

**UNLOADING, STORAGE, ERECTION,  
INSTALLATION & MAINTENANCE MANUAL**



**420 kV MAINTENANCE EARTH SWITCH**

**TYPE: FEE(MES)**

**Disconnectors are remarkable pieces of equipment. They can stay in the same position for years before they have to switch. But, then at the critical moment they have to work perfectly. No matter what the condition are, whether they are in the freezing cold or in the extreme hot.**



# INDEX

1.0.	PREAMBLE	5
2.0.	GENERAL DESCRIPTION OF THE MAINTENANCE EARTH SWITCH	5
<b>SECTION: A UNLOADING AND STORAGE INSTRUCTIONS</b>		
3.0.	UNLOADING	6
3.1.	STORAGE	6
3.2.	LONG TERM STORAGE INSTRUCTIONS	6
<b>SECTION: B CONSTRUCTION</b>		
4.0.	BASE ASSEMBLY	9
5.0.	FIXED CONTACT SUPPPORT	9
6.0.	OPERATING MECHANISM	10
7.0.	DOWN OPERATING PIPE	11
8.0.	TANDEM PIPE ASSEMBLY	11
9.0.	EARTH SWITCH ASSEMBLY. TYPE- DIRECT ENTRY (DEE)	12
10.0.	EARTH FIXED CONTACT ASSEMBLY	13
11.0.	INSULATOR ASSEMBLY	13
12.0.	SUPPORT STRUCTURE	13
<b>SECTION: C INSTALLATION &amp; SETTING INSTRUCTION</b>		
13.0.	STRUCTURE	14
14.0.	BASE ASSEMBLY	14
15.0.	INSULATORS	15
16.0.	FIXED CONTACT ASSEMBLY	16
17.0.	EARTH SWITCH ASSEMBLY	18
18.0.	OPERATING MECHANISM AND DOWN OPERATING PIPE	19
19.0.	TANDEM PIPE ASSEMBLY	24



## **SECTION: D COMMISIONING AND MAINTENANCE**

20.0. COMMISIONING OF MAINTENANCE EARTH SWITCH	25
21.0. MAINTENANCE	25
22.0. TOOLS AND TACKLES	25
23.0. RECOMMENDED SPARES	26
24.0. RECYCLING OF END OF PRODUCT LIFE MATERIAL AND DISPOSAL	27

### **DOCUMENTS ATTACHED**

LIMIT SWITCH AND AUXILIARY SWITCH SETTING PROCEDURE

O&M INSPECTION PROCEDURE

DISCONNECTOR SITE SETUP / CHECK PROCEDURE



## **1.0. PREAMBLE:**

The maintenance earth switch described in this publication is designed, manufactured and tested with care and will give satisfactory service if it is installed, operated and maintained in accordance with the instructions, by fully skilled personnel duly authorized to carry out this work.

Efforts are constantly being made to improve design and manufacturing. Hence the equipment supplied may differ in minor detail from the data given in this publication.

## **2.0 GENERAL DESCRIPTION OF THE MAINTENANCE EARTH SWITCH:**

- Maintenance earth switch are used to connect the live parts/line conductors and discharge the voltage to earth, during maintenance and testing.
- 420 kV maintenance earth switch are designed for independent single pole operation or three pole mechanically ganged operation. It can be operated either manually or by motor.
- 420 kV maintenance earth switch are checked for satisfactory operation at the works. They are supplied in knock down condition ready for assembly at site. The relevant standards for maintenance earth switch are IEC: 62271-102 and IS: 9921. For insulators IEC: 60273 / 60168 and IS: 2544.

## SECTION-A

### UNLOADING AND STORAGE INSTRUCTIONS

#### 3.0 UNLOADING:

- Unload the crates / boxes using crane / fork lift truck, as appropriate.
- **Do not roll the crates. Do not drop the crates over tyres / rubber mats. Etc.**
- Use proper lifting tools / tackles like nylon belts / ropes etc.
- Count the number of crates / boxes and tally them against the shipping document.
- Inspect thoroughly all the crates / boxes for damages.
- In case of damage, identify the crate / box and keep it separately.
- Take adequate photos of the damage.
- Kindly report the damage to the transporter in writing.
- Also mail the damage report (along with the photographs) to **Mr. S.R. Kumaresh of S&S Power Switchgear Equipment Limited**. Email: [srk@ssppower.com](mailto:srk@ssppower.com).
- Segregate the crates, voltage rating wise. Colour codes are provided in individual crate / box for each voltage rating.  
(White – 36kV, Yellow – 145kV, Green – 245kV & Blue – 420kV)

#### 3.1 STORAGE:

**“Failure to properly store and protect disconnectors / parts may cause damage to equipment. Such damage could cause hard operation, mal-operation and contact resistance issue when equipment is installed / tested and mal-function in service.”**

- Storage shall be made in an area that is well ventilated and provided with drains to prevent water stagnation.
- It is advisable to leave all crates / boxes in packed condition until the start of erection.
- All crates / boxes shall be properly stored / stacked with proper covers.
- Disconnector and operating mechanism crates / boxes should always be stored in elevated position (at least two feet above ground) to prevent water entry.
- In case of longer storage period / damp atmosphere, the operating mechanism boxes shall be removed from packing and electrical space heating is to be provided.
- Space heating should continue till complete removal of moisture / condensation.
- Adequate care to be taken to prevent entry / ingress of dirt, moisture, cement, sand and other corrosive material.



### 3.2 LONG TERM STORAGE INSTRUCTIONS:

#### General instruction (for all materials):

##### Ground clearance:

All materials, including operating mechanisms, should be kept at a minimum of 600 mm (two feet) height from the ground level using pallets or cement concrete bed, to avoid water entry during rainy season. However, the water level rise at the respective site / storage locations shall be considered for fixing the ground clearance (but shall not be less than 600 mm).

##### Operating mechanisms:

**The primary consideration in case of long term storage of operating mechanism is the temperature and relative humidity level of the storage location. This should be maintained as closely as possible to the standard reference atmospheric conditions.**

Upon unloading from the container / truck, kindly follow the steps specified below, to ensure proper storage and preservation of operating mechanisms, for long term storage:

##### During normal seasons (without rain / snow):

- Take out the operating mechanisms from the wooden cases.
- Remove the polythene cover / bubble wrap sheet carefully.
- Check the operating mechanisms visually for any damages.
- Clean all the outer surfaces.
- Open the door and remove the desiccants (silica gel pack) fitted inside the box.
- Place five fresh bag indicator type desiccant packs (each 100 grams) of fresh silica gel granules (preservatives).
- Close the door.
- Do not cover or wrap the operating mechanism (so that better breathing is provided during long term storage).
- In case of longer periods of storage, replace the silica gel once in 3 months and close the door. (Note: the three month period is indicative only. Kindly check with the supplier of silica gel for time period of usage and time after when it has to be replaced).
- Ensure that the silica gels used are the fresh ones removed from the air tight container (before placing them inside the operating mechanism boxes).
- Keep all the drive mechanisms in a dust free environment.
- If dust is unavoidable then ensure complete cleaning at least once in a month.
- In addition carry out periodical checks for any abnormal dust accumulation and clean accordingly.
- Ensure that the entire storage area is temperature controlled (to ensure better storage and condition of the equipment).
- The optimum temperature is 20 deg c and relative humidity is 45% (values to be checked using combined humidity and temperature indicators placed throughout the warehouse / storage area and should be visible for close monitoring).



**During monsoon seasons (with rain / snow):**

- All points given above shall be followed.
- In addition, during rainy season, anti condensation heaters to be kept “on” and suitable electrical protection to trip the electrical circuit to be provided in case of any short circuit.
- Foam adhesive backed strip with volatile corrosion inhibitors also to be paste along the inner surfaces of the operating mechanism in place of silica gels.
- Inspect all operating mechanism boxes for integrity of the painted surfaces once in a month.

**Other contacts and steel materials:**

- Clean all the contact surfaces thoroughly with a lint-free cloth.
- Protect all contact surfaces with a thin layer of petroleum gel.
- Cover all contacts and aluminium arms with polythene sheets / covers.
- Ensure that the inside surfaces of the polythene coverings are pasted with foam based adhesive strip.
- Provide volatile corrosion inhibitors sheets and paste them along the inner surfaces.
- Kindly repeat the above steps once in every three months.

**Galvanized steel items:**

These are to be wrapped / covered with waterproof / dust proof covering and sufficient bags of silica gels to be placed in various places inside the covering. Once in 3 months all materials to be cleaned and replaced with silica gel bags.



## SECTION – B

### CONSTRUCTION

Our 420kV Maintenance earth switch comprises the following:

- 4.0. Base assembly.
- 5.0. Fixed contact support.
- 6.0. Operating mechanism.
- 7.0. Down operating pipe.
- 8.0. Tandem pipe assembly.
- 9.0. Earth switch assembly. Type – Direct Entry (DEE).
- 10.0. Earth fixed contact assembly.
- 11.0. Insulators (Optional).
- 12.0. Support structure (Optional).

