JOB ROLE – **LINEMAN DISTRIBUTION**

Sector: Power
(Qualification Pack Code : PSS/Q0102)

PSS Central Institute of Vocational Education
Shyamla Hills, Bhopal – 462013, Madhya Pradesh, India

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Unit 4: Repair and maintenance of power distribution lines

Session 1: Prepare for repair and maintenance of distribution lines

Content

Session Objectives

1. The student will be able to know components of distribution line
2. explain tools to be used for repair and maintenance.
3. describe distribution line standards.
4. identify various types of circuits.

Introduction

Repair and maintenance of lines is very important for uninterrupted supply of electricity. Maintenance is done primarily twice a year one is before mansoon and another is after mansoon. If any breakdown occurs in line then repair of line is required. In maintenance part normally these work have been performed. Line patrolling, maintaining ground clearance, replacement of insulators, restringing of lines, replacement of burnt jumpers, replacement of damage conductor, replacement of damage pole etc.. Proper maintenance of line improve the lines life drastically.

Materials and Accessories Used in Power Distribution

In this section, we will discuss some materials and accessories used in power distribution

Poles (Supports)

The pole or supports are classified as per the material used for it: 1. Steel 2. Cement 3. Wooden

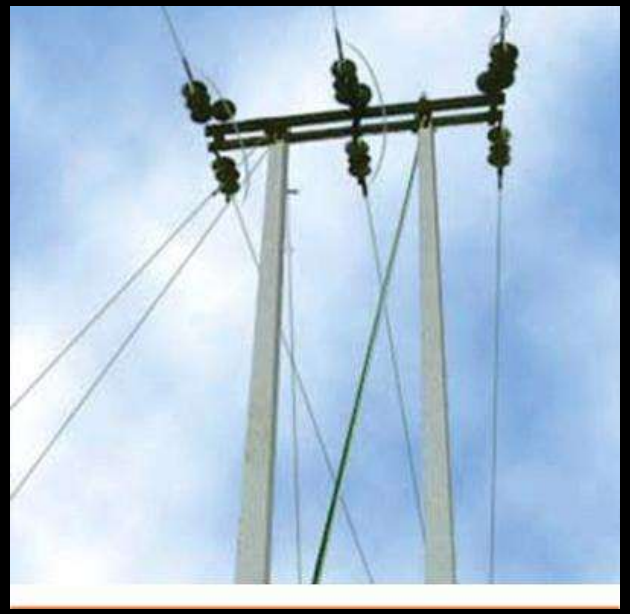
Steel poles are further classified as follows:

Rail Pole: These are of L shape, rail type and tubular shape and better than R.C.C. poles, being light in weight, cheaper in cost. The poles are affected by atmospheric moisture, rains, etc. hence always painted or coated chemicals to avoid rusting. These are normally used for 33kv lines.

Tubular Pole: Tubular poles are either of swaged section (built up sections) or stripped single unit type (joint less one casting). The wind pressure acting is very low because of their circular section as compared to plain section R.C.C. poles and is erected easily by digging pits of diameter or section slightly greater than the pole diameter. These are normally used in hilly areas.

Cement poles are further classified as follows:

R.C.C. pole: These poles are made by reinforcing (i.e. embedding) steel rods concrete sla of pole shape. These poles are of permanent nature, long life, unaffected by rain, sunlight, etc. and heavy in weight due to concrete and steel rods construction.



P.S.C. poles: Pre-stressed Cement Concrete poles are essentially made of concrete, high tensile wire is inserted into the pre-designed moulds and stretched to reach a certain tension. Galvanised wire is fixed inside the mould for earthing following which a right proportion of concrete mix is poured. Then, the concrete is compacted through vibration to produce high strength concrete poles.

As per CEA (Central Electricity Authority) Regulations 2010, Relating to Safety and Electric Supply, Clause 57(2), the supports should have the following minimum factor of safety:

S. No.	Supports	Factor of Safety
1	Metal Supports	1.5
2	Mechanically processed concrete supports	2.0
3	Hand molded concrete supports	2.5
4	Wooden supports	3.0

- Earthing arrangement with projected length of 50 mm at both ends of pole, using 8 S.W.G. G.I. wire embedded in concrete is provided. In actual practice, it is convenient to use 8m size poles for all purposes (instead of having different sizes) with minor adjustments in spans, if required. This avoids future replacement costs, omission or errors by workmen in transportation and selecting different poles for different locations. The selection of poles for erection of lines depends on a number of factors such as:
- Pole strength
- Type and size of conductor
- Maximum wind pressure

- Maximum line tension
- Snowfall
- Fruit farm
- Guarding

Different crossings like river, road, railway, telephone lines, etc.

The erection of power distribution lines involves only erection of different types of poles, such as steel, PSC, wooden poles, etc.

