and 20% oxygen (the maximum concentration of gas possible without lowering the oxygen supply to an unsafe level) for periods of 16-24 hours. The rats showed no signs of intoxication or irritation either during exposure or afterward. SF_6 is heavier than air and will accumulate in low lying areas. Because the gas is odorless, colorless and non-poisonous, it cannot easily be detected without the use of proper equipment. The possibility of asphyxiation due to oxygen displacement needs to be considered. Proper gas detection instruments should be used.

At very high temperatures or in the presence of an electric arc, SF_6 can be slowly decomposed. Decomposition products include lower fluorides of sulfur, which are hydrolyzable, yielding SO_2 and HF. Arced SF_6 in the presence of moisture may form potentially toxic by-products which can exist in both the gaseous and solid states. G&W uses the driest, highest grade SF_6 gas commercially available. G&W SF_6 switches have short arcing times, small volumes of dry SF_6 and contain a molecular sieve to absorb possible moisture and arc by-products thus minimizing the amount of by-products released. However, all SF_6 by-products should be considered potentially dangerous**.**

6.4.4 Solid By-products

Tests have shown that arcing in SF_6 gas will produce solid by-products in the form of a fine dust or powder which consists of metal fluorides. These fluorides can be irritating and dangerous when in contact with skin or eyes. Contact with the power should be avoided. Also, precautions should be taken to avoid inhaling the powder. The powder particles are small and light enough to be suspended in air for substantial periods of time. This dictates the use of respirators or other protection to prevent inhaling the suspended particles when internal maintenance of the switch is required.

6.4.5 Gaseous By-products

G&W has sampled the gas from a test switch to analyze the by-products. The switch was initially filled with approximately 13 pounds of SF_6 gas. The switch was operated 104 times under full load conditions (nominally 26 to 31 kV, 585 to 735 amps) and 30 times under loop circuit conditions (nominally, 5kV, 400 amps). The arc by-products and their concentrations resulting from these tests are in general agreement with those reported in other industry published papers and include SOF_2, CO_2, CF_4, and SO_2F. SOF_2, thionyl fluoride, is the most highly concentrated arc by-product produced. SOF and SO_2F are irritants to the respiratory tract and eyes. Fortunately, these gases are characterized by a pungent odor (rotten egg) noticeable in concentrations from 1 to 5 ppm. Industry reports indicate the lethal concentration for sixty minutes of exposure to SOF_2 is 100 ppm for rats and mice, and 500 ppm for rabbits. Carbon dioxide, CO_2, and carbon tetraflouride, CF_4 are considered nontoxic.

6.4.6 Recommended Precautions

Vault or Enclosed Area Applications. In the unlikely event of a catastrophic switch failure which may cause the gas to be released to the environment, special precautions are necessary for vault or enclosed area applications. In this situation, toxic gases may accumulate and be present at dangerous levels. The gases that are produced will have a characteristic "rotten egg" odor. However, smell should not be used a s a test for the presence of by-products. The vault should be completely ventilated of all contaminated gases. If a vault has been purged, use a halogen type detector to test the air in the vault to determine if all SF_6 gas has been vented and sufficient oxygen is present. If all SF_6 has been vented, then the other gaseous by-products should have been removed at the same time. In any case, it is recommended that personnel entering the enclosed area be provided with air masks or rescue breathing apparatus. Self-contained oxygen masks should be used for maximum safety.[(1)]

Above Ground Outdoor Applications. In the unlikely event of a catastrophic switch failure in above ground, applications, typically the gases would be dispersed into the atmosphere. Allow adequate time, approximately thirty minutes, depending on conditions, for this to occur before investigating the equipment.

6.4.7 Opening an SF_6 Switch for Disposal

In order to dispose of a G&W SF_6 gas insulated switch, the switch must be opened. If the tank is still under pressure, the SF_6 must first be removed from the switch. This should be accomplished using suitable gas recovery equipment if at all possible.

Alternately, the gas may be released to a well ventilated area where personnel will not be subject to possible arc by-products. One method might be to vent the gas through an absorber to neutralize any acid present. This can be accomplished using a hose on the fill valve of the tank. Air masks, breathing apparatus or, for maximum safety, self-contained oxygen masks should be provided for personnel if proper ventilation is not possible. Do not allow personnel to continually breathe gas that has an odor. Store the gas in suitable containers.

⚠ WARNING

Do not open any SF_6 filled equipment that has experienced arcing, corona or very high temperatures without taking adequate safety precautions to protect personnel from potentially hazardous solid and gaseous products.