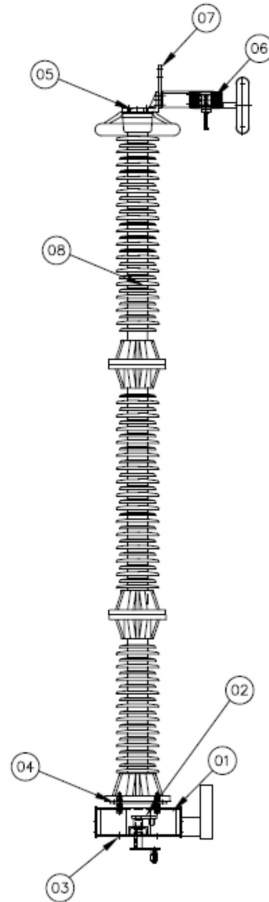
#### **4.0. BASE ASSEMBLY:**

- Each 3 pole maintenance earth switch (R, Y, B) is supplied with two types of base assemblies.
  - a) One base Assembly (say R pole) with drive arrangement.
  - b) Other two bases (i.e. Y&B) without drive arrangement.
- The base consists of a hot-dip-galvanized steel channel (1) (**See figure. A**).
- All ferrous parts in base assembly are hot-dip galvanized to IS 4759-1984.
- Base assemblies are supplied with:
  - a) Torque bearing (2) in assembled and aligned condition (only for drive end).
  - b) Lever and hinges with pins, Friction washer, Brass washers and Split pins.
  - c) Four holes on plate fixed at base bottom (3) for fixing the base channel to the supporting structure.
  - d) One fixed support to hold insulator (4).

#### **5.0. FIXED CONTACT SUPPORT:**

- The Aluminium support (5) has provisions to fix the earth fixed contact (6) as well as terminal pad (7) (**See figure. A**).

**FIGURE - A**



**POLE ASSEMBLY**

**6.0. OPERATING MECHANISM:**

- Geared motor operating mechanism consists of a final worm reduction gear driven by a DC or 3Ø AC motor in line with customer requirements.
- Necessary Overload protection, Control Switches for Local / Manual / Remote operation and Limit Switches for Control / Signal are provided. In the event of supply failure, the Mechanism can be operated manually. Manual operating mechanisms are supplied with or without reduction gear in accordance with customer requirements.
- The Mechanisms are housed in an IP55 grade box made of Aluminium / Mild steel / Stainless steel having a thickness of 2-3mm. Auxiliary switches having silver-plated contacts with positive wiping action with adequate number of NO, NC and long wipe contacts as per specific requirements are provided. Suitable blank gland plate is provided at the bottom for cable terminal gland.
- Suitable terminal blocks made of non-inflammable thermosetting plastic are provided for terminating control and auxiliary wiring. Front door of the mechanism box is provided with good quality gasket to ensure high degree of protection against polluted atmosphere. (See figure. B)

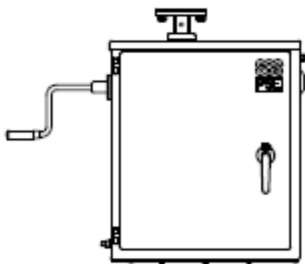
## 7.0. DOWN OPERATING PIPE:

- This assembly is used to connect the 'T' Bar torque bearing assembly fitted in base assembly to the flange fitted in operating mechanism box assembly.  
(See figure. C).
- The above assemblies are made out of MS Pipe with 'T' Bar Welded in topside and vernier flange-welded at the bottom according to structure height.
- The above welded Assembly is hot dip galvanized.
- Depending on customer requirement universal joints can be provided as follows.
  - a) Two Universal joint (1), one with 'T' Bar (2) and other on the vernier flange (3) of the drive mechanism.
  - b) One Universal joint at the bottom and diaphragm plate (4) on the top.

## 8.0. TANDEM PIPE ASSEMBLY:

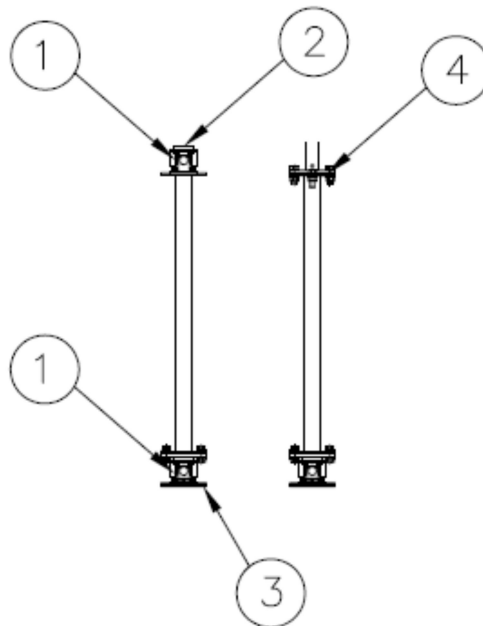
- The tandem pipe assembly is used to connect adjacent poles for gang operation of all the three poles with one drive mechanism. The lengths are adjustable to suit minor variation at site. (See figure. D)
- These parts are hot-dip galvanized and assembled with necessary pins & bushes etc.

**FIGURE – B**



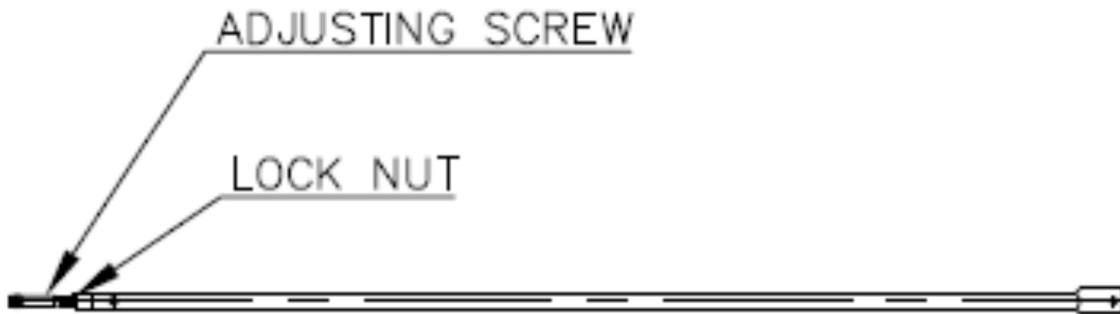
**DRIVE BOX**

**FIGURE - C**



**DOWN OPERATING PIPE**

**FIGURE - D**

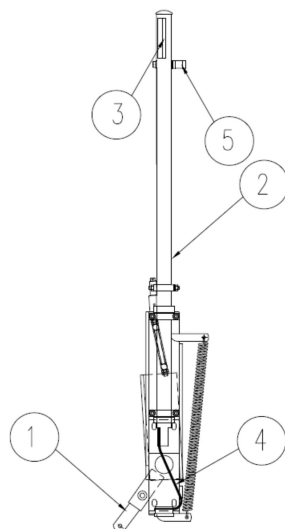


### **TANDEM/GANG PIPE**

#### **9.0. EARTH SWITCH ASSEMBLY. TYPE- DIRECT ENTRY (DEE):**

- Direct Entry Earth Switch is operated through levers (1) and has over center provision to prevent the switch from opening due to wind forces, vibrations or any short circuit force. **(See figure. E)**
- Extrusion contacts (3) which is made out of electrolytic copper with silver plating are fixed to end of the moving Blade made out of Aluminium tube (2).
- Mounting Plate and all other parts are Hot-Dip Galvanized and supplied in assembled condition.
- The lower end of the tube is provided with flexible tinned copper connector (4) (number and size according to the short-circuit withstand capability) for the connection to the earthing switch base.
- Hook (5) is provided in the tube to hold the fixed screw in earth fixed contact by turn and twist mechanism to safeguard accidental opening of earth blade from short circuit force, wind force etc.,

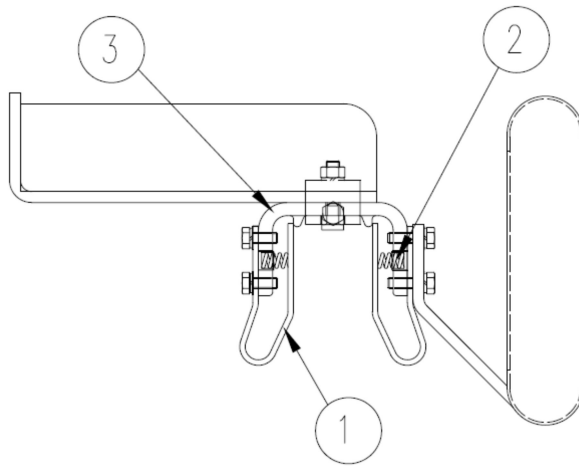
**FIGURE – E**



#### 10.0. EARTH FIXED CONTACT ASSEMBLY:

- The fixed contacts are of the multi-finger reverse-loop pattern (1). Contact pressure is applied to each individual finger by an insulated stainless steel spring (2). Contact fingers are of hard drawn copper, silver plated and are bolted into the aluminum alloy support casting (3). **(See figure. F).**
- Electrolytic corrosion between the fingers and aluminium alloy is inhibited by doing tin plating at the bottom side (contact surface with aluminium casting) of finger and also application of electrical jointing compound during assembly.

**FIGURE – F**



#### 11.0. INSULATOR ASSEMBLY:

- Insulators (8) are selected to meet the basic insulation level, minimum creepage and minimum bending load to suit the Customer / Design requirement. **(See figure. A).**

#### 12.0. SUPPORT STRUCTURE:

- Support structure, when ordered, shall be designed and manufactured to meet customer specifications. They are assembled on the civil foundations of the customer and shall meet the dimensions of the maintenance earth switch with their respective drives etc.
- Structures are hot dip galvanized to meet IS4759 – 1984 Specifications.
- Structures are designed with necessary factor of safety to withstand all forces i.e., short circuit force, wind force and dead load etc.

## SECTION – C

### INSTALLATION & SETTING INSTRUCTION

**Warning: Earth Switches are high voltage equipment. In all the site safety precautions and requirements shall be strictly followed. The line where the Earth Switch is to be connected should be de- energized before commencing of the work.**

#### 13.0. STRUCTURE: (WHERE SCOPE IS INCLUDED)

- Refer the site layout and identify the structures of the respective maintenance earth switch to meet the sub-station lay-out.
- Assemble the members on their respective foundations as per their general layout.
- Complete the assembly and tighten all the bolts with nuts, washers etc.
- Check for levels at the top of the Structure in the both directions by using spirit level / Water levels. If required give shims below the base plate of structure and tighten the nuts.
- Similarly complete erection of all structures.
- After erection, check for the following:
  - a) All fixing dimensions with respect to the centre of the structure.
  - b) Diagonal distance to match as per contract drawing.

