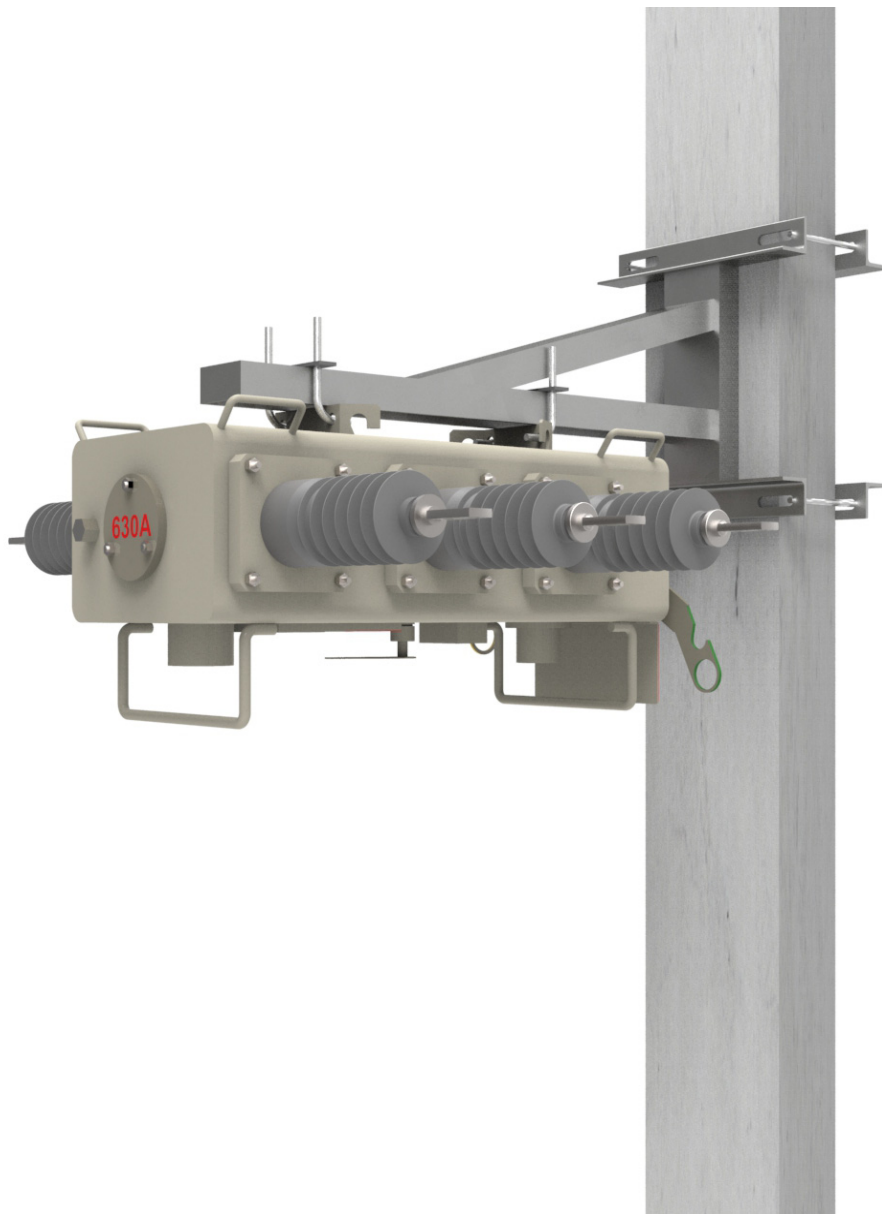


# Rapier GX

## Gas enclosed load break switch and sectionaliser

*Installation, Operation and Maintenance Manual*



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## Validity

This manual was produced in April 2021 and applies to the Rapier GX Range.

Due to Lucy Electric policy of continuous research and development, Lucy Electric reserves the right to change the design and specification of its products without prior notice.

## Safety



Operators of this equipment must have experience and expertise with switchgear. To prevent personal injury or equipment damage, this manual must be read carefully.



This manual **MUST** be readily available whenever the unit is handled or operated.



If this equipment suffers from any fault or damage, contact the manufacturer and/or supplier immediately.

- **Before commencing any work, ensure that the necessary safety precautions, risk assessments and safety documents are in place.**
- **Installation must be carried out observing the Operational Safety Rules.**
- **Check substation earthing is intact - if missing, seek advice.**
- **In all instances Risk assessments should be undertaken prior to undertaking any new activity where potential hazards are concerned. This is particularly important in order to identify the necessity for specific PPE, that may be required and that cannot be avoided even with safe systems of work in place.**
- **It is strongly recommended when undertaking any form of switching operation that the appropriate PPE is worn. Many manufacturers provide Flash resistant or Arc Flash clothing for this purpose.**

**This equipment contains the fluorinated greenhouse gas SF6 covered by the Kyoto Protocol with a global warming potential. SF6 shall be recovered and not released into the atmosphere.**

**For further information on use and handling of SF6, please refer to IEC 62271.**

# 1. General Description

## 1.1. Switchgear

The RAPIER GX has been developed for use in automation and remote control systems on networks up to 38kV. The SF6 gas in the switching tank is utilised for both insulating and arc quenching requirements and together with the puffer principle ensures the interruption of small currents such as mainly active load, cable charging and magnetizing currents. The tulip style contact system manufactured with arc resistant material, ensures a long switching life and short circuit making capacity.

This product serves as both a remotely controlled load break switch and a sectionaliser. The sectionalising function operates in conjunction with an upstream recloser.

The RAPIER GX gas enclosed, load break switch is a manually operated device. It is ideal for situations where a low cost, gas enclosed, manually operated LBS is preferred by the customer and where there is little likelihood of upgrading the GX switch to remote control or automation modes. It comes available at maximum voltages of 15, 24 and 38kV with the necessary mounting steelwork for the pole structure. Customers, if interested in this product, should contact Lucy Electric for further details.

## 1.2. Operating Mechanism

A manual operating arm is designed for hookstick operation from the ground level. By pulling on the appropriate side of the operating arm, the GX switch can be opened or closed. All three set of contacts are ganged together and driven by an over-toggle spring mechanism. The operation is "manual independent" meaning the speed of operation is independent of the strength of the operator.

## 1.3. Tank

The switching contacts are housed in a SF6 filled, stainless steel tank and suitably treated against corrosion for maximum durability. Each tank is equipped with -

- A safety membrane or bursting disc on the side to safely release any over-pressure caused by an internal arc fault.
- A mechanical low gas locking device that, when operated, inhibits any further operation of the GX switch (it remains in its current state) and displays a low gas, red indicator in an aperture underneath the mechanism compartment.
- A manual interlock which when operated by a hookstick locks the GX switch in its current switch position; this is normally applied when the GX switch is in its OPEN position and a Point of Isolation is being established for safe working downstream of the switch.

## 1.4. Arc Extinguishing Method

'Puffer' is the type of method used to compress and release the SF6 gas around the linear contact system that is used on the Rapier GX unit. As the switch contacts separate an electrical arc is drawn between the two. As the moving contact opens, the gas within its polycarbonate support housing compresses until it is forced out of its containment through a nozzle by pressure and extinguishes ('puffs') the arc by smothering it with fresh SF6 gas. If the volume of gas ejected is of insufficient speed and volume, then arc extinction at the next current zero may not be achieved and a re-strike may occur.