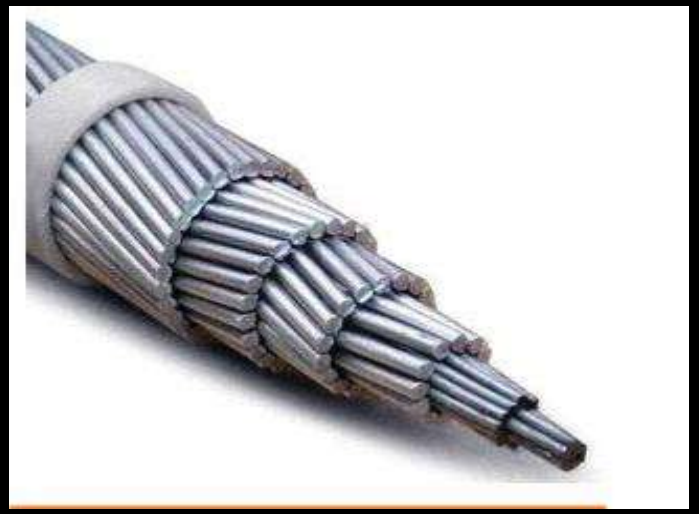
Conductors

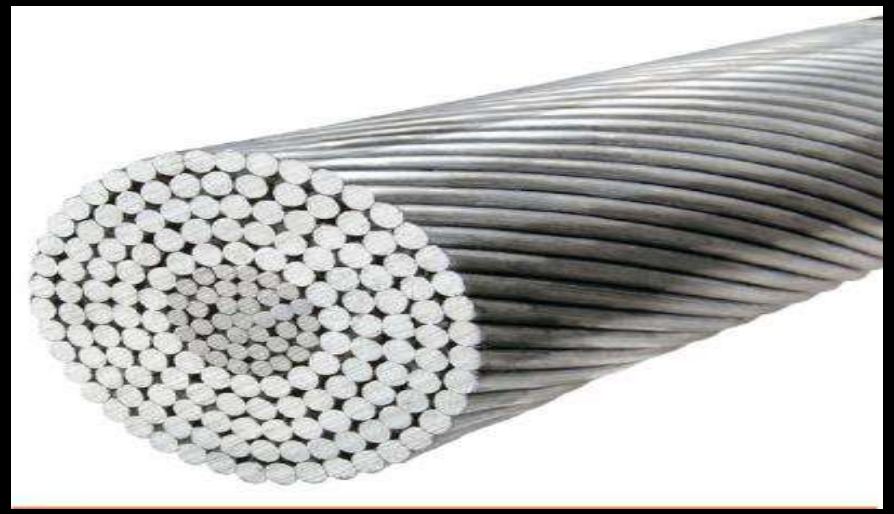
Aluminium conductors of different types and sizes are used for drawing overhead lines, whether they are LT or HT lines. These include:

AAC – All Aluminium Conductors: This conductor is made up of one or more strands of hard drawn 1350 aluminium alloy. These conductors are used in low, medium and high voltage overhead lines. AAC is used extensively in urban areas where spans are usually short but high conductivity is required.

ACSR – Aluminium Conductor Steel Reinforced: It is a type of high-capacity, high-strength stranded conductor typically used in overhead power lines.

The outer strands are high-purity aluminium, chosen for its excellent conductivity, low weight and low cost. The center strand is of steel for additional strength to help support the weight of the conductor.





- **AAAC – All Aluminium Alloy Conductors:** These conductors are made out of high strength Aluminium-Magnesium-Silicon Alloy. These conductors are designed to get better strength to weight ratio and offer improved electrical properties, excellent sag-tension characteristics, and superior corrosion resistance when compared with ACSR.

Insulators

Pin Type Insulators: These are commonly used on 11 kV Lines. The pins for pin insulators shall have a stalk length of 135 mm, shank-length of 125 mm and minimum failing load of 2kN. They are to be forged. The pin type insulator is secured to the cross-arm on the distribution pole. There is a groove on the upper end of the insulator for housing the conductor. The conductor passes through this groove and is bound by the annealed wire of the same material as the conductor. Pin type insulators can be of one part, two parts or three parts type, depending upon the application voltage. For example, in 11KV system, one part type insulators are used where whole pin insulator is one piece of properly shaped porcelain or glass.

Shackle Type Insulators: These are commonly used on LT Lines. These are used in low voltage distribution lines. They are otherwise known as spool insulators. Shackle Insulators are used at the end of distribution lines or at sharp turns where there is excessive tensile load on the lines. These insulators can be mounted either in the vertical or horizontal position.

There are two types of shackle insulator fittings: strap type and u-clamp type fittings. Strap type fittings are for dead-end locations. On the other hand, u-clamp type fittings are for tangent locations or for service lines where load is small. All fittings are to be galvanised.