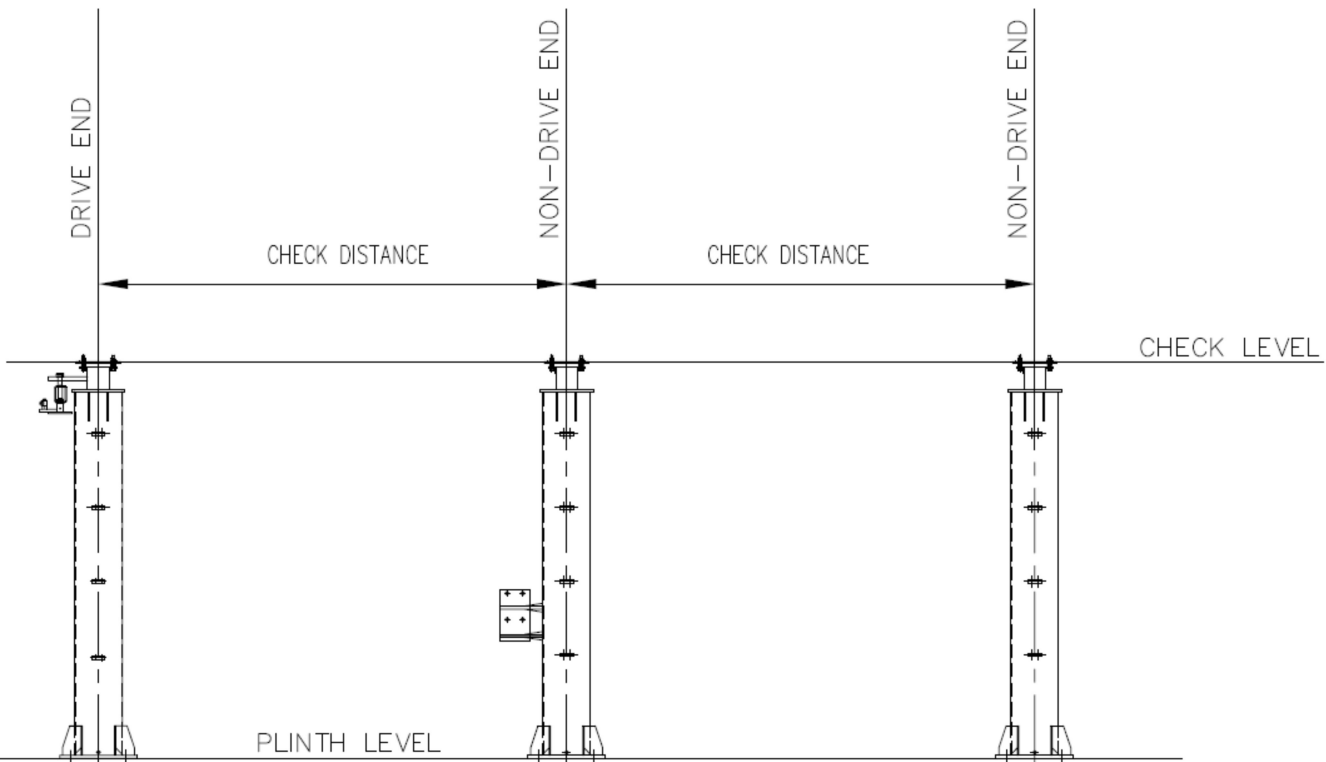
#### 14.0. BASE ASSEMBLY:

- Identify the base drive & non drive end.
- Remove the base fixing hardware from bases and keep it in proper place.
- Lift the base assembly and keep it on a leveled platform.
- Identify the drive end base and place in the proper position on top of the structure. Fix the hardware; do not tighten fully.
- Place the other two bases on top of the structure in the proper position. Fix the hardware; do not tighten fully.
- Check with spirit level on top of bearing shaft (**See figure. G**) and give shims if required on the leg of the bases.
- Check the diagonal distances.
- Tighten all the bolts. After complete tightening once again check with spirit level.

**Note:**

- Ensure the correctness of centre line of same pole and centre line of other phases.

**FIGURE – G**



**STRUCTURE (TYPICAL)**

**15.0. INSULATORS:**

Before Start of erection

- Clean the insulator thoroughly.
- Keep the fixing hardware in respective places.
- Identify the Insulator and keep them in respective position.

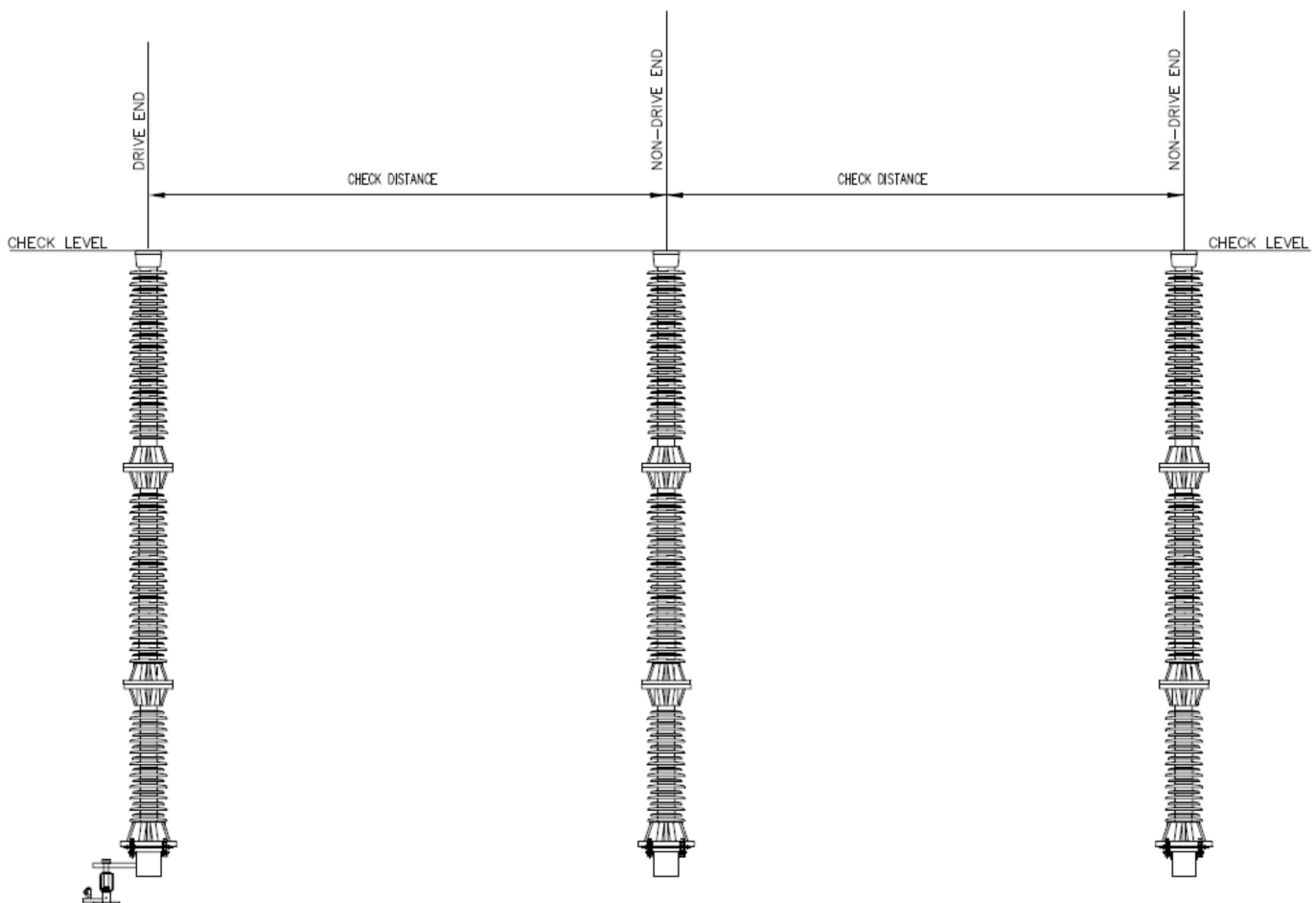
**ERECTION**

- Lift the insulator by using proper Cloth / Nylon sling and place it over the base assembly (Middle). (Ensure top 4 holes of insulator are parallel to base center line).
- Without removing the sling match the bottom fixing holes and fix all bolts.
- Remove the sling and check for level of the top surface of insulator by spirit level / plumb (See **figure. H**).
- If necessary add shims below the bottom flange of the insulator.

## 16.0. FIXED CONTACT ASSEMBLY:

- Identify the fixed contact support (1) and direction to fix the earth fixed contact assembly through contracts general assembly drawing (See figure. I).
- Take the terminal pad (2), earth fixed contact assembly (3) and fix it with fixed contact support by using M12 bolts and nuts.
- Lift the fixed contact assembly with support and place it over the insulator as per the general assembly drawing and tight the bolts.
- Repeat the same for the other two poles.