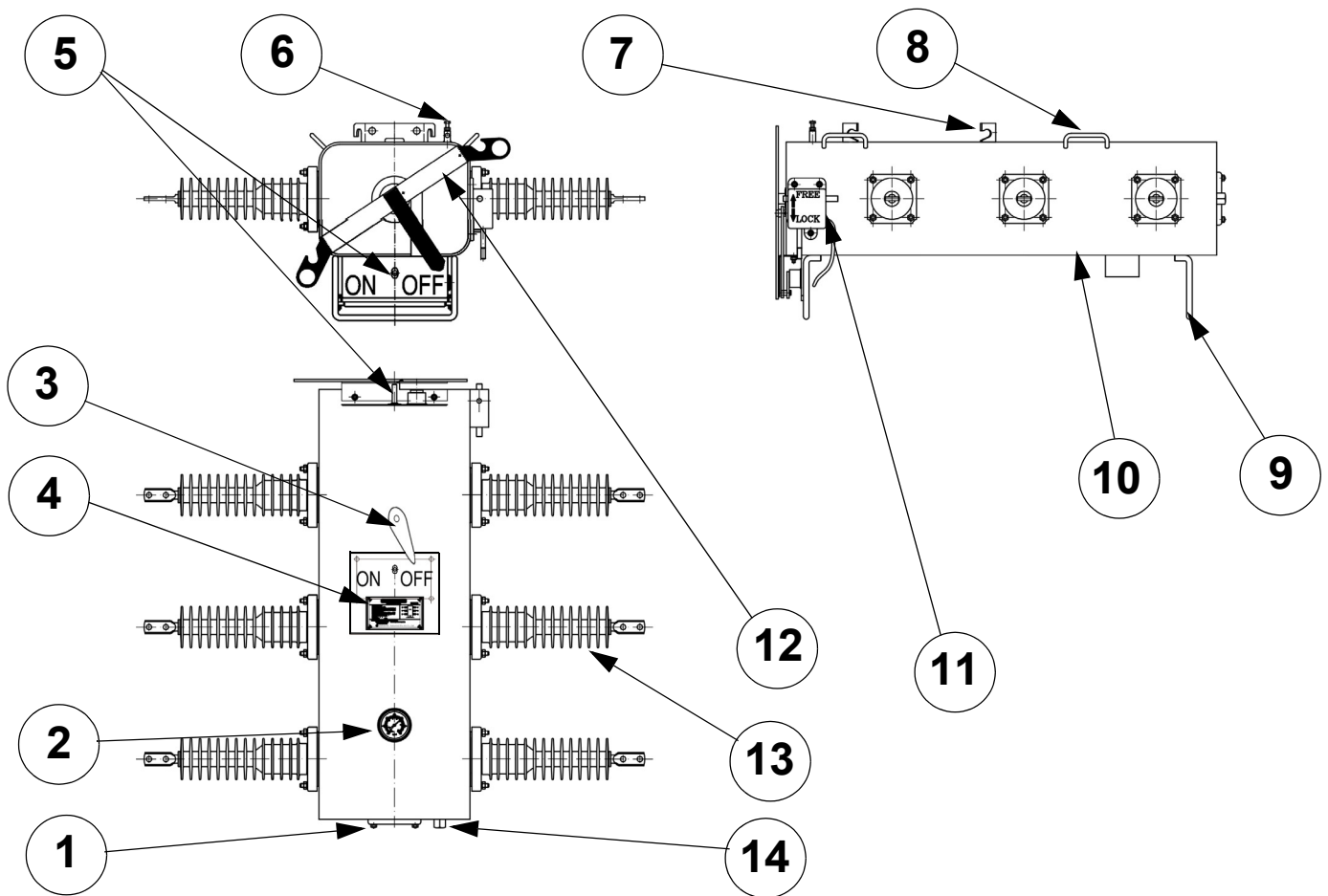
The speed of contact separation is also important, not only to build sufficient gas pressure and rapidly eject the fresh SF6 gas onto and around the arc, but also to build up electrical insulation across the ever widening contact gap quickly enough so as re-strikes cannot occur.

## 1.5. Indication

Two ON/ OFF mechanical indicators are provided, one on the side of the tank with the operating arm and one underneath the mechanism compartment visible to an operator at ground level. The indicators underneath the tank are directly operated from the switching shaft.

## 1.6. Actuation

As mentioned beforehand, the operating mechanism, which OPENS and CLOSES the GX switch, can be actuated manually by an operator at ground level, using a hookstick to pull the operating arm.



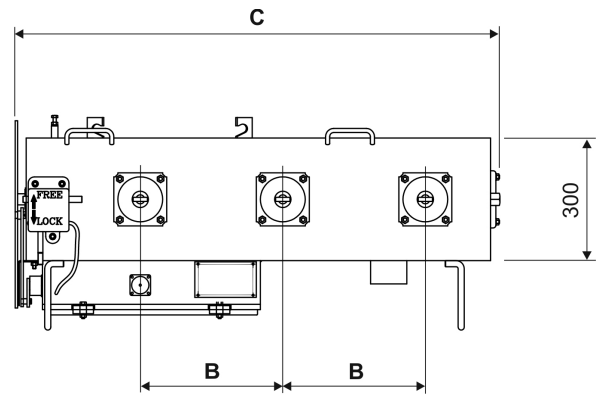
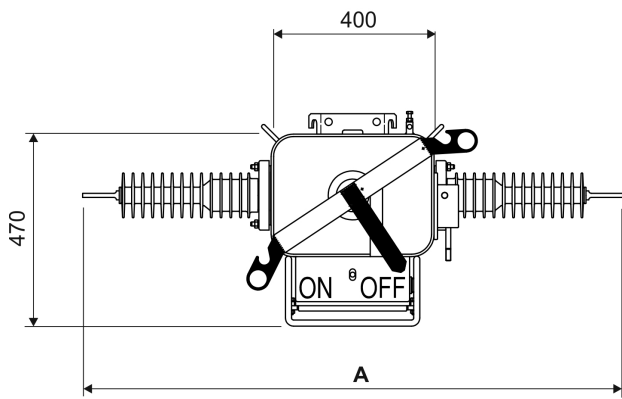
**Item list**

- 1 : Safety Membrane
- 2 : Pressure Gauge
- 3 : Position Indicator
- 4 : Rating Plate
- 5 : Pressure Locking Device
- 6 : Earthing Terminal
- 7 : Mounting Hangers
- 8 : Lifting Lugs
- 9 : Leg
- 10 : Tank
- 11 : Manual Lock
- 12 : Operating Handle
- 13 : Bushings
- 14 : Gas 'Top Up' Valve

## 2. Technical Data

Basic Ratings	GX-17.5	GX-24	GX-38
Maximum System Voltage	17.5kV	24kV	38kV
Rated Continuous Current	630A	630A	630A
Rated Frequency	50/60 Hz	50 Hz	50/60 Hz
Short Time Withstand Current (rms)	16 kA 1 sec	16kA 1 sec	16 kA 1 sec
Mainly Active Load Current	630A	630A	630A
Number of Load-Break Operations	100	100	400
Making and Breaking Capacity			
Short - Circuit Making Current (peak)	32.5 kAp	31.25kAp	32.5 kAp
Number of Making Operations	5	5	5
Cable Charging Current	10A	16A	20A
Line Charging Current	1A	1.5A	2A
Closed Loop Circuit Current	630A	630A	630A
Power Frequency Withstand Current Test			
Wet Conditions - 10 sec (Phase to Phase,,Phase to Earth)	38kV	50kV	70kV
Dry Condition - 1 min (Phase to Phase, Phase to Earth)	38kV	60kV	70kV
Dry Condition - 1 min (Across Interrupter)	45kV	60kV	80kV
Impulse Withstand Current Test (1.2 x $\mu$ s)			
Phase to Phase, Phase to Earth	95kV	150kV	170kV
Across Interrupter	110kV	150kV	195 kV
Other Ratings & Specifications			
Internal Arc Test	16kA 1 sec	16kA 1 sec	16kA 1 sec
Arc Extinction Medium	SF6 Gas	SF6 Gas	SF6 Gas
Insulation Medium	SF6 Gas	SF6 Gas	SF6 Gas
Minimum Creepage Distance (Polymeric Bushing)	525mm	768mm	1082mm
Operation Performance			
Closing/Opening Time	< 0.7 sec	< 0.7 sec	< 0.7 sec
Mechanical Operations	5000	5000	5000
Operating Temperature	-25 to 55°C	-25 to 55°C	-25°C - +55°C
Gas Pressure			
Nominal Pressure (Kg/cm <sup>2</sup> (MPa) at 20°C)	0.7(0.07)	0.7(0.07)	0.7(0.07)
Bursting Pressure (Kg/cm <sup>2</sup> (MPa) at 20°C)	0.36 to 0.58 (0.035 - 0.057)	0.36 to 0.58 (0.035 - 0.057)	0.36 to 0.58 (0.035 - 0.057)
Minimum Gas Pressure (Kg/cm <sup>2</sup> (MPa) at 20°C)	0.005(0.0005)	0.005(0.0005)	0.005(0.0005)
Leakage Rate (%/year)	0.001%/year	0.001%/year	0.001%/year

## 2.1. Rapier GX Dimensions



Dimensions in millimetres

	Dim A	Dim B	Dim C	Weight (kg)
GX-15	1120	250	900	97
GX-24	1380	290	980	106
GX-38	1530	350	1170	118

## 3. Receipt, Inspection and Storage

After the packing material has been removed, the GX switch should be checked for possible damage caused by rough handling during transportation. At the same time check that all parts according to Packing Sheet are delivered. If the switch is installed with a GAS PRESSURE GAUGE (METER) or GAS PRESSURE SENSOR, the gas pressure should also be checked.