Since G&W SF_6 tanks are welded, it is necessary to grind or otherwise remove the weld off of the lid. This can be accomplished by grinding the weld filet flush and then chisel the remaining weld. This will minimize the possible spread of the solid by-products. Once the lid is removed, the exposed interior of the switch should be allowed to stand in a well ventilated area for at least thirty minutes in order for any retained gaseous by-products to dissipate. The use of gas detection equipment and proper protective clothing is recommended.

6.4.8 Internal Cleanup

Although the amount of by-products should be minimal, personnel required to handle or remove the SF_6 solid by-products should wear skin protection equipment including disposable coveralls and gloves. Respiratory protection as previously described should also be worn. Any powder should be vacuumed [(2)] up or if possible wiped up with rags. The powder should be stored in an air tight metal container. The switch may have a light coating of white powder on the walls and components. These should be wiped down with a solution of sodium bicarbonate (baking soda).[(3)] The excess solution and rags should be disposed of with any powder previously collected. Parts with powder on them that cannot be reached should be disassembled and wiped down.

6.4.9 Disposal of Materials

The tank and components that have been cleaned in the prescribed manner may be disposed of safely. The collected powder, solution and cleanup materials should be placed together in double plastic bags inside a metal container and have water added to cover them The pH of the solution should be checked. Solutions with a pH between 6 and 9 are generally suitable for normal disposal. If desired, soda carbonate (soda lime)[(4)] can be placed on top of the materials to neutralize the acidity.

Emission of SF_6, or disposal of contaminated absorbents may be subject to environmental regulations. Users should review their operations in terms of applicable federal, state and local laws and regulations.

6.4.10 SF_6 General Guideline References

1. Study of Arc By-products in Gas Insulated Equipment. EPRI Report EL1646, Project 1204-1.

2. SF_6 Gas Analysis Service. M J. Mastroianni & R. B. Jackson, Allied Chemical Corp. (Allied Signal)

3. Handling of SF_6 and Its Decomposition Products in Gas Insulated Switchgear (GIS). CIGRE Working Group 23.03, Electra No. 136 Part 1 dated June 1991 and Electra No. 137 Part 2 dated August 1991.

6.4.11 Footnotes

(1) Can be supplied from safety equipment manufacturers, e.g., Scott Aviation, a division of Figgie International Inc., 2225 Erie St., Lancaster, New York, 14086, USA Telephone 716-683-5100.

(2) Can be supplied from safety equipment manufacturers, e.g. Nilfisk of America, Inc., 300 Technology Drive, Malvern, Pennsylvania, 19355, USA or equivalent. Telephone 800 - *NIL - FISK*.

(3) Rule of thumb is dissolving 4 oz. (114 grams) of baking soda in one gallon (3.785 liters) of water.

(4) Rule of thumb is dissolving approximately 2.5 lbs. (*1.1325* kilograms) of sodium carbonate (soda lime) to 55 gallons (*211.538* liters) of water.

6.5 SF_6 Gas Specification

SF_6 is made from two materials, sulfur and fluorine, which are in abundant supply. SF_6 is readily available from any of several suppliers.

The use of commercial grade SF_6, per ASTM D2472, is recommended and may be obtained in cylinder sizes ranging from 6 to 115 pounds (2.714 to 52.036 kilograms).

Because high moisture content will affect the interrupting and dielectric properties of SF_6, cylinders should be sampled, testing dew point per ASTM D2029, before using. Simplified equipment for making this check is readily available. Cylinders whose dew point occurs above -45^oC (-49^oF) should be rejected.

6.6 Finish of Switch

The switch paint finish is comprised of a two part epoxy, gray coating (Munsell No. 5BG7/0.4). Clean using soap and water. Touch up paint is available.

6.7 Repair Parts List

Items such as operating handles, motor actuators, pressure gages, fill valves, shaft seals, bushings, gaskets, viewing windows, etc. are available from the factory if required. To inquire about spare or repair parts, contact G&W Representative or customer service with the switch serial number.

6.8 Returning Equipment to Service

6.8.1 Make sure that the load interrupting and fault interrupting switches grounding means are removed.

6.8.2 Make certain the load interrupting and fault interrupting switches are in the correct position. If the switch operators are to be padlocked, do so at this time.

6.8.3 For padmounted switches, padlock the enclosure before leaving the area even momentarily. This should be done even if the switch is accessible only to qualified persons.