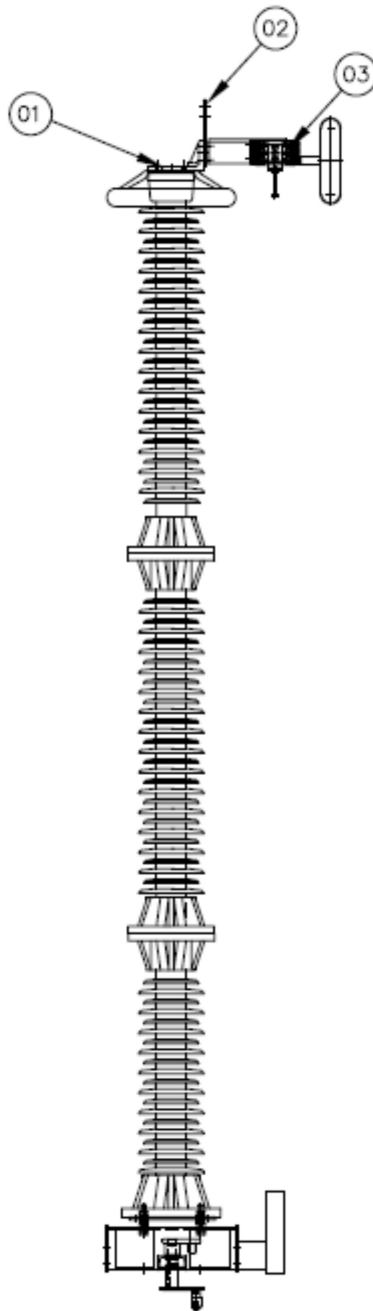
**FIGURE – H**



## **ERECTION OF INSULATOR ASSEMBLY**



**FIGURE – I**



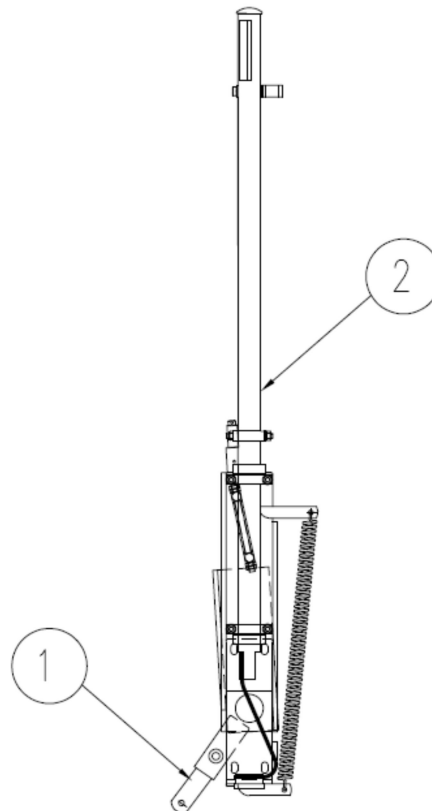
**MOUNTING OF FIXED CONTACT**

## 17.0. EARTH SWITCH ASSEMBLY:

- Identify the drive & non-drive earth switch and fixing side of the earth switch by referring to the general arrangement drawings.
- Lift the earth switch assembly by using rope and fix it with base assembly by using M12 bolts and nuts.
- Operate the Earth Switch by using lever (1) and check for the alignment. (See figure J).
- If the centre line of the moving blade (2) and fixed contact is not straight adjust the moving blade assembly by using necessary shims.
- Tighten all Bolts.
- Repeat the above procedure on the other two poles.
- Induced current contacts (if fitted) should be checked for proper operation. Upon closing the earth switch, the induced current contact should touch the insulated lever on the groove. If not adjust the induced current contact fixing by unlocking the nut and moving it on the earth switch tube.

**Caution:** The alignment of the Earth Switch should be checked after cables and bus bars have been connected.

**FIGURE – J**



## 18.0. OPERATING MECHANISM AND DOWN OPERATING PIPE:

Identify the mechanism box with the help of drawing and packing list and open the case carefully.

### MOUNTING:

**Do not attempt to lift mechanism by drive coupling flange.** Use slings or forklift at base of cubicle. Lift mechanism box into position and fix with structure. At this stage fixing bolts should only be hand tightened.

### CONNECTING MAINTENANCE EARTH SWITCH:

- Check for centre line and vertical line between torque bearing flange and drive flange with a plumb.
- Fix the tee bar end of the down operating pipe to the universal yoke and fix the assembly to the provision available on the drive end base (**See figure. K**).
- Now fix the other end of down operating pipe to the universal yoke and fix the assembly to drive box flange using the principle of vernier hole alignment (Only two holes will be aligned).
- Tighten all bolts.
- Operate the pole manually and ensure open/close label is in proper position.

### ADJUSTMENT:

#### A. MANUAL

By using handle, operate the maintenance earth switch and observe whether it is OPENS or CLOSES fully at each end of its operating cycle. (Ensure minimum 10mm gap between pad lock brackets.) If the maintenance earth switch does not CLOSE fully remove clamping bolts which is bolted on the operating mechanism flange and turn mechanism slightly towards OPEN and retighten bolts with the help of vernier flange provided. Proceed with earth switch closing. Repeat until satisfactory operation is obtained.

#### B. ELECTRICAL

Make electrical connections strictly according to the contract diagram of connections of incoming supply. Do not attempt to operate the maintenance earth switch under power at this stage.

When selector switch is fitted, set it to LOCAL.

When Motor is fitted, manually set Mechanism to mid Position and: -

- Operate Control Switch and at the same time observe whether the mechanism rotates towards the selected position.
- If it rotates in opposite direction to that selected, stop motor immediately, by switching off power supply or by using Emergency push button switch.
- Reverse the connection of motor supply.



### **ELECTRICAL OPERATING EQUIPMENT:**

A hinged panel on the left hand or right hand side of the cabinet carries the electrical control, for operation of the mechanism, which is accessible immediately after the cabinet outer door is opened.

### **PANEL DOOR COMPONENTS:**

#### **LOCAL / REMOTE / MANUAL SELECTOR SWITCH**

This selector switch is provided to select the position according to the requirement. When the selector switch is set to local, operation of the mechanism will be governed by the controls in the cabinet. Setting the selector switch to remote transfers controls of the mechanism to remote control point.

#### **OPEN AND CLOSE SWITCH**

In case of individual pole drives, the master control cabinet will have push buttons / selector switch for opening / closing also. The control switch determines the direction of travel of the maintenance earth switch. When a cycle is initiated by switching to the appropriate position, the earth switch will open or close. Once the mechanism receives a signal from the push button/ selector switch, the mechanism will commence the operation and will not respond to further signals until it has completed its operation. An indicator is provided outside the top sheet of the cabinet (below the output shaft) to show the earth switch is OPEN or CLOSE.

#### **HEATER AND THERMOSTAT (OPTIONAL)**

An anti-condensation heater is fitted in the cabinet. A switch is mounted on the front of the control panel for the control of the heater through a thermostat. It should be switched on as and when required to ensure that appropriate temperature inside the cabinet is maintained. The heated air leaves the cabinet by way of a breather.

#### **OPEN AND CLOSE CONTACTORS**

These contactors are mounted in the rear of the panel door. They directly control the reversing operation of the motor. Further contacts are used for electrically interlocking the contactors, providing circuit across the 'OPEN' and 'CLOSE' Push Buttons / Cam Switch.

#### **AUXILIARY SWITCHES**

Auxiliary switch are mounted in the rear side of the cabinet connected to gear shaft through cam and operating lever. It consists of silver plated contacts with a positive wiping action, which provides low current signal to control circuit.

#### **TERMINAL BLOCKS**

Terminal Blocks are designed for use with 1.5 / 2.5 Sqmm.cable. Rated Miniature circuit Breaker / Fuse is mounted in the panel door. The current ratings of fuse-links/MCB are shown on the schematic diagram.



### **FOR CLOSING OPERATION OF MAINTENANCE EARTH SWITCH**

Set the selector switch to local execution as required and then operate the cam switch for closing, there by causing the closing contactor (CC) to pick up. The hold on contact of closing contactor (CC) will now be closed there by retaining the supply after the cam switch is released.

After completion of closing cycle, when the earth switch operate for opening, the opening contactor (OC) will pickup. The hold on contact of opening contactor (OC) will now be closed there by retaining the supply after the cam switch is released. Ensure motor direction is towards closing. Otherwise change the phase sequence of motor in terminal box. The earth switch will start to close. At the end of the closing operation limit switch for closing (LSC) will open, de-energizing the closing contactor (CC). The circuit is now de-energized and the closing operation is completed.

Kindly note, to prevent mal functioning, contact (CC) of the closing contactor will isolate the opening circuit, once contactor (CC) is energized.

### **FOR OPENING THE MAINTENANCE EARTH SWITCH**

A Similar sequence of operation will be executed by operating the cam switch in the other direction.

### **OPERATION OF BOLT COIL (MOTOR / MANUAL)**

LMR (Local Manual Remote) switch in local or remote position.

- The plunger is in protruded condition (coil de-energized).
- The cap fixed to the plunger blocks the insertion of the manual handle (there by preventing manual operation).
- When the MPB switch is pressed, the supply will go to bolt coil and pulls the plunger downwards.
- The plunger inturn actuates the limit switch positioned below the plunger, cutting off the supply to the motor.
- The manual operating handle can now be inserted & the gear box can be operated manually.

### **OPERATION OF AUXILARY SWITCH OPERATION / SETTING CONSTRUCTION – 1**

- Auxiliary switch is fixed to the rear sheet of the drive box along with bracket.
- A slotted lever is fixed with the drive shaft (square) of auxiliary switch and clamped with bolt and nut.
- A cam is fixed with the main shaft (bottom side extended) of the gearbox below the limit switch cams and locked with screw and nut.
- A link plate is assembled with cam on one side and with auxiliary lever on the other side.

## **OPERATION**

Whenever the main shaft rotates either to close or open the cam also will rotate and operates the auxiliary switch through the link.

