



American International University- Bangladesh
Faculty of Engineering (EEE)
Power System Protection Laboratory

Title: Familiarization with different kinds of Insulators, Fuses and Miniature circuit breakers.

Introduction:

Electric power system operates at various voltage levels ranging from 0.4 KV to 400 KV or even more. Electrical apparatus may be enclosed or open. All such equipment undergoes the abnormalities in their lifetime due to various reasons. To avoid abnormalities for the safety of equipments and human personnel which may be endangered due to exposure to live parts under faulty conditions, protection systems are used. They either isolate the fault or de-energize the devices.

Theory and Methodology:

The different types of insulators, fuses, miniature circuit breakers, lightning arresters are discussed in detail.

Insulators:

Insulators are the devices which provide necessary insulation between line conductors and support structures/poles.

High mechanical strength, electrical resistance, relative permittivity and safety factor are the desirable properties of insulators which are required for the successful functionality of insulators.

Depending on the voltage level and functionality, insulators are classified into four categories-

- (i) Pin type insulators
- (ii) Shackle type insulators
- (iii) Disc/Suspension type insulators
- (iv) Strain type insulators

All four types of insulators, along with diagram are discussed below for the better understanding.

Pin Insulators: Pin insulators are used in 11 KV and 33 KV overhead lines.

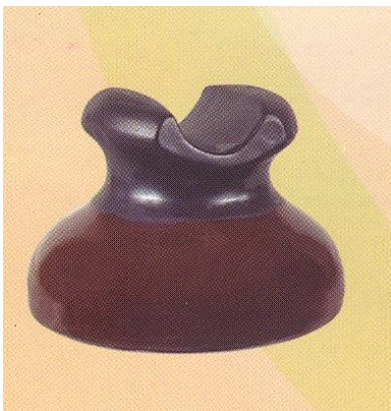




Fig 1.1: Pin type insulator

Shackle Insulators: These insulators are used in the 0.4 KV overhead service lines.

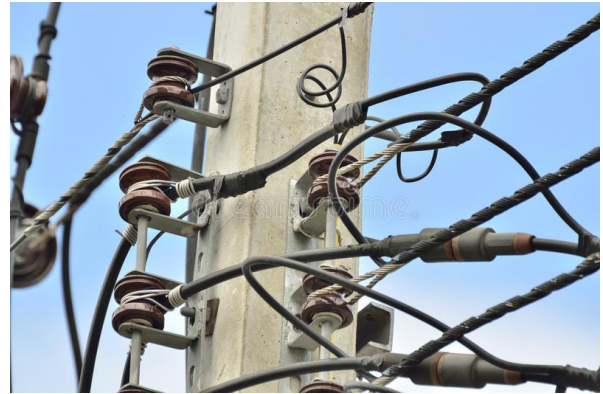
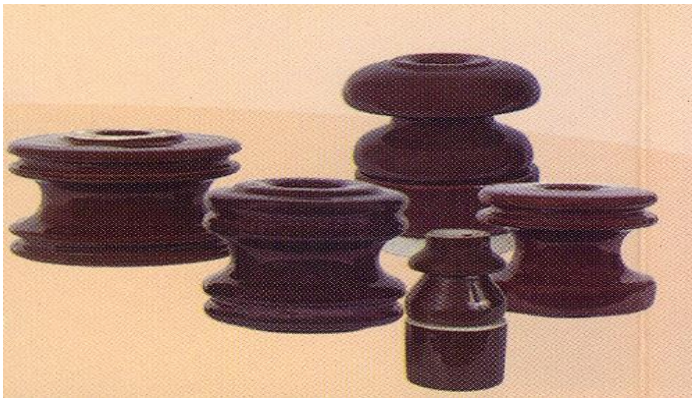


Fig 1.2: Shackle insulator

Disc/Suspension Insulators: These Insulators are used normally in HV overhead transmission lines. Total Insulation of the string can be increased by increasing the number of disc unit in the string to use in EHV lines. Table 1.1 indicates the number of units/discs necessary for insulation of specific voltage level.

Table 1.1

Typical No. of disc insulator units for standard line voltages	
<i>Line Voltage (KV)</i>	<i>No. of Discs</i>
34.5	3
46	4
69	5
92	7
115	8
138	9
161	11
196	13
230	15
287	19
345	22
360	23