SECTION 7 TESTING

7.1 Installation Testing

⚠ WARNING

Follow these precautions when performing electrical tests:
1. Completely de-energize the switch and disconnect it from all power sources.
2. Terminate all bushings with an insulated cap or other suitable cable termination capable of withstanding the test voltage.
3. Verify the SF_6 gas pressure is in accordance with Table X, Section 6.2.
Failure to observe these precautions can result in flash over, injury and equipment damage.

⚠ WARNING

The DC withstand capability of switches may be reduced due to damage, gas leakage, or electrical or mechanical wear. The DC test voltage must not exceed the withstand limits of the switch. Application of DC voltages greater than the withstand capability of the switch can result in flash over, injury and equipment damage.

⚠ CAUTION

Do not pressurize the switch beyond 103kPa or 15 psig. The tank has a maximum operating pressure of 103 kPa or 15 psig. Exceeding 15 psig or 103 kPa can lead to a switch explosion resulting in serious injury and/or death.

⚠ WARNING

When it is necessary to test the cables connected to an energized switch, proper insulation between the power-frequency source and the DC test equipment must be maintained. Follow the recommendations of the manufacturer of the test or fault location equipment.

⚠ DANGER

Do not exceed the Maximum Dielectric Test Levels as shown in Section 7.1.2. Exceeding the test levels can cause flash over. This can lead to a fault in the switch or test equipment and cause serious personal injury or death.

7.1.1 General

After switches are completely installed in accordance with local practices, high voltage testing may be performed before the switch is energized. Test levels will generally be established by the cable or termination manufacturer but should not exceed the values listed in the tables below. Insure the test equipment is used in accordance with the manufacturer's instructions.

7.1.2 Maximum Dielectric Test Levels:

Switchgear Rating			Withstand Test Voltage	
50 Hz	**60 Hz**	**Impulse (BIL)**	**Power Frequency**	**DC**
12kV	N/A	75kV	28kV	35kV
N/A	15.5kV	95kV	34kV	42kV
24kV	27kV	125kV	40kV	62kV
36kV	38kV	150kV	50kV	82kV

7.2 Cable Testing

DC testing is primarily used to test the integrity of installed cable systems and terminations. DC testing should be performed in accordance with appropriate cable test standards, and must not exceed the rating of the switch.

⚠ WARNING

DC testing cables installed on switches must only be performed when all ways of the switch and cables are isolated from all system voltages. Applying a DC test voltage to a switch with energized ways may lead to electrical failure of the switch resulting in personnel injury or death.

⚠ WARNING

Testing of switches with internal potential transformers must not exceed the rating of the transformer. Applying a test voltage in excess of the transformer rating may damage the transformer leading to electrical failure of the switch which could result in personnel injury or death.

7.2.1 Maximum Cable Testing Levels:

Switchgear Rating			Cable Testing	Cable Thumping
50 Hz	**60 Hz**	**Impulse (BIL)**	**Power Frequency**	**DC**
12kV	15.5kV	95kV	30kV	15kV
24kV	27kV	125kV	40kV	20kV
36kV	38kV	150kV	40kV	20kV

7.3 Factory Production Tests

Routine (production) tests are conducted in accordance with applicable standards. The following are typical production tests performed.

Loadbreak Switches:

- Circuit Resistance Test
- Dielectric Test (60hz Withstand Test)
- Tightness Test (Leak Test)
- Design and Visual Checks (Operating Assurance Test)

Fault Interrupters:

- Circuit Resistance Test
- Dielectric Test (60hz Withstand Test)
- Tightness Test (Leak Test)
- Design and Visual Checks (Operating Assurance Test)
- Calibration of Minimum Power Up Level and Time Current Tests
- Control and Secondary Wiring Tests

7.4 Interrupter Testing

G&W can supply an optional tester to verify the proper operation of the fault interrupter electronics. Contact your G&W representative for further information**.**

SECTION 8 TROUBLESHOOTING

8.1 Leak Checking

SF6 switchgear is designed and built to be sealed for life. Should the pressure of the switch fall outside the range specified on the pressure/temperature chart, the switch should be checked for possible leaks. Hand held halogen leak detectors are generally suitable for detection of leaks which have caused a drop in pressure greater than allowed. These hand held detectors are commonly used for refrigeration equipment servicing and are readily available.

If a leak does occur, it is generally found to be at on of the points of penetration into the tank. These points of penetration typically consist of:

- Pressure Gauge
- Fill Valve
- Shaft Seals
- Bushings
- Viewing Windows
- Electrical Feedthroughs

Leak checking should be done in an area free of other substances that can be detected by the leak detector. The presence of solvents on the device being tested can give false leak detection readings.