### **Note:**

The auxiliary switch settings are done at works. However, in case fine tuning is required then follow the steps given below.

## **SETTING**

- Keep the earth switch in open / closed condition.
- Keep the auxiliary switch lever in 'NO' position according to scheme.
- Rotate the cam and check the continuity of required contacts in auxiliary switch.
- If required loosen the pin in auxiliary switch slot and move the pin with in the slot either inside or outside and lock it again.
- After this adjustment again operate and check for continuity.
- In the same way other positions also can be set.

## **LIMIT SWITCH OPERATION IN DRIVE MECHANISM**

### **CONSTRUCTION-1**

- Limit switch is fixed to a bracket and the entire set is fitted to the rear sheet of the drive box.
- The operating cam is fixed to the main shaft (bottom side extended) of gear box and locked with screw after positioning the cam.

## **OPERATION**

Whenever the main shaft rotates either in close direction or open direction, the cams fitted in the main shaft also will rotate and operates the relevant limit switch.

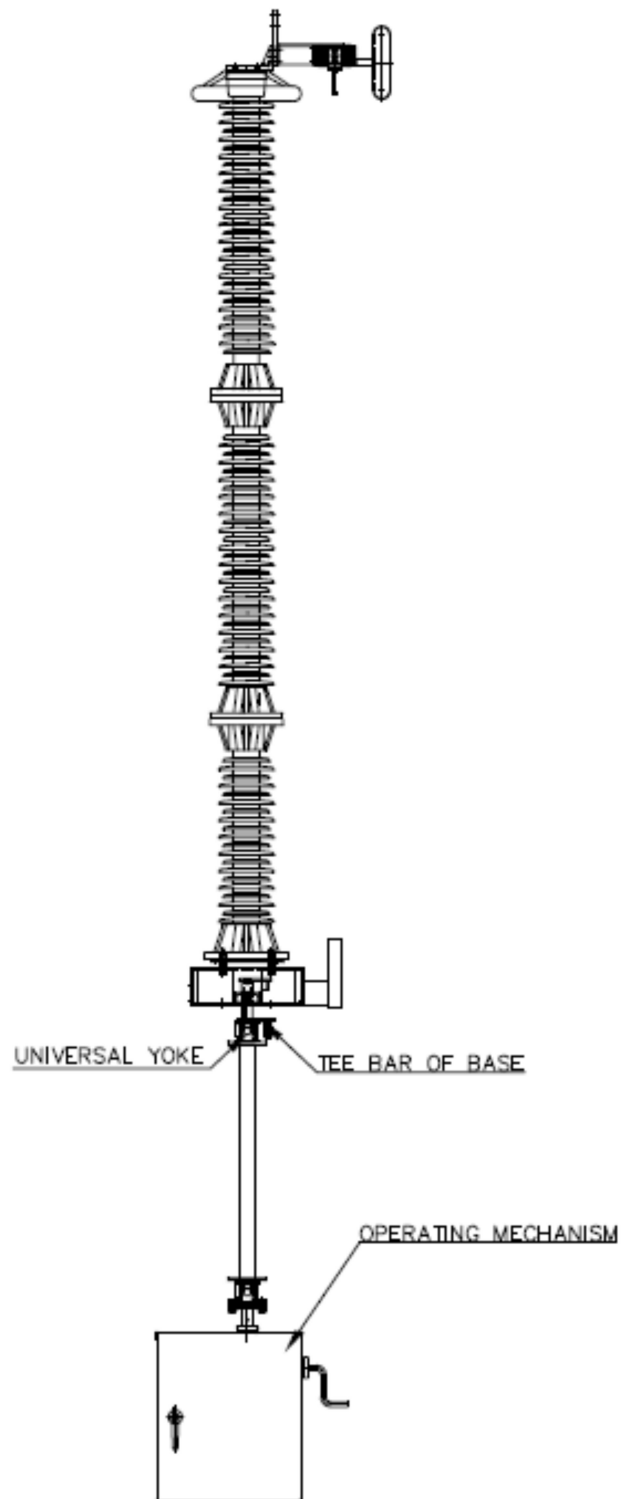
### **Note:**

The limit switch settings are done at works. However, in case fine tuning is required then follow the steps given below.

## **SETTING**

- Operate the earth switch manually to open position.
- Rotate the cam and press the limit switch roller till it disconnect the contact (a click sound will be heard).
- Again close the earth switch manually.
- Now operate the earth switch by motor and see that the operation is completed by limit switch.
- If any further small adjustment is required, the cam can be rotated towards roller or away from roller.
- In the same way another switch (for closing) can be set.

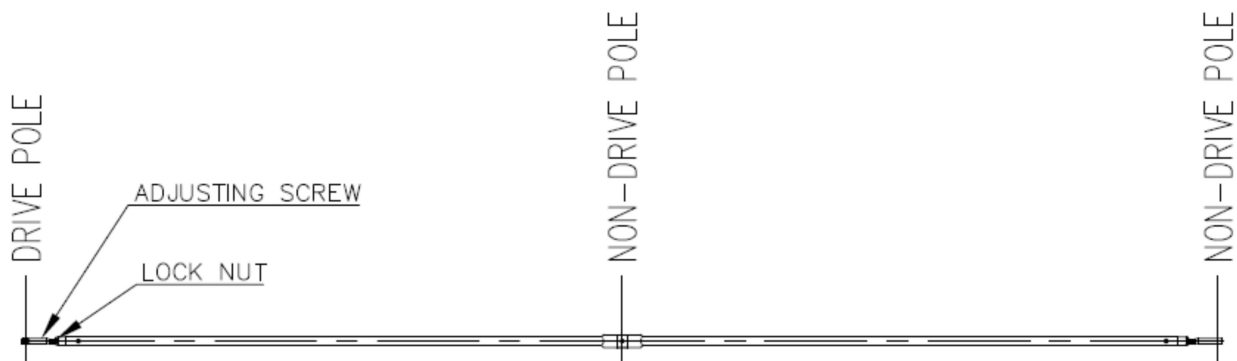
**FIGURE - K**



## 19.0. TANDEM PIPE ASSEMBLY:

- Remove the connecting pin from the lever and keep it separately.
- Keep the drive pole maintenance earth switch in closed position.
- Keep the second pole in closed position. Connect the tandem pipe (Phase coupling pipe). If required extend or shorten by adjusting the screw rod.
- Likewise, with the drive pole & second pole in closed condition, keep the third pole also in closed condition and connect the tandem pipe between the second & the third pole.
- Operate the maintenance earth switch manually and ensure it opens and closes properly. If not, then adjust the tandem pipe length.
- Ensure all split pins are secured properly. **(See figure. L).**
- Connect the small push pipe which is with base assembly to be connected with the earth switch lever assembly as shown in general arrangement drawing.

**FIGURE - L**





## SECTION – D

### COMMISSIONING AND MAINTENANCE

#### 20.0. COMMISSIONING OF MAINTENANCE EARTH SWITCH:

- Carry out test operation manually; ensure satisfactory engagement of contacts for all three poles. If necessary, align the contacts.
- Operate the maintenance earth switch by power. Ensure proper open/close operation. Ensure limit switch / auxiliary switch settings are proper.

#### 21.0. MAINTENANCE:

##### Caution:

- **Working on high-voltage is very dangerous; hence follow substation and other standard safety rules.**
- Don't use emery paper for cleaning the contacts.
- Don't try to operate the earth switch when terminal is live.

##### Do:

- Ensure disconnection of circuits before doing maintenance activity.
- Do proper earthing of the circuit.
- Stay clear of adjacent live parts; wherever possible, earth the adjacent live parts.
- Use proper tools.

We recommend the following inspection intervals

- Normal ambient condition: After every 5 years or after every 1000 operations (Close/open cycle).
- Extreme ambient conditions i.e. Climate (tropical) and heavy contamination (dust, salt, rust and sulphur): After every 2 years or after every 500 operations (Close/open cycle).

#### 22.0. TOOLS AND TACKLES:

Apart from standard tools, the following are required

- Brass wire brush for cleaning of Copper surfaces.
- Steel wire brush for cleaning for Aluminum and steel surfaces.
- Contact grease (Petroleum jelly).
- Cold cleaning agent for Silver plated surfaces.
- Lint – free cloth.

**Cleaning:**

Bolted or sliding contact surfaces that conduct current have an effect on the electrical resistance of the current path. Dirty or oxidized contact surfaces increase the electrical resistance. This will result in damage to main contacts. Hence the following cleaning procedure shall be strictly adhered to:

**Bolted Contact Surfaces: Aluminum**

- Grease lightly.
- With steel wire brush, remove oxide film fully (Do not use emery paper).
- Wipe off contaminated grease immediately using lint – free cloth.
- Re-apply grease again (Immediately after cleaning with lint –free cloth).
- Bolt together treated surfaces and grease joints.

**Silver plated contact surfaces.**

- Clean with cold cleaning agent (do not destroy silver surfaces).
- Grease immediately.
- Bolt together treated surfaces and grease joints.

**Silver plated contact surfaces (Sliding)**

- Clean with cold cleaning agent (do not destroy silver surfaces).
- Grease immediately.

**Inspection checks:**

The following operations must be carried out during inspection

**Maintenance earth switch:**

- Clean contact area (Male and Female contacts). Check for any damage; if required, change the contacts.
- Apply grease on contact surfaces.
- Clean the insulators. Check for any damage; if required, change.
- Check all bolted connections.
- Carry out three or four test operations manually.
- Reconnect the power supplies and control voltage.
- Carry out three or four test operations electrically.
- Check the earthing connections between earth blade and base; if required, replace.

**23.0. RECOMMENDED SPARES:**

Keep adequate quantity of following spares at all times.