### 3.1. Gas Monitoring

After unpacking the GX switch, the gas pressure has to be checked with a special tool (Gas Pressure Checker) through the gas filling valve placed on the side of the switch. Contact Lucy Electric for further information on the special tool for gas pressure monitoring.

If the switch is installed with GAS PRESSURE GAUGE, a visual check is easily made from the gauge. Ensure the gauge pressure is in the green zone. The normal operating pressure is 0.07 Mpa.

If the switch has low pressure gas, DO NOT install the switch and contact Lucy Electric for further information.



### 3.2. Storage and Transportation

- 1 : All goods furnished are packed in wooden seaworthy cases to ensure safe arrival at destination, withstanding such overseas hazards as rough handling and corrosion due to exposure to salt atmosphere and water spray.
- 2 : All goods furnished are preserved, packed, crated, loaded and braced, in accordance with the best commercial export practices
- 3 : The packaging case shall be numbered by the supplier to designate the package and total number of the package being shipped: for example: 1/3: 2/3: 3/3 the first figure designating the package number and the second figures to total number of package in the shipment.
- 4 : All packages are marked with a description of contents and destination. Marking is according to IEC specification.
- 5 : Do not stack more than 3 high.

### 3.3. Control Unit Storage

For extended storage periods, the GX switch and control unit should be stored in a cool and dry condition. The plastic packing around the control cabinet should be kept sealed until ready to be installed. Any wooden packaging should also not be subject to excessive moisture.

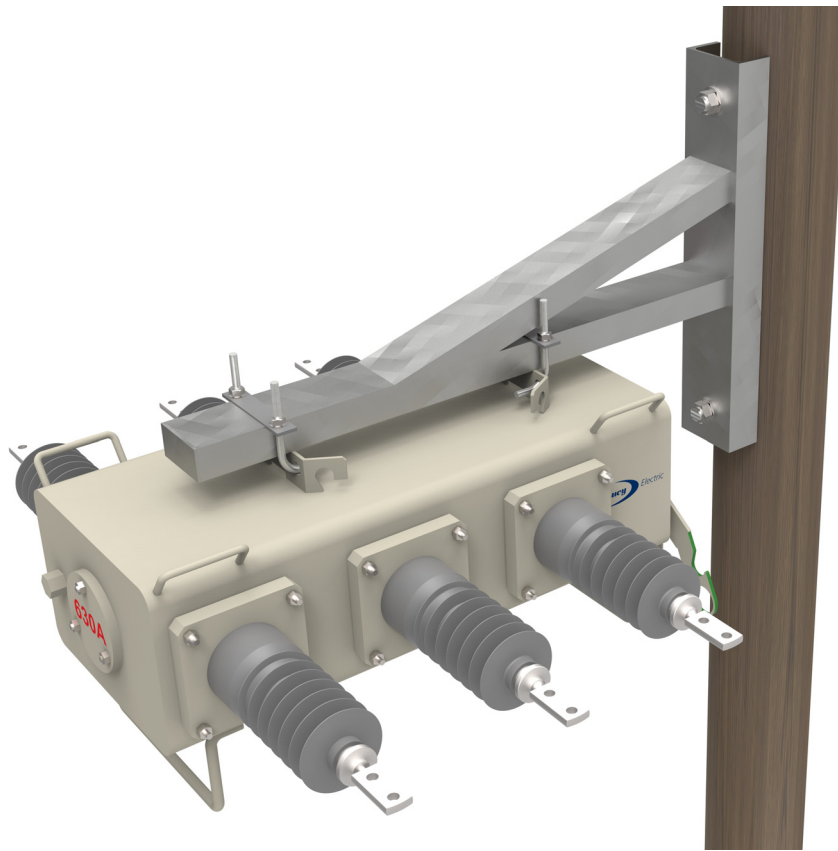
### 3.4. Damage

Any damage should be reported to Lucy Electric by email as soon as noticed.

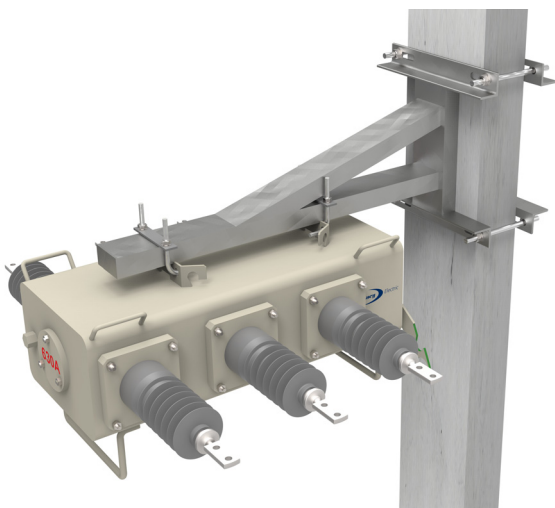


# 4. Pole Mounting Installation

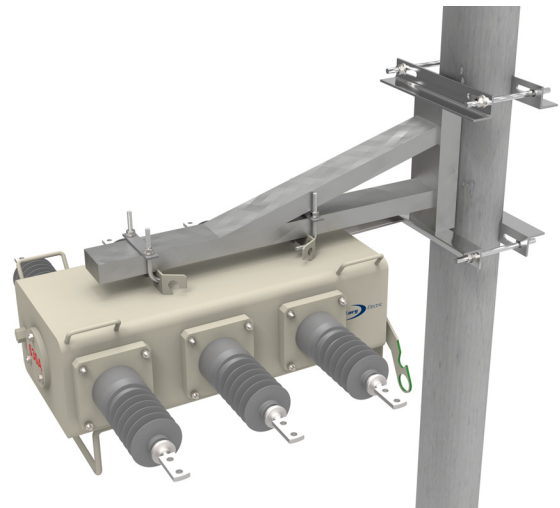
## 4.1. Mounting Arrangements



**Wooden Pole Mounting Arrangement**



**Rectangular Type Pole**



**Round Type Pole**

**Concrete Pole Mounting Arrangement**

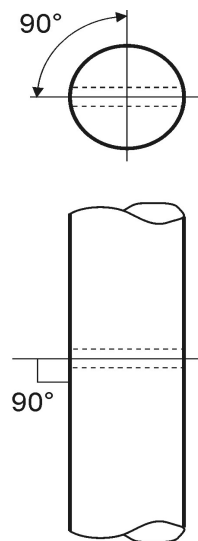
## 4.2. Main Tools Required for Switch Installation

- Equipment Lifting Device
- Lifting Rope/Straps
- Switch or Cable for Electricity Power Disconnection and Bypass
- Wrench to tighten up bolts and nuts
- Drill and Ø22mm drill bit (for wooden pole mounting only)

## 4.3. Mounting Switch Bracket to Wooden Pole

Fit switch bracket to the pole in conjunction with the contract drawing.