Disc Type Insulators:

In higher voltage, such as beyond 33KV, it becomes uneconomical to use pin insulator as the size and weight of the insulator becomes more. Handling and replacing bigger size single unit insulator is a difficult task. To overcome these difficulties, suspension insulator was developed. In suspension insulator, the numbers of insulators are connected in series to form a string and the line conductor is carried by the bottom most insulator.

Each insulator of a suspension string is called disc insulator because of its disc-like shape. Disc insulators are normally used in 11kv lines for dead end locations.

Guy Strain Insulators: These are only used for guy/stay wires. These are designed to work in mechanical tension or strain, as they are capable to withstand the pull of a suspended electrical

wire or cable. They are used in overhead electrical wiring, to support radio antennas and overhead power lines. A strain insulator may be inserted between two lengths of wire to isolate them electrically from each other while maintaining a mechanical connection. It may also be used where a wire attaches to a pole or tower, to transmit the pull of the wire to the support while insulating it electrically.

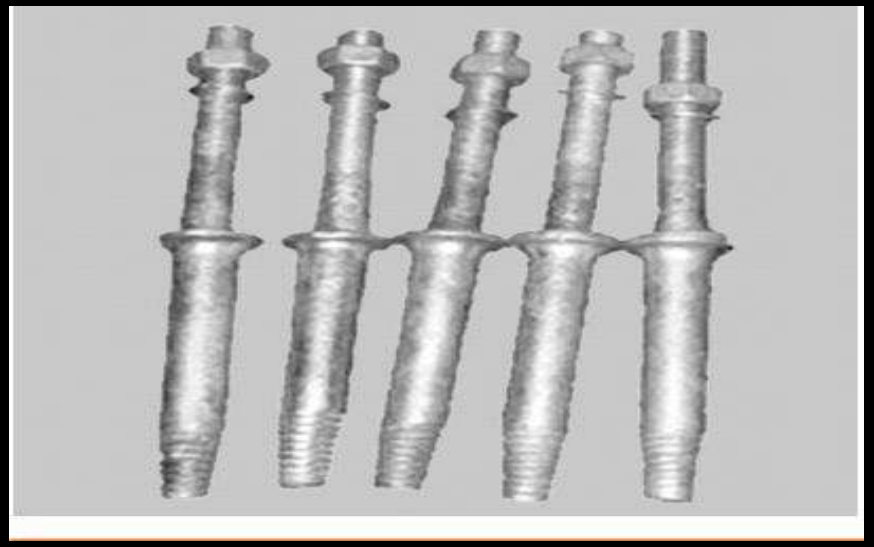
Pins for Insulators

Pins for pin insulators have to be of single piece-forged.

All ferrous parts should be galvanized.

Helically formed Pin Insulator ties used for holding the Conductor on the Pin Insulator have been standardized and should conform to the requirements of IS: 12048-1987. Type and dimensions of pins are as follows:

Voltage (kV)	Type	Stalk Length	Shank Length (mm)	Failing load minimum kN
33	Large Steel Head type L 300 N	300	150	10
11	Small Steel Head type S 165P	165	150	5



Guy Assembly

Guy assembly is needed for dead-end and angular locations to counter balance the load on the supports due to pulling of the conductors, so that supports remain straight in vertical position without bending in any direction. They are also provided at mid-span support as a protection against the wind load.

G.I. Wire

G.I. wires are used for protective guarding at the crossing of lines with roads, railway tracks, telecommunication lines, etc. These have to be of 3.15, 4 and 5 mm sizes. The wires shall be galvanised with “heavy coating”. G.I. wires are used in reinforcement of Aluminium conductors in distribution and transmission of electricity. ACSR wire is used for power fencing as this material is most suitable for electricity conductivity.

11kV Cross-arms

The following types of cross-arms are used for 11kV Lines:

V cross-arms for tangent locations with clamps. V cross-arms are widely used in many electrical transmission lines, for effective and efficient distribution of power. They have the capacity to bear heavy electrical fluctuations and voltages.