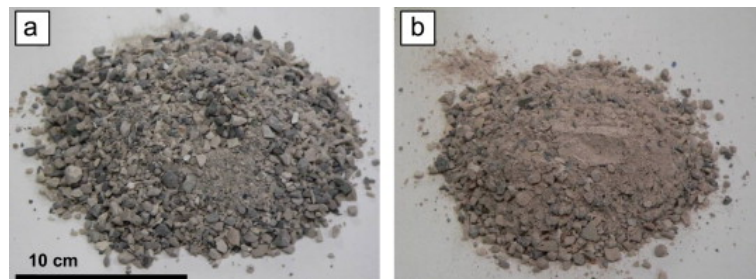
- Fixed contact fingers.
- Moving blade extrusion.
- Clevis pins with nylon washers, split pins.
- Control springs.

## 24.0. RECYCLING OF END OF PRODUCT LIFE MATERIAL AND DISPOSAL

### 1. Overview

From power transmission and distribution systems, scrap white porcelain-insulators were collected. These insulators have a high degree of hardness, and low water absorbability. A study was conducted in the use of crushed porcelain as a ceramics aggregate.

Commercially available ceramics aggregate is used in colored permeable pavement. Such products are expensive. It is anticipated, however, that the pavement market will expand because permeable pavement material is useful for: (1) alleviating the so-called "heat island" phenomenon, (2) lessening the load on sewage treatment plants, and (3) improving the rhizosphere and environment for vegetation.



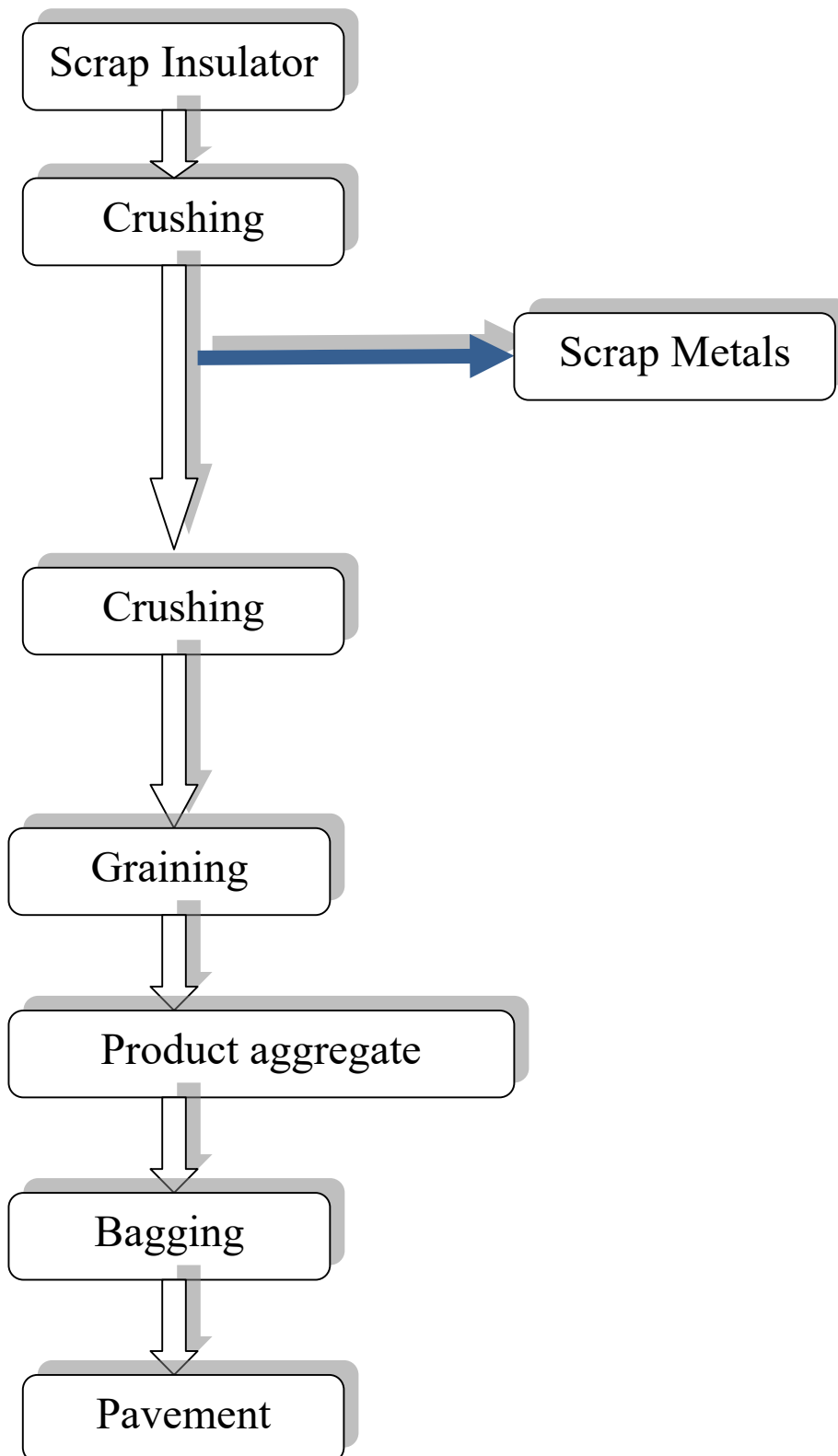
### 2. Description of Development

Attempts were made to develop permeable pavement material that contains crushed porcelain (grain size: 0.5-3.0 mm) as aggregate, and epoxy resin adhesive for solidification. The ability of rain-water to penetrate through the aggregate is a special feature.

#### (1) Crushing porcelain-insulators

Conventional methods of crushing hard porcelain-insulators produce sharp fractured fragments that resemble broken pieces of glassware. The newly developed method uses a granulating machine that forces crushed pieces to collide with each other thereby forming grains. Fig. 1 shows steps in the manufacture of the ceramics aggregate.

Fig. 1 Steps in Manufacture of Ceramics Aggregate



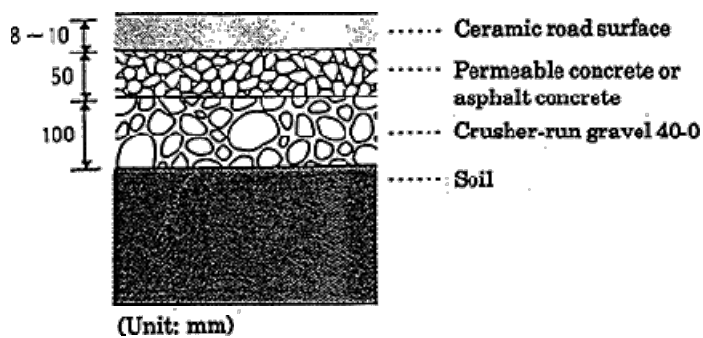
## 2) Determining optimum resin percentage

Strength and permeability of the pavement are determined by the percentage of resin that maintains point adhesion of aggregate materials. Several samples were produced of varying resin percentages. The samples were tested and according to the results, the resin percentage of 7.5%, by weight, was selected as the standard specification.

## (3) Experimental paving

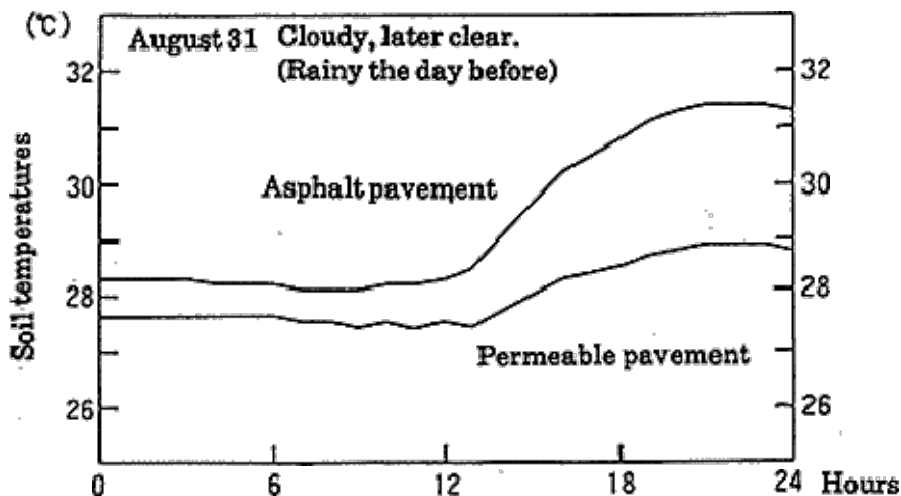
As shown by the cross-section in Fig. 3, the surface layer of permeable pavement material made from porcelain-insulators is bonded onto an underlying layer of permeable concrete or asphalt in order to reduce the use of expensive epoxy resin.

Fig. 2 Structure of Permeable Pavement (Cross-section)



This permeable pavement was tested and compared with asphalt pavement to assess its effectiveness in moderating the heat island phenomenon.