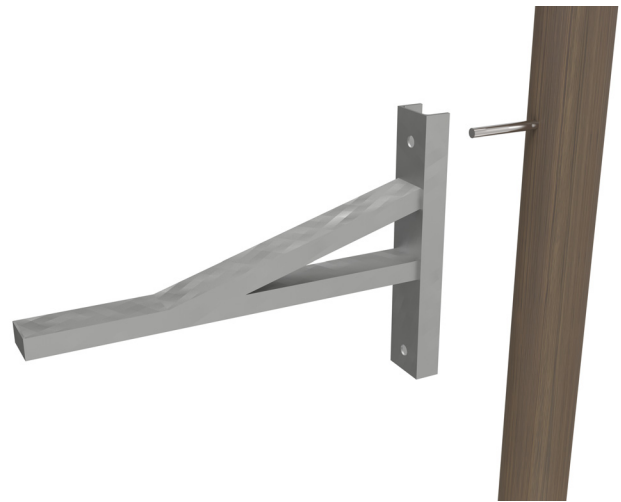
1 : Determine the mounting height of the switch unit from the contract drawing, then drill Ø22mm top mounting hole through the pole.



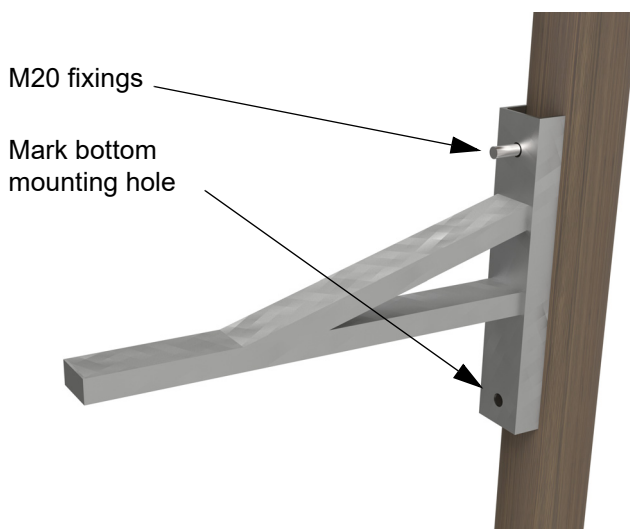
When drilling, ensure the hole is level and square to the pole in both directions.

**Note:** Hole must be at 90° to the direction of the power lines.

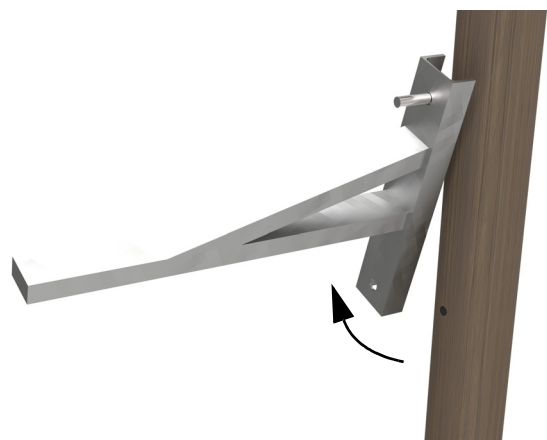
2 : Fit M20 stud through the pole and loosely mount the switch bracket using the top mounting hole.



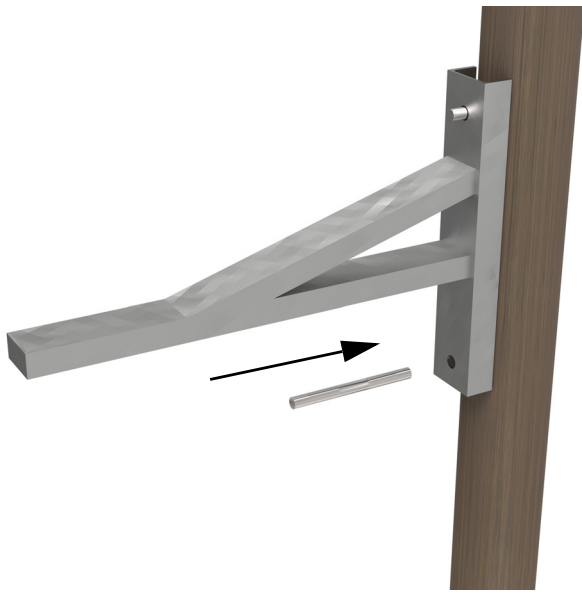
3 : Loosely tighten M20 fixing to stud. Ensure the bracket is at 90° to the pole and mark the bottom mounting hole on the pole.



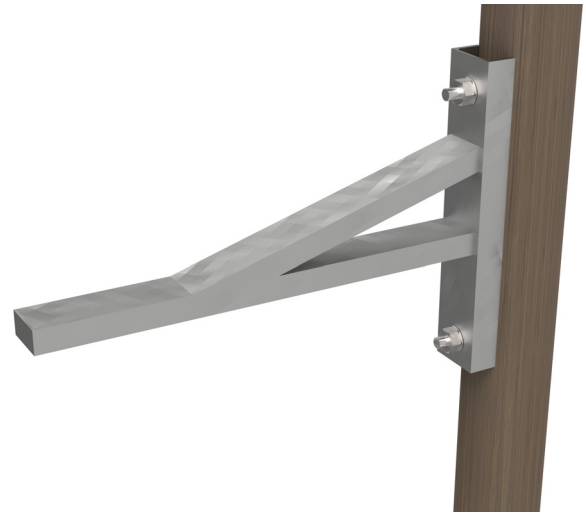
4 : Pivot the bracket out of the way, then drill Ø22mm bottom mounting hole into the pole.



5 : Fit bottom M20 stud.



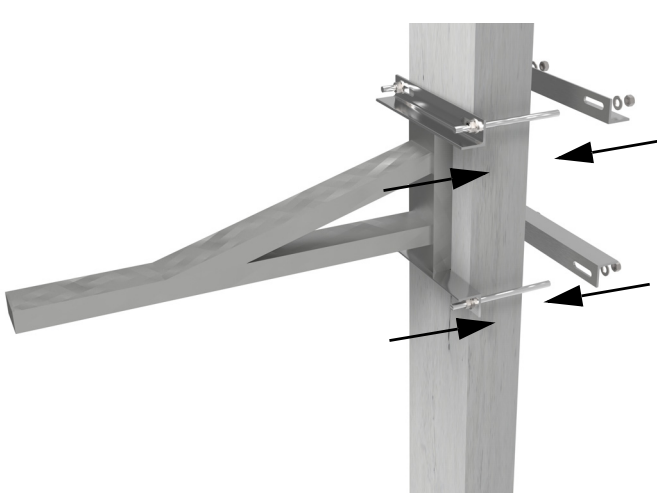
6 : Ensure the bracket is square with the pole, then fit and fully tighten all fixings to secure bracket



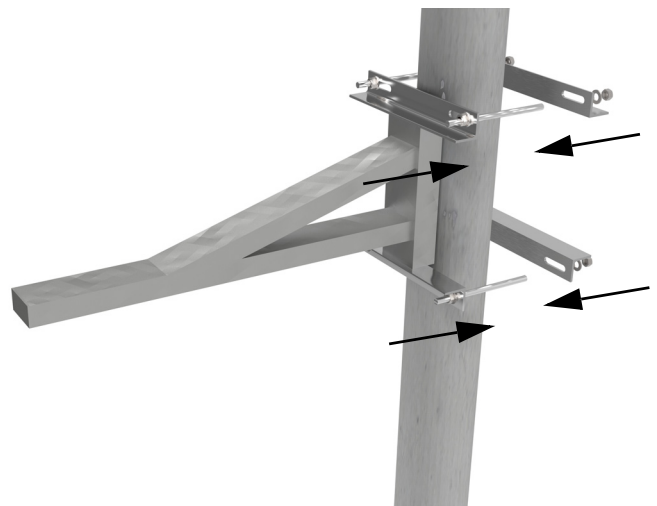
#### 4.4. Mounting Switch Bracket to Concrete Pole

Fit switch bracket to the pole in conjunction with the contract drawing.

1 : Determine the mounting height of the switch unit from the contract drawing, then fully clamp the mounting switch bracket either side of the concrete pole as shown below.