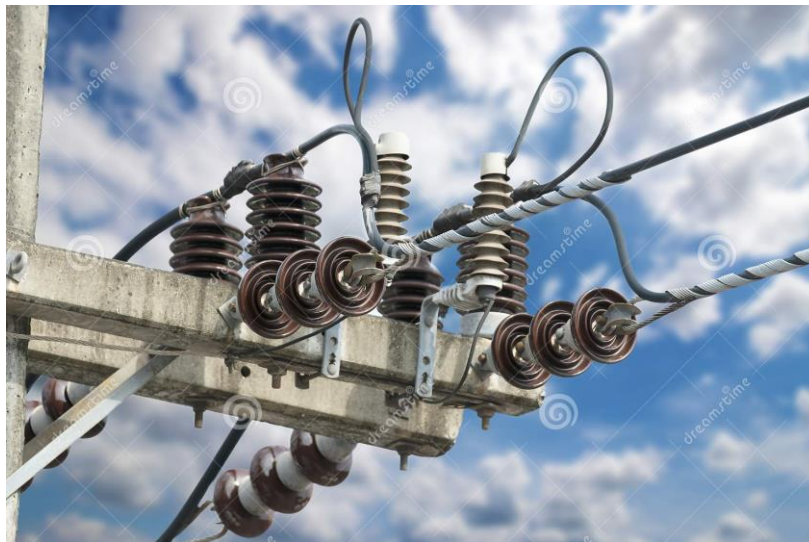


Fig 1.3: Disc insulator

Strain Insulators: These insulators are used to take tensions of the conductor at terminations of the line and at the angle towers.



Fig 1.4: Disc insulator

Fuses:

Fuse: Fuse is the simplest and cheapest current interrupting device for protection of the electrical devices from excessive currents. So it can be used for overload and /or short circuit protection.

Semi-enclosed or Re-wire able Fuse: These types of fuses are used for the protection of appliances at 0.4 KV voltage level and usually called **cut-out**. The Fuse carrier can be pulled out and the blown out fuse element can be replaced.



Fig 1.5: Re-wire able fuse

Totally Enclosed or cartridge Fuse: The Fuse Element (the conductor which melts) is enclosed in a totally enclosed container and is provided with metal contact on both side.



Fig 1.6: Totally enclosed Fuse

Drop out Fuse: A fuse link in which the fuse carrier drop out after melting the fuse wire thereby providing isolation between the terminals. This type of fuse is normally used in 11 KV side of a 11/0.4 KV distribution transformer.

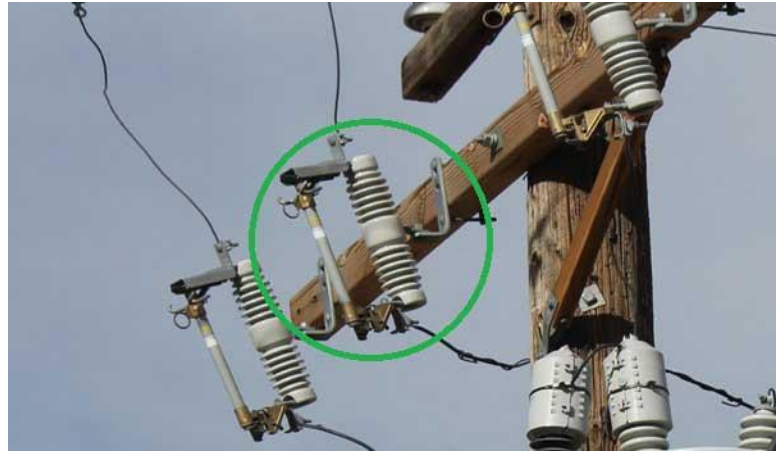


Fig 1.7: Drop out fuse

HRC (High Rupturing capacity) cartridge Fuse: A cartridge fuse link having breaking capacity higher than certain specified value (e.g. above the 16 KA for medium voltage)



Fig 1.8: HRC fuse

Lightning Arrestor: The main function of a Lightning arrestor is to divert any surge over voltage caused by lightning to the ground, so that equipment or devices behind the arrestor are saved from insulation failure and eventually short circuit fault.

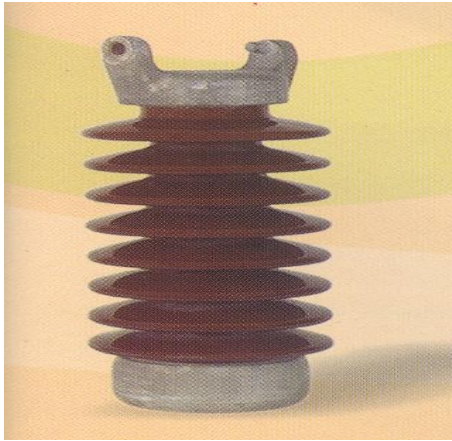


Fig 1.9: Lightning arrester

Miniature Circuit Breaker (MCB):

A circuit Breaker (CB) is an automatically operated electrical switch designed to protect an electrical circuit from damage caused by overload or short circuit. Its basic function is to detect a fault condition and by interrupting continuity, to immediately discontinue the high current flow. Unlike a fuse, which operates once and then has to be replaced, a CB can be reset (either manually or automatically) to resume normal operation. CBs are made in varying sizes, from small devices to large switchgears.

MCBs are used to protect electrical appliances in LV system. MCBs use the medium air alone to extinguish the arc, which is produced during high current interruption. Larger units will have metal plates or non-metallic arc chutes to divide and cool the arc. Magnetic blow out coils deflect the arc into arc chute.



Fig 1.10: MCBs

Report:

1. Explain why pin insulators are not used above 33 KV.
2. Explain how a fuse can provide time delayed protection for normal overload and high-speed protection for short circuit.
3. What are the differences between a MCB and a CB.