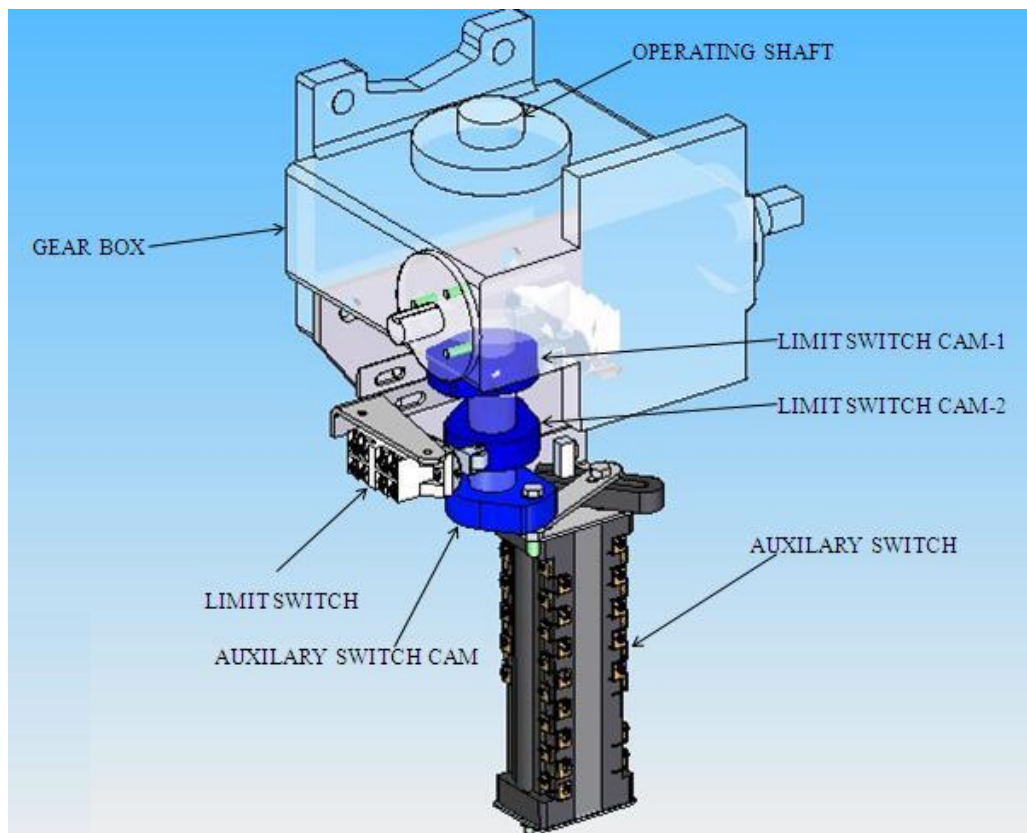
Fig. 3 Measurements of Heat Island Phenomena (Examples)





On the morning that measurement took place, soil temperatures slightly differed depending on types of pavement because it rained the day before. In the afternoon, however, the weather was clear, and therefore, a greater soil temperature difference was observed between asphalt and permeable pavements. Even during the night, no significant change in soil temperature was observed. This observation suggested that the experimental pavement can moderate the heat island phenomenon.

## SETTING OF AUXILIARY SWITCH AND LIMIT SWITCH CAMS



### OPERATION OF AUXILIARY SWITCH AND SETTING CONSTRUCTION - 1

- Auxiliary switch is fixed to the rear sheet of the drive box along with bracket.
- A slotted lever is fixed with the drive shaft (square) of auxiliary switch and clamped with bolt and nut.
- A cam is fixed with the main shaft (bottom side extended) of the gearbox below the limit switch cams and locked with screw and nut.
- A link plate is assembled with cam on one side & with auxiliary lever on the other side.

### OPERATION

Whenever the main shaft rotates either to close or open, the cam also will rotate and operates the auxiliary switch through the link

### Note

The auxiliary switch settings are done at works. However, in case fine tuning is required then follow the steps given below.

## **SETTING OF AUXILIARY SWITCH**

- Keep the main Disconnecter in open / closed condition.
- Keep the auxiliary switch lever in 'NO' position according to scheme.
- Rotate the cam and check the continuity of required contacts in auxiliary switch.
- If required loosen the pin in auxiliary switch slot and move the pin with in the slot either inside or outside and lock it again.
- After this adjustment again operate and check for continuity.
- In the same way other positions also can be set.

## **LIMIT SWITCH OPERATION IN DRIVE MECHANISM**

### **CONSTRUCTION-1**

- Limit switch is fixed to a bracket and the entire set is fitted to the rear sheet of the drive box.
- The operating cam is fixed to the main shaft (bottom side extended) of gear box and locked with screw after positioning the cam.

### **OPERATION**

Whenever the main shaft rotates either in close direction or open direction, the cams fitted in the main shaft also will rotate and operates the relevant limit switch.

### **Note**

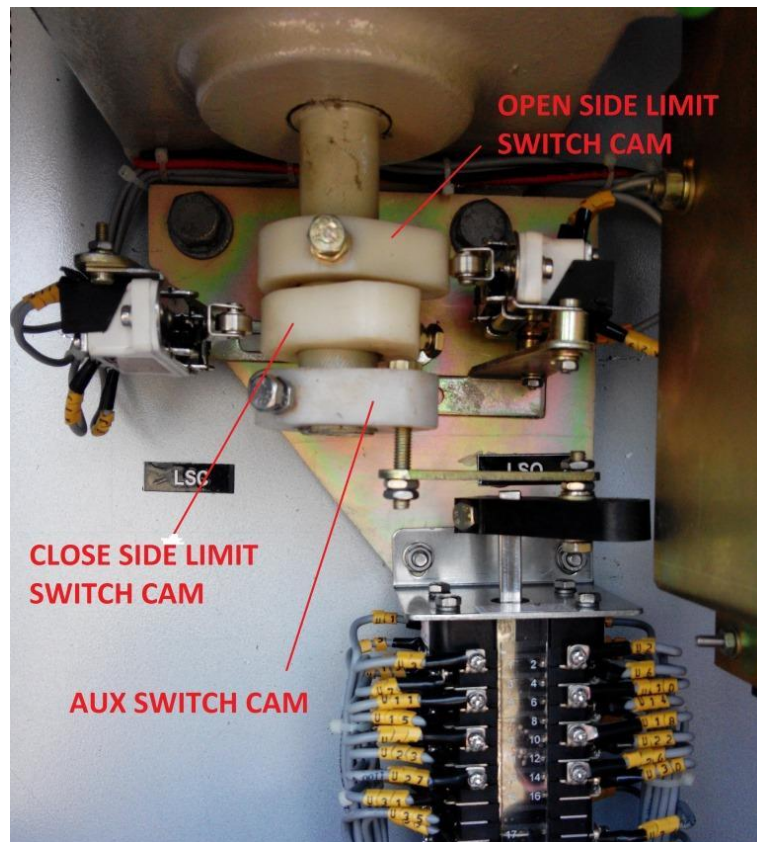
The limit switch settings are done at works. However, in case fine tuning is required then follow the steps given below.

### **SETTING OF LIMIT SWITCH CAM 1 AND CAM 2**

- Operate the disconnecter manually to open position.
- Rotate the cam and see that the cam presses the limit switch roller till it disconnects the contact (a click sound will be heard).
- Again close the disconnecter manually.
- Now operate the disconnecter by motor and see that the operation is completed by the limit switch.
- If small adjustment is required, then, loosen the screw of the limit switch CAM 1.
- Rotate the cam either towards the roller or away from the roller, as required.
- Ensure the cam makes contact with the limit switch (for opening).
- Tighten the screw of the limit switch CAM 1.
- In the same way another switch (for closing – CAM 2) can be set.



## PICTORIAL REPERSENTATION



### OPEN LIMIT SWITCH CAM SETTING:



## CLOSE LIMIT SWITCH CAM SETTING:



## AUXILIARY SWITCH CAM SETTING:





# Disconnecter & Earth switch

## O&M and Inspection Procedure



### Substation Maintenance - Health & Safety Guideline

#### Electricity can KILL, Civil Work in Progress

- Obtain necessary work permit before start of the Job
- Be familiar with any electrical hazards in the workplace.
- Understand procedures to follow and to protect yourself when you work around electricity.
- Know when and how to report electrical problems.
- Must use the required Personal Protective Equipment's.
- Know what to do in the event of emergency involving electricity.
- Do proper Grounding of the circuit.
- Use proper tools for erection & testing activity.
- Know how to inspect electrical tools and equipment before use to make sure insulation and wiring are in good condition.
- Use trained MHE Operator and follow SOPs for Handling heavy structures, insulators
- Working at height requires safe ladder and safety belts and helmets- please follow
- Housekeeping in site and hazards related to civil work- trench etc should be properly guarded







## Inspection and Overhauling Schedule

### Erection & Commissioning

- ❖ Clean contact area (Male and Female contacts). Check for any damage.
- ❖ Apply petroleum jelly on contact surfaces.
- ❖ Clean all the insulators. Check for any damages.
- ❖ Check the tightness of all bolted connections.
- ❖ Lubricate rotating parts.
- ❖ Carry out few Open-Close test operations manually.
- ❖ Check contact Resistance
- ❖ Carry out few Open-Close test operations Electrically.

### After 1 Year

- ❖ Clean contact areas, Check for any contact damage and apply petroleum jelly on contact surfaces.
- ❖ Clean all insulators..
- ❖ Lubricate all rotating parts.

### After 5 years

- ❖ Clean contact areas, Check for any contact damage and apply petroleum jelly on contact surfaces.
- ❖ Clean all insulators..
- ❖ Lubricate all rotating parts.

### After 10 years

- ❖ Change all the contact areas with new one.
- ❖ Check all insulators..
- ❖ Lubricate all rotating parts and pins.
- ❖ Check the auxiliary switch contacts.
- ❖ Check operation of mechanical interlocks

### After 20 years

- ❖ Clean all contact areas and apply petroleum jelly on contact surfaces.
- ❖ Check Tightness of all hardware's

### After 25 years

- ❖ Recommended to change all current carrying blades and Operating Drive mechanism boxes.



## Disconnectors and Earth switches

### Visual Inspection

- Inspect insulators for cracks, or burns or pollutants deposits.
- Inspect the all current carrying contacts and tubes.
- Check motor drive cabinet for the following:
  - \* Heater operation
  - \* Miniature circuit breaker (MCB)
- Check motor drive cabinet is properly latched and seals are in good condition.
- Check for visible misalignment/over travel/discoloration of primary contacts.
- Check for leakage of grease at insulator base and motor gear.
- Check earth tape connections from the Disconnectors to the substation Earthing system.