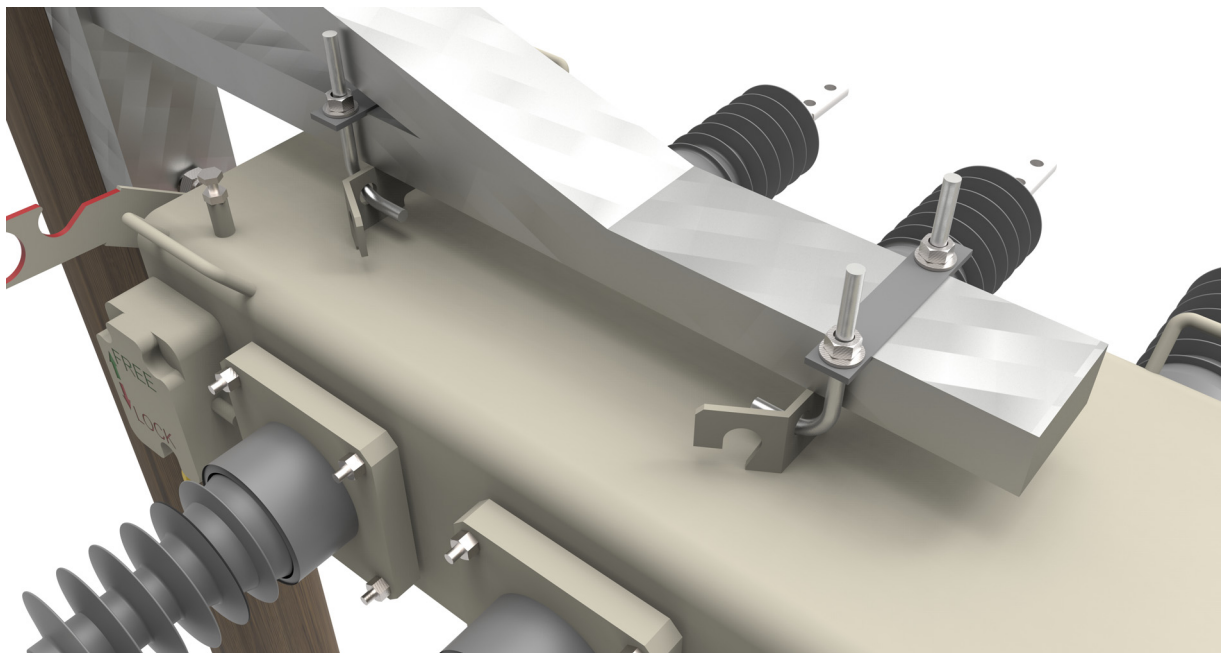
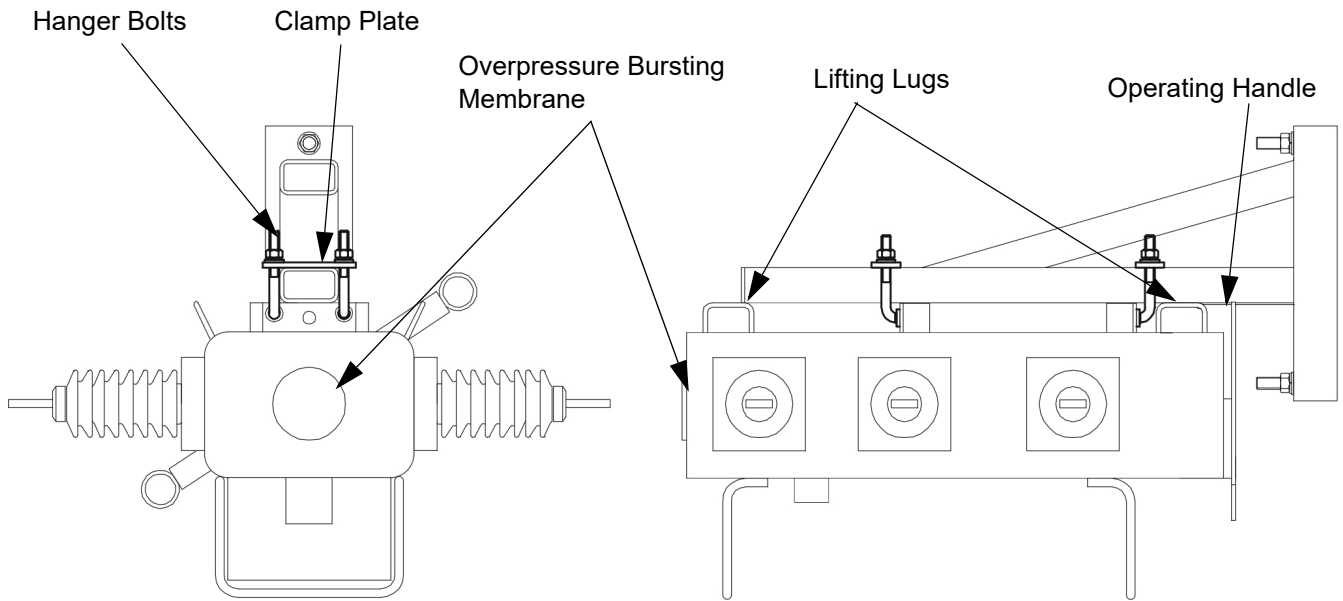
Rectangular Type Pole



Round Type Pole

## 4.5. Mounting Switch Unit to the Switch Bracket

**Note:** For mounting the switch unit to the switch bracket, a four-point lifting is strongly recommended utilising the four lifting lugs on the upper side of the Switch.



Clamp the switch unit to the switch bracket using the supplied hanging bolts and clamp plate.

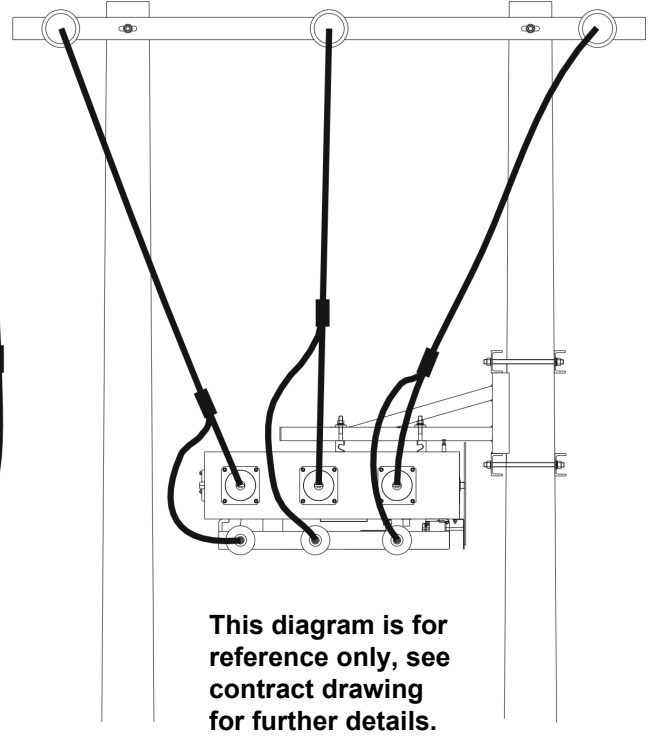
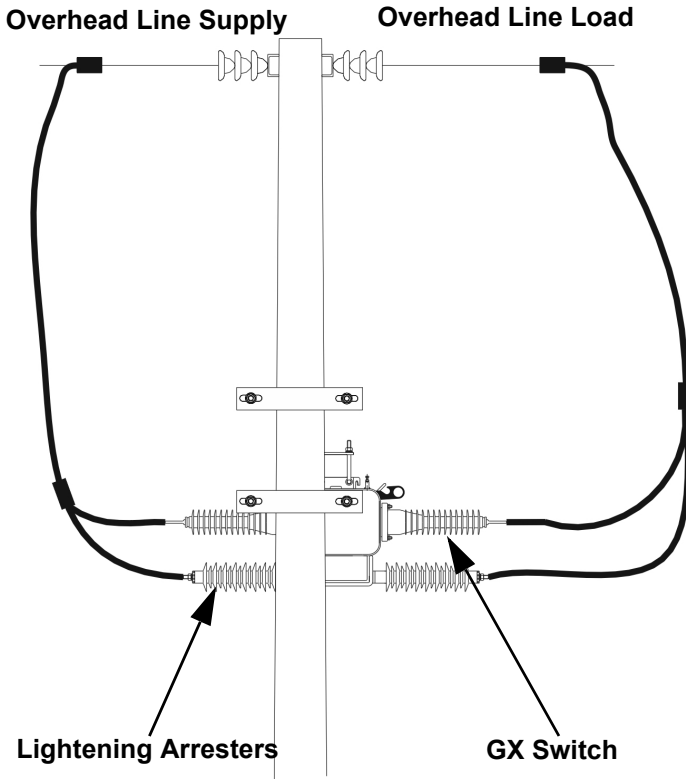
The Overpressure Bursting Membrane is located at the opposite end to the manual operating handle. When mounting the switch unit ensure the manual operating handle is facing the pole in order to safeguard any persons or other equipment.