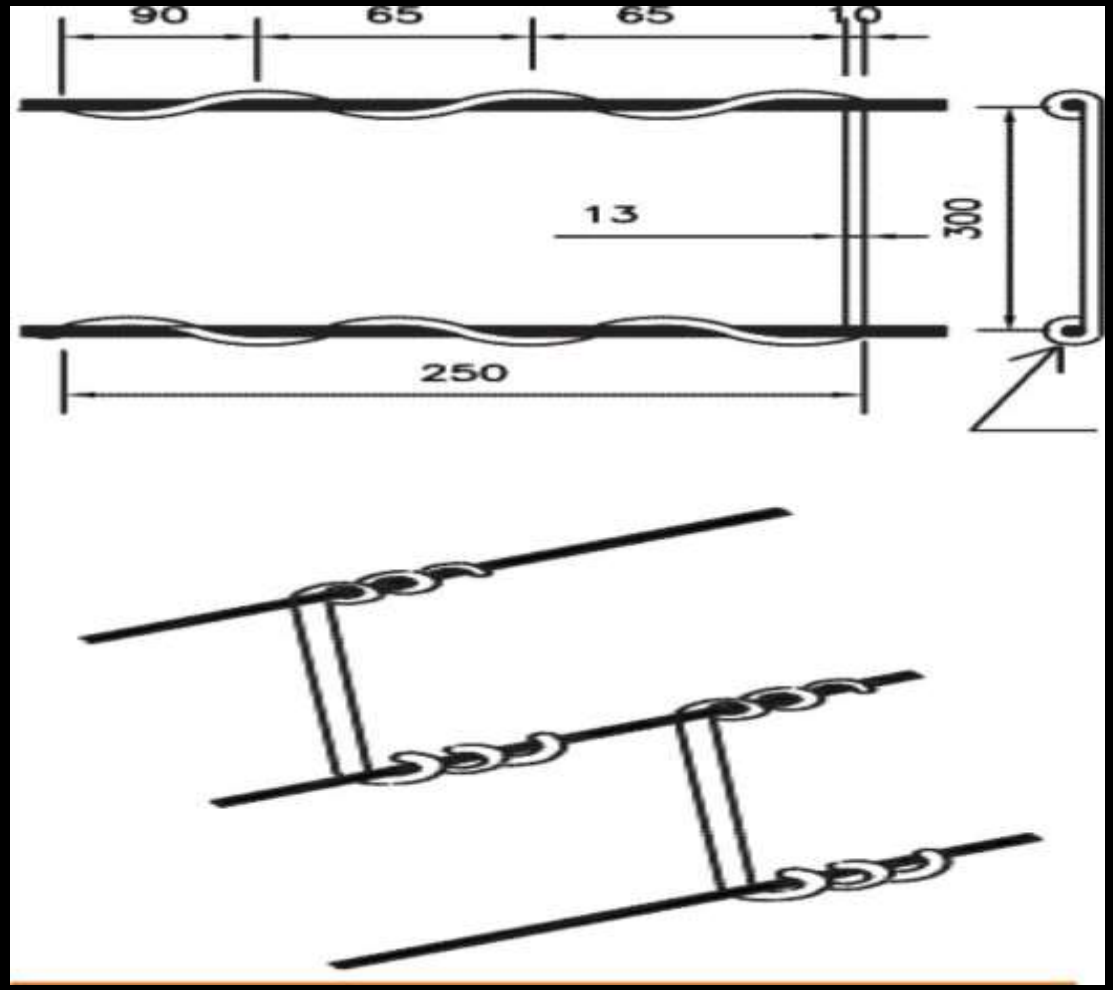
Double-channel cross-arm for tension or cut point locations where D.Ps. are used. The conductors for the double cross-arm configurations are suspended from an adjustable tie plate which connects the two timber cross-arm members together. The cross-arm can be used to support up to three conductors, one mounted at the center and one mounted 1 feet from either end of the cross-arm.

L.T. Cross-arms: L.T. cross-arms have been standardised for horizontal as well as vertical formation of conductor. They have a strong structure and high sensitivity

L.T. Line Spacers: Clashing of L.T. conductors in the mid-span very often takes place due to sag, wind and longer spans. This results in faults and interruptions. In order to overcome this problem spacers are provided. As per REC Construction Standards two types of spacers generally used:

Spiral - made from high quality PVC. They should be circular with 13 mm diameter.

Composite - made from poly-propylene in a single mould (except the clamping pieces). They should be rectangular strips of 25 mm x 12 mm dimensions.


90
65
65
10
13
300
250

Various tools are used for distribution line maintenance like screw driver, ratchets, spanners, wrenches etc.

Pole Locations

In locating poles on lines, the following general principles are to be kept in mind:

1. Keep spans uniform in length as far as possible.
2. Locate to have horizontal grade.
3. By locating the poles on high places short poles can be used and will maintain proper ground clearance at the middle of the span. In extremely hilly or mountainous country, poles are located on ridges thereby increasing the spans without greatly increasing the poll on the conductor. This is possible because the sag can be made very large maintaining the required ground clearance.

4. Poles should not be placed along the edges of cuts or embankment or along the banks of creeks of streams.

5. Cut-point for a section could be at 1.6 km length (except in special cases), where Double-pole structures are to be provided to take tension of the conductors. It may have been already estimated that 10 supports (locations) are mostly required in one km. length of H.T. lines and15 supports for L.T. line.

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