Leak detection should follow the recommendations of the manufacture of the detection equipment being used. For hand held leak detectors of the "sniffer" type, generally the detection wand is moved slowly (1 cm/sec) over the area being tested. The presence of a leak is typically indicated by a change in audible tone or other visual indication.

⚠ WARNING

Repair of leaks on switches must only be attempted on de-energized equipment. Attempting repair on an energized switch can result in complete loss of pressure leading to failure of the switch which could cause severe personal injury or death.

Once the source of the leak has been detected, repair generally falls into one of three categories. If the leak is occurring from a threaded connection (pipe thread entrance) the fitting can be removed, sealant applied to the threads and the fitting reinstalled. If the leak is from a gasketed surface, the gasket may be replaced. When replacing a gasket it is important to clean the mating surfaces and apply a thin film of lubricant to the gasket for proper seating during assembly. Lubricant for gaskets should be a flourosilicone based oil for best results. If the leak is occurring from a component such as a pressure gauge or fill valve, then the component must be replaced.

Proper replacement components should be obtained from G&W Electric Co.

8.2 Controls

See separate control instructions.

9.1 Ratings[1]

Module Type	Rotary Puffer, 2 & 3 Position (RP)		Linear Puffer (PI)[2]			Three Position (MR)		Vacuum Interrupter, (VI)			Vacuum Interrupter, (FI)		Vacuum Interrupter, (NI)		
Maximum design voltage	**15.5**	**27**	**15.5**	**27**	**38**	**15.5**	**27**	**15.5[3]**	**27[3]**	**38[3]**	**15.5[4]**	**27**	**15.5[5]**	**27[5]**	**38[5]**
Impulse level (BIL)	**110**	**125**	**110**	**125**	**150**	**110**	**125**	**95**	**125**	**150**	**95**	**125**	**95**	**125**	**150**
One minute withstand (dry)	**35**	**60**	**35**	**60**	**70**	**35**	**60**	**34**	**40**	**60**	**34**	**40**	**34**	**40**	**60**
15 minute withstand	**53**	**78**	**53**	**78**	**103**	**53**	**78**	**53**	**78**	**103**	**53**	**78**	**53**	**78**	**103**
Continuous and load break current, Amps	**630**	**630**	**630**	**630**	**630**	**630**	**630**	**600**	**600**	**600**	**600**	**600**	**600**	**600**	**600**
Momentary current, kA asym	**20**	**20**	**40**	**40**	**40**	**40**	**40**	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**
Fault close, kA asym (3 times)	**20**	**20**	**40**	**40**	**40**	**40**	**40**	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**	**19.2**
One second current, kA asym	**12**	**12**	**25**	**25**	**25**	**25**	**25**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**NA**	**NA**	**NA**
Operation load endurance at 600A	**500**	**500**	**1200**	**1200**	**1200**	**1200**	**1200**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**NA**	**NA**	**NA**
Mechanical endurance, operations	**2000**	**2000**	**2000**	**2000**	**2000**	**2000**	**2000**	**2000**	**2000**	**2000**	**2000**	**2000**	**2000**	**2000**	**2000**
Interrupting, kA asym [3]	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**

NOTES:

(1) The above ratings are for the specific type of switch module. Cable entrances, internal bus configurations and other design factors may reduce the rating of the switch assembly. Always refer to the attached nameplate prior to applying a switch in a system and verify the nameplate rating is equal to or greater to the available voltage, continuous and fault current available on the circuit.

(2) Additional Ratings: Ten operating overload interrupting capacity 3,000 Amps; Open gap withstand 200kV.

(3) 18 kA sym. available.

(4) 16 kA sym. available.

(5) 20 kA sym. available.

ANSI C37.60 Fault Interrupting Duty

Percent of Maximum Interrupting Rating	15-20%	45-55%	90-100%
Approximate Interrupting Current, Amps	2,000	6,000	12,000
Number of Fault Interruptions	44	56	16

Total number of Fault Interruptions: 116

SECTION 10 ATTACHMENTS

10.1 Customer Drawing(s)

10.2 Supplemental Instructions, if applicable. May include:

1) **Motor Actuators**
2) **Controls**
3) **Fuses**
4) **Facet Indicators**
5) **Voltage Sensors**
6) **Interrupter Relays**
7) **Low Pressure Warning Devices**

10.3 Material Safety Data Information

See G&W website at www.gwelec.com for MSDS information.