**Exercise care during lifting to avoid damage to the bushings. The switch must not be lifted or moved by the bushings. This may cause excessive stress on the bushings and damage may result.**

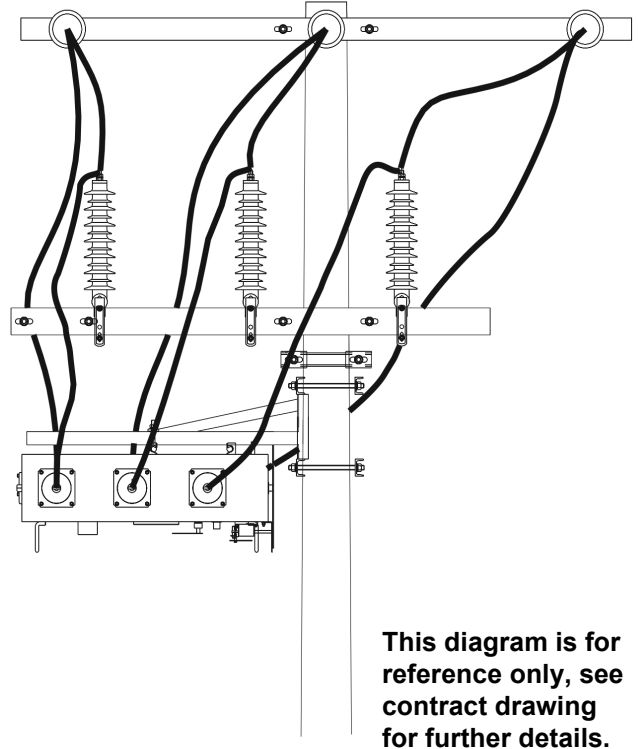
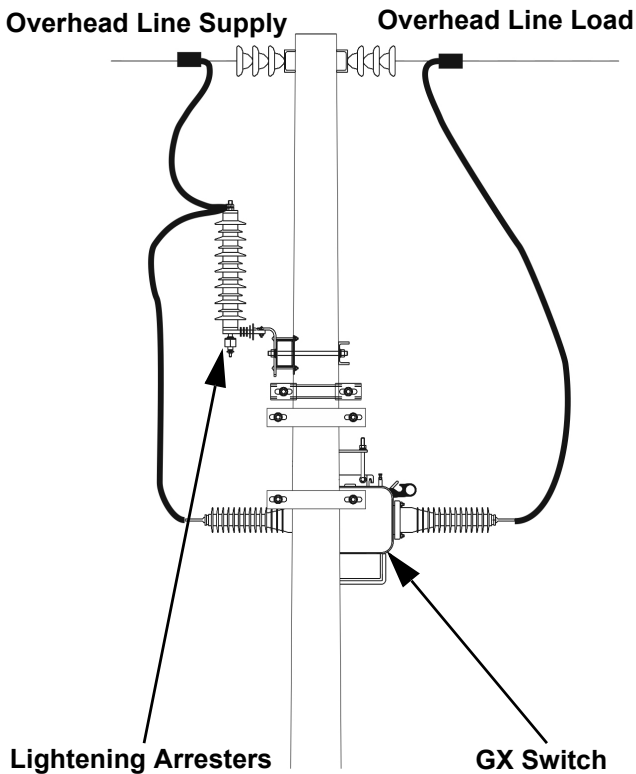
## 4.6. Installation of Lightning Arresters

Lightening arresters are necessary to guarantee safety insulation co-ordination on overhead lines. The lightning arrester should be mounted on the (optional) Lightning Arrester Plate welded on both sides of two legs of the GX Switch. Alternatively, if your Switch is not equipped with Lightning Arrester Plates, it should be installed on the mounting pole to protect the Switch and Control Cabinet.

### GX Mounted Lightning Arrester

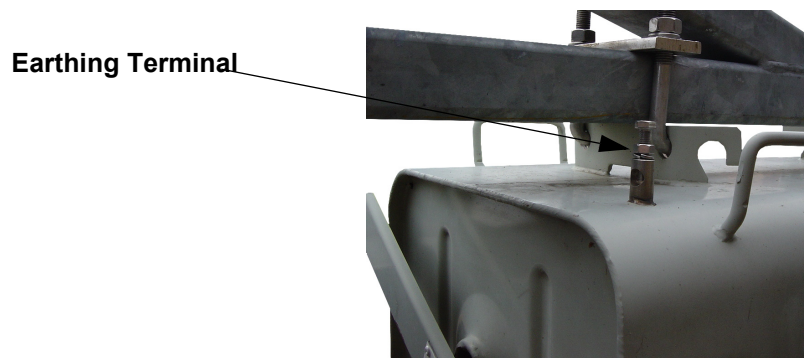


### Pole Mounted Lightning Arrester



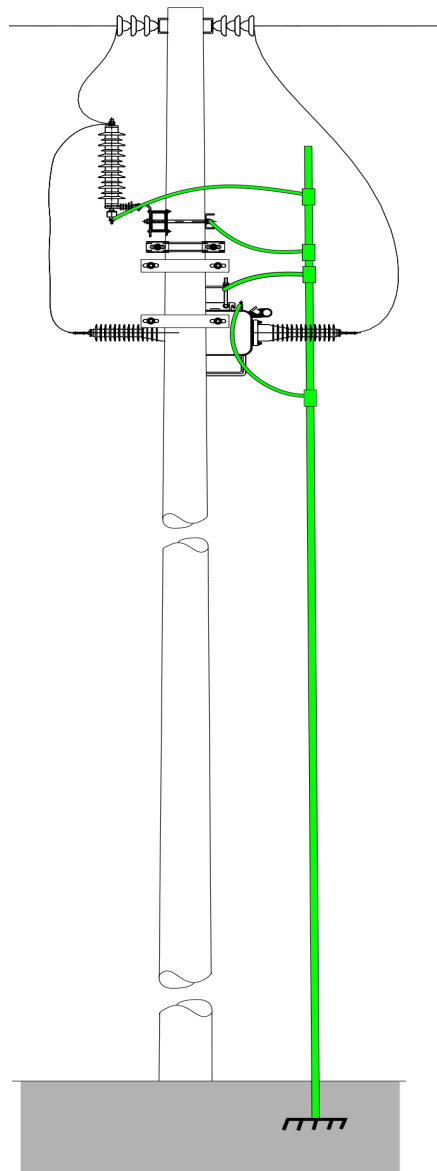
## 4.7. Earthing

The earthing of the switch unit must be in accordance with local safety regulations. The earthing cable must be connected to the earthing terminal on top of the unit as shown below.