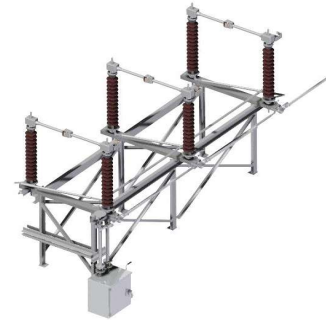




### Primary contact routine inspection

Where possible

- Check tightness of bolts and nuts
  - Check springs of female contact for rust and its elasticity
  - Check contact fingers for pitting marks, erosion, corrosion
  - Check for alignment of primary contacts and arcing tips
  - Check arcing tips for excessive arc damage
  - Check for simultaneous closing of all blades for 3 phases
  - Check linkages, rods and levers for smooth operation, ensure all joints are secured tightly.
  - Lubrication of bearings with appropriate approved grease for non sealed bearings.
- ❖ The alignment of Disconnectors is very important for smooth operation. The limit switches, the healthiness of auxiliary contacts needs to be checked periodically.
  - ❖ Mis-alignment leads to Hot Spots and breakage.



### Operating mechanism functional check

- Checking of Limit switches (Open/close)
- Checking of Auxiliary switches (NO+NC Contacts)
- Check operation of electrical interlocks
- Check operation of motor and it's readings
- Lubrication of gear box and spur gear wheels
- Check operation of OLR relay and emergency stops
- Manual operational checks smooth operation
- Local and remote end operational checks

Hands on training will be given to erection team, site operators and site in-charges about the alignment and limit switch setting of Disconnectors and earth switches





## Contact resistance measurement

### Purpose

- ❖ Purpose of measuring contact resistance measurement is to assess the condition of the male and female contacts against erosion or misalignment of the main contacts. Contact resistance of Disconnectors switch contacts should be measured to check the healthiness of the current carrying parts.

### Instrument Required

- ❖ Micro ohm meter of 100 A or more current injection capacity kit with cabling accessories is required for this test.

### Evaluation

- ❖ If the value of the contact resistance exceeds the permissible limits, this could lead to over heating of contacts, Monitoring contact resistance values is very good techniques for assessing the condition of main contacts.

**Contact resistance value should not exceed the type tested value.**



## Disconnectors and Earth switches

### CLEANING OF CONTACT SURFACES

#### Silver-faced contact surfaces (bolted)

- Clean with cold cleaning agent Trichloroethylene (Without destroying silver plating of surface of contacts).
- Apply tin layer of Grease.

#### Galvanized contact surfaces (bolted)

- Clean using steel wire brush
- Apply tin layer of grease immediately.

#### Lubricant Details

- For all pins and bushes, Shafts and bushes --- P3-Multipurpose grease or equal
- For all sliding contact parts --- Petroleum jelly or equivalent.
- For fixed parts Anti corrosive compound for electrical joints -- ACC50 or equivalent.



## Disconnectors and Earth switches

### Rust Protection:

- For Rust protection, grease G Or Tectyl- 506 is recommended.

### Earth Switches:

- The earth switch is a safety device and smooth operation is to be ensured by proper alignment.
- The earth blade contacts are to be cleaned properly for proper contact and contact resistance to be measured to ensure healthiness.
- The earth connection from blade to earth is to be carefully checked. All the joints should be tightened.
- Flexible copper braid connections are provided and healthiness ensured.
- All moving parts should be lubricated for smooth operation.



## Disconnectors Maintenance

### CLEANING PROCEDURES

#### Recommended cleaning methodology:

- ❖ The outdoor parts (like supporting insulators and contacts) should be checked and cleaned at least every two years; however, this period might change according to the environmental conditions, weather and pollution of the site.
- ❖ Every eight years a complete inspection should be performed, under the instructions of the manufacturer personnel (checking of drives and disconnectors operation, control of the contacts condition, etc.).
- ❖ Special care should be taken on the insulating parts and, in case of abnormal operating conditions (such as salt accumulation, dust, cement or acid vapours), a frequent cleaning shall be performed to avoid flashovers.



## Surface Cleaning & Greasing



Steel Wire Brush



WD40-Anto corrosion



AP3- Grease

Petroleum Jelly



Tectyl- 506



## Safety Procedure



Lockout & Tag-out Tags





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Site setup / Check Procedure:- Assembly of 145/245/420kV Maintenance Earth Switch		Document: Dis-MES-SSF-001 Site Setup Assembly Maintenance Earth Switch
Issued By: Customer Service Date: 17.03.18	Approved By: Quality Manager Date: 17.03.18	Issue: 1 (Mar'18) V: 1 (Mar'18)

### **Project Information:**

Order Number :

Customer Name :

Substation Name :

Site Location. :

Serial Number :



### **Maintenance Earth Switch:**

#### **Purpose:**

The checks will show the correct assembly of the Disconnecter and that its component parts are in conformance with the design drawings.

**Important Note:** Before starting Disconnecter ensure that the **structure erection done properly and levelling carried out with water level and spirit level**. Ensure all hardware's are tightened with torque wrench after levelling.

#### **Procedures:**

1. Carefully remove and identify the required component parts from shipping crates and that they are in accordance with supplied packing lists.
2. Place each Phase Base assembly on a leveled structure. Identify the base serial numbers and keep the same in respective position as per the approved drawing.
3. Assemble Insulators onto the base assemblies. Ensure proper leveling using shims/leveling bolts (jacking screws) Ming as required to maintain vertical alignment.
4. Assemble the Earth blade on base assembly and female fixed contacts on top of the insulator assembly along with dummy/earth adaptor o as per the GA drawing. Do leveling/shimming for vertical / horizontal axis as required.
5. Set and check the earth switch push pipe over toggle linkages.
6. Close the earth switch, if a particular phase is not closing properly adjust the insulators accordingly and ensure proper closing of all three phases.

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7. Check all fixings for tightness and torque as required
8. Check all control boxes for damaged paintwork if painted
9. Fix the drive mechanism with the structure as per GA drawing.
10. Connect the Earth Down pipe to the tee bar on the base and the flanged end to the drive box flange.  
Ensure flanges are mated properly and the down pipe does not pull the flange of the drive box.  
(if required, use the spacers provided between the down operating pipe and drive box flange).
11. Conduct random pull test on wiring and check wire crimping for security.
12. Check all wired connections are tight.
13. Check operation of all auxiliary switches.
14. Check operation of interlocks.
15. Check switch handles for fitment.

#### **Maintenance Earth Switch Checks:**

1. Check for damaged components.	Check	Yes	No	N/A
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Phase A Base level	Check	Yes	No	N/A
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Phase B Base Level	Check	Yes	No	N/A
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Phase C Base Level	Check	Yes	No	N/A
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Phase A Insulators fitted	Check	Yes	No	N/A
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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6. Phase B Insulators fitted	Check	Yes	No	N/A
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Phase C Insulators fitted	Check	Yes	No	N/A
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Phase A Earth blade fitted	Check	Yes	No	N/A
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Phase B Earth blade fitted	Check	Yes	No	N/A
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Phase C Earth blade fitted	Check	Yes	No	N/A
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Phase A fixed contacts fitted	Check	Yes	No	N/A
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Phase B fixed contacts fitted	Check	Yes	No	N/A
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Phase C fixed contacts fitted	Check	Yes	No	N/A
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. Phase A Earth blades open/close smoothly.	Check	Yes	No	N/A
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. Phase B Earth blades open/close smoothly	Check	Yes	No	N/A
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16. Phase C Earth blades open/close smoothly	Check	Yes	No	N/A
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
17. Torque bearings operates correctly	Check	Yes	No	N/A
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18. Down Pipe fitted correctly	Check	Yes	No	N/A
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19. Interlocks operate correctly	Check	Yes	No	N/A
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20. Manual operation of MES satisfactory	Check	Yes	No	N/A
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
21. All fixing are tight and secure	Check	Yes	No	N/A
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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22. All wired connections are tight and secure	Check	Yes	No	N/A
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23. Auxiliary Switches operate satisfactorily	Check	Yes	No	N/A
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
24. Switch Handle correct and secure	Check	Yes	No	N/A
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
25. Check all operating handles are present.	Check	Yes	No	N/A
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
26. All items fitted and labeled correctly	Check	Yes	No	N/A
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
27. Petroleum jelly applied on contacts	Check	Yes	No	N/A
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Comments**

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## Statement of Acceptance

Upon satisfactory completion of all the checks outlined in this Acceptance Check Document, it is state stated that as at today's date being the site Acceptance date, the Equipment's identified have been properly documented and witnessed. Any discrepancies, resulting from the Checks specified in this document are accepted subject to any observations /comments raised during the Site Acceptance.

1. The Equipment have been duly accepted at the Site in accordance with and subject to the provisions of the purchase contract and the minutes raised during any progress meetings.
2. Duly appointed and authorised technical experts have inspected the Equipment to ensure that they conform to technical specifications of the purchase contract.
3. The equipment's are fully equipped in accordance with the technical specifications of the purchase contract and are satisfactory in all respects.

It is understood that all outstanding NCR's / Comments and Corrective Actions will be rectified prior to final commissioning and or notification given of any items that need to be rectified

## CERTIFIED BY:

S&S PSE Service Engineer		Date
Contractor Representative		Date
Customer Representative		Date



**S&S POWER SWITCHGEAR EQUIPMENT LTD.,**

**Works:**

No.4, EVR Street,  
Sederapet,  
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**Corporate Office:**

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