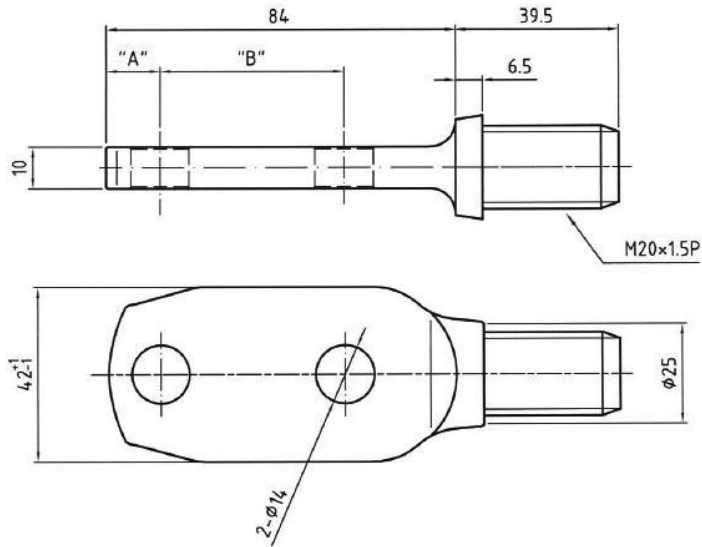
The earthing terminal uses a M12 bolt to clamp the cable. The diameter of the earthing terminal is to be a maximum of 9mm and no smaller than 2.6mm.

The standard earthing resistance should be below 10 ohms, although adherence should be made to local earthing regulations.



## 5. Main Circuit Connection

The bushing terminal is a NEMA type bare terminal.



Section	"A" Dia	"B" Dia	Type
H02	13	44.5	NEMA HOLE

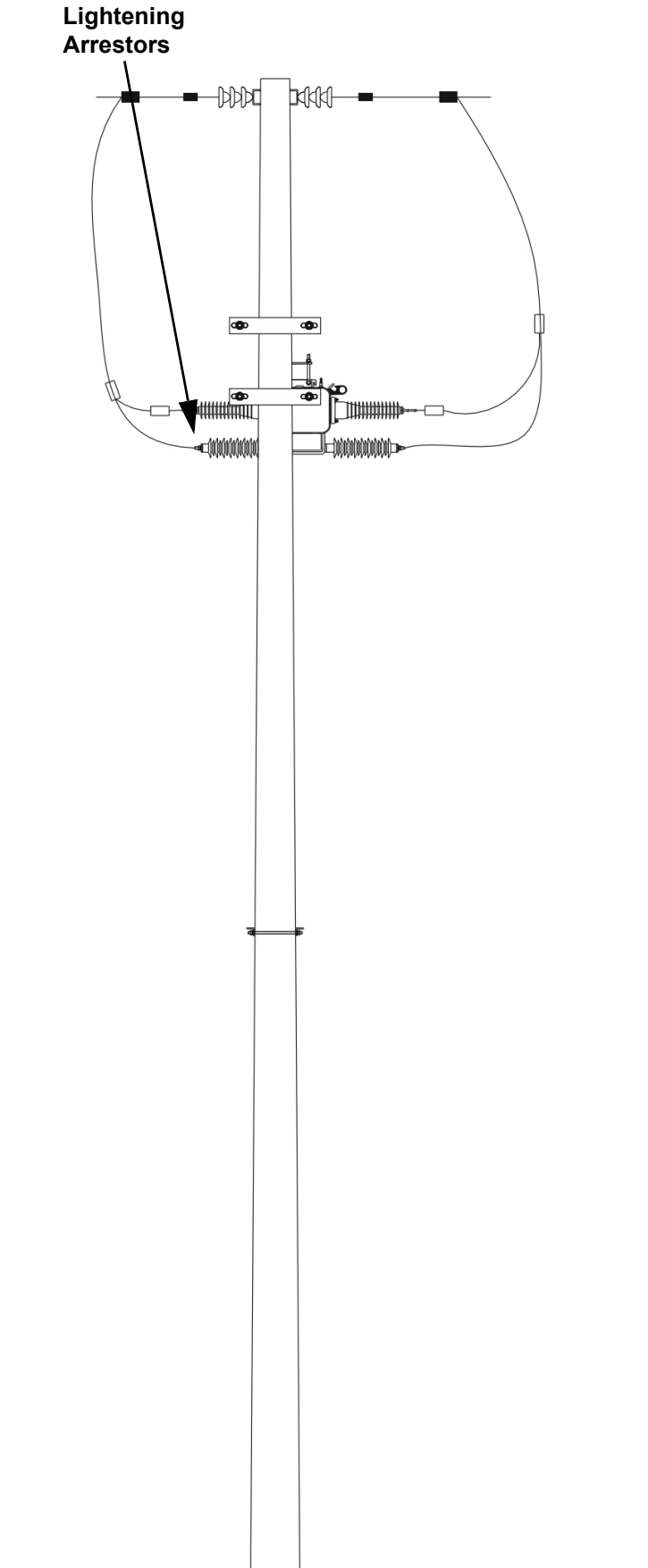
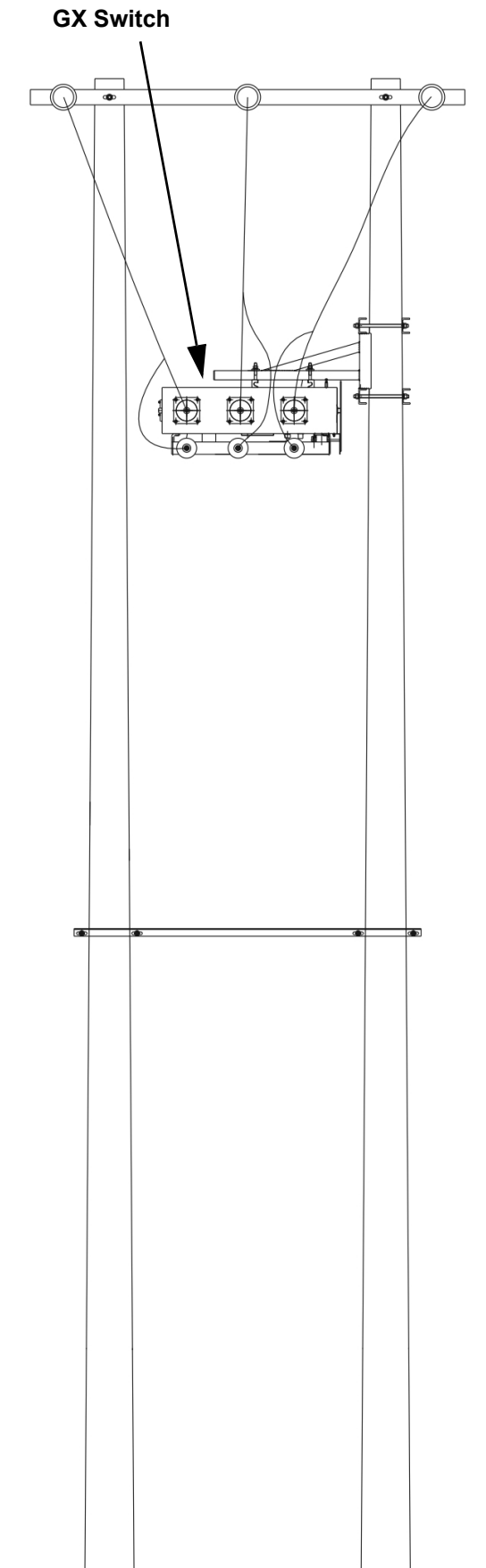
Dimensions in Millimetres

- Thickness - 6mm
- Slots 14mm wide for M12 bolts
- Surfaces suitable for electrical contact

The type of connectors to be used on the GX bushing terminals are the lug compression type. This terminal lug is an accessory part and is only supplied upon customers' demand.



## 6. Typical Installation





# 7. Operation

## 7.1. Energizing



Before energizing the GX unit, make sure that:

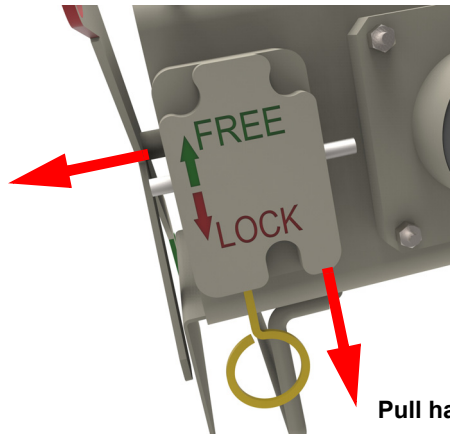
- The gas pressure is correct.
- The function of the operating devices and position indicators is correct.
- The line and earthing cables are connected correctly and with sufficient clearances.

## 7.2. Manual Interlock

The manual interlock is a device to manually **LOCK** the operating handle in position, normally in the **OPEN** position, but it can also be locked in the **CLOSED** position.

The operation of the manual interlock is achieved by applying an operating rod (hookstick) to the ring handle and pulling downwards. Conversely, pushing the ring handle upwards frees the manual interlock.

Shootbolt moves out to block the operating handle



Pull handle downwards to lock.

**Note:** Ensure that the manual interlock is pushed up into its 'FREE' position before performing any manual operations.

## 7.3. Manual Operation

To **CLOSE** the switch, fully pull down the **RED** right hand end of the operating handle. The operating handle indicator will now be in the 'ON' position.

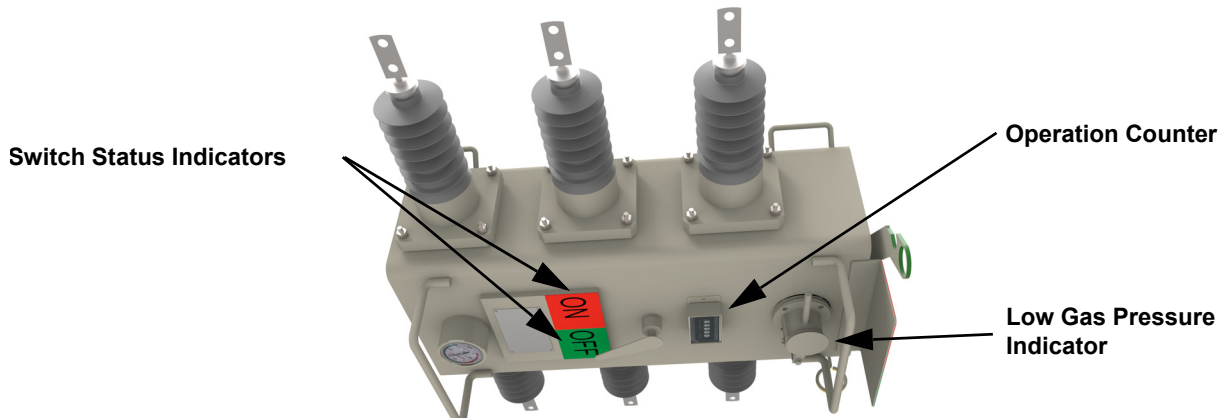


To **OPEN** the switch, fully pull down the **GREEN** left hand end of the operating handle. The operating handle indicator will now be in the 'OFF' position.



### 7.3.1. Switch Status Indicator

The switch status can be confirmed by the manual operation handle and also by the indicator on the underside of the switch.



**Note:** The GX switch has a dead point toggle action mechanism and the operating handle moves an extra 5° past the dead point. This means that even though the handle has fully rotated, the main driving shaft of the contacts may not move any further so therefore the position of the contacts should be confirmed by the switch status indicator.

The switch status indicator is directly coupled to the main driving shaft of the contacts, with the CLOSE and OPEN positions maintained by a pre-tensioned spring. This ensures that the switch cannot be opened or closed unintentionally by gravity, vibrations and wind force etc.

### 7.4. One Stage Alarm / Low Pressure Locking Device

A low SF6 pressure locking device is activated at below 0.039MPa.

In the event of an internal arc within the GX switch tank, the low pressure locking device will operate and drive a pin out on the operating handle side of the tank. This mechanically inhibits the GX switch from being operated from its current state. A red low gas pressure indicator will appear underneath the switch mechanism compartment. Also refer to “Internal SF6 Switch Short Circuit” on page 20

### 7.5. Safety Rules During Operation

If the low pressure or manual locking device is activated, then do not try to operate the handle with excessive force as this could damage the unit.

With the switch in its open position, before any work is conducted on the line, the line voltage should be checked and the load side earthed.

During line maintenance pull down the manual interlock into the LOCK position.

### 7.6. SF6 Gas

Pure SF6 gas is a non toxic, non flammable, heavy inert cooling gas of high dielectric strength and thermal stability. The GX switch uses SF6 gas as an insulation and arc quenching medium. Arcing in SF6 decomposes a small amount of the gas. Parts of these decomposition products may be toxic. Under normal operating conditions these de-composites are only present in small quantities and for limited periods inside the switch tank. They are dissipated by actively absorbing back into the surrounding pure SF6. During normal operation of the GX switch, the operator does not need any special protection.

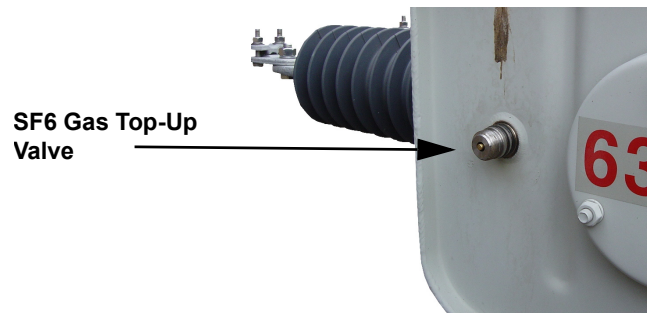
## 8. Rapier GX Maintenance

### 8.1. SF6 Gas Leakage

If the gas pressure gauge indicates low gas (needle in the red zone), then the unit must be topped up before operating.

If required, Lucy Electric recommend that the line is isolated, the GX switch disconnected and lowered to the ground before topping up with SF6 gas. The topping up of the SF6 gas **MUST BE** carried out by a person fully trained in SF6 and using approved equipment.

If a GX switch has been topped up with SF6 gas, then it must be monitored for a period. If still losing gas then the unit must be decommissioned, replaced and sent for investigation.



### 8.2. Internal SF6 Switch Short Circuit

If there is an internal fault within the switch, the pressure will rapidly increase, and the pressure relief device will release the excessive gas pressure before explosion. If the pressure relief device (not resettable) bursts, then the low-pressure locking device will operate, and the close/open operation will be prohibited both mechanically and electrically. **In this event the GX can no longer be used and will have to be replaced.**

In normal switch operation the arc by-product powder will remain inside the GX switch tank because of the safety design of the pressure relief device, if the back up protective device clears the fault within a required time (0.3 sec).

### 8.3. Maintenance

The GX switch is maintenance free for the expected service life of the switch. The tank is made of stainless steel, so no need for corrosive protection. Maintenance is needed only if the gas pressure has dropped below the initial pressure level.

### 8.4. Disposal of the GX Switch

The GX switch includes valuable materials for recycling such as stainless steel, copper, steel and SF6 gas. Small amounts of SF6 gas de-composites may be formed during the switching operations. These are mainly eliminated by reabsorption. However some precautions are recommended to ensure safe handling of these materials. Local regulations, if any, must be followed (see IEC 60480).

During the dismantling of the unit, care should be taken to avoid contact with decomposed SF6 powders and cleaning fluids with skins and eyes. Compressed air **SHOULD NOT** be used for removing powders.

#### SF6

SF6 gas can be removed from the switch tank by using a vacuum pump and compressor which scavenges the SF6 to a gas containment vessel. Once the gas is fully pumped out, allow dry air into the evacuated tank. The scavenged gas should be recycled by the SF6 gas manufacture.

#### Tank

The tank should be cut open outside or in a well ventilate room. Cutting methods based on temperatures above 500°C should not be used to avoid formation of toxic products. The decomposed SF6 power should be neutralized. A suitable method is immersing in a solution of 1- 3kg sodium carbonate with 100 litres of water for 24 - 48 hours. Contact with skin and eyes should be avoided, especially if higher concentration of sodium carbonate is used. After neutralization the decomposed SF6 powder can be handled as normal waste.

#### Other items

All other parts of the switch can be handled as normal metallic or plastic waste. It is recommend to remove any decomposed SF6 power using a vacuum cleaner or by rinsing with clean water. The vacuum cleaner bags should be disposed of safely and be treated as SF6 waste.

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