

## TESTING OF INSULATORS

Various types of overhead line insulators are (i) Pin type (ii) Post type (iii) String insulator unit (iv) Suspension insulator string (v) Tension insulator.

Arrangement of Insulators for Test String insulator unit should be hung by a suspension eye from an earthed metal cross arm. The test voltage is applied between the cross arm and the conductor hung vertically down from the metal part on the lower side of the insulator unit.

Suspension string with all its accessories as in service should be hung from an earthed metal Cross arm. The length of the cross arm should be at least 1.5 times the length of the string being tested and should be at least equal to 0.9 m on either side of the axis of the string. No other earthed object should be nearer to the insulator string than 0.9 m or 1.5 times the length of the string whichever is greater. A conductor of actual size to be used in service or of diameter not less than 1 cm and length 1.5 times the length of the string is secured in the suspension clamp and should lie in a horizontal plane.

The test voltage is applied between the conductor and the cross arm and connection from the impulse generator is made with a length of wire to one end of the conductor. For higher operating voltages where the length of the string is large, it is advisable to sacrifice the length of the conductor as stipulated above. Instead, it is desirable to bend the ends of the conductor over in a large radius. For tension insulators the arrangement is more or less same as in suspension insulator except that it should be held in an approximately horizontal position under a suitable tension (about 1000 Kg.). For testing pin insulators or line post insulators, these should be mounted on the insulator pin or line post shank with which they are to be used in service. The pin or the shank should be fixed in a vertical position to a horizontal earthed metal cross arm situated 0.9 m above the floor of the laboratory.

A conductor of 1 cm diameter is to be laid horizontally in the top groove of the insulator and secured by at least one turn of tie-wire, not less than 0.3 cm diameter in the tie-wire groove. The length of the wire Should be at least 1.5 times the length of the insulator and should over hang the insulator at least 0.9 mon either side in a direction at right angles to the cross arm. The test voltage is applied to one end of the conductor. High voltage testing of electrical equipment requires

two types of tests: (i) Type tests, and (ii) Routine test. Type tests involves quality testing of equipment at the design and development level i.e. samples of the product are taken and are tested when a new product is being developed and designed or an old product is to be redesigned and developed whereas the routine tests are meant to check the quality of the individual test piece. This is carried out to ensure quality and reliability of individual test Objects.

High voltage tests include (i) Power frequency tests and (ii) Impulse tests. These tests are carried out on all insulators.

**(i) 50% dry impulse flash over test**

The test is carried out on a clean insulator mounted as in a normal working condition. An impulse voltage of  $1/50 \mu$  sec. wave shape and of an amplitude which can cause 50% flash over of the insulator, is applied, i.e. of the impulses applied 50% of the impulses should cause flash over. The polarity of the impulse is then reversed and procedure repeated. There must be at least 20 applications of the impulse in each case and the insulator must not be damaged. The magnitude of the impulse voltage should not be less than that specified in standard specifications.

**(ii) Impulse withstand test**

The insulator is subjected to standard impulse of  $1/50 \mu$  sec. wave of specified value under dry conditions with both positive and negative polarities. If five consecutive applications do not cause any flash over or puncture, the insulator is deemed to have passed the impulse withstand test. If out of five, two applications cause flash over, the insulator is deemed to have failed the test.

**(iii) Dry flash over and dry one minute test**

Power frequency voltage is applied to the insulator and the voltage increased to the specified value and maintained for one minute. The voltage is then increased gradually until flash over occurs. The insulator is then flashed over at least four more times, the voltage is raised gradually to reach flash over in about 10 seconds. The mean of at least five consecutive flash over voltages must not be less than the value specified in specifications.

**(iv) Wet flash over and one minute rain test**

If the test is carried out under artificial rain, it is called wet flash over test. The insulator is subjected to spray of water of following characteristics:

Precipitation rate  $3 \pm 10\%$  mm/min. Direction  $45^\circ$  to the vertical  
 Conductivity of water 100 micro Siemens  $\pm 10\%$  Temperature of water ambient  $+15^\circ\text{C}$  The insulator with 50% of the one-min. rain test voltage applied to it, is then sprayed for two Minutes, the voltage rose to the one minute test voltage in approximately 10 sec. and maintained therefore one minute. The voltage is then increased gradually till flash over occurs and the insulator is then flashed at least four more times, the time taken to reach flash over voltage being in each case about 10 sec. The flash over voltage must not be less than the value specified in specifications.

**(v) Temperature cycle test**

The insulator is immersed in a hot water bath whose temperature is  $70^\circ$  higher than normal water bath for T minutes. It is then taken out and immediately immersed in normal water bath for T minutes. After T minutes the insulator is again immersed in hot water bath for T minutes. The cycle is repeated three times and it is expected that the insulator should withstand the test without damage to the insulator or glaze. Here  $T = (15 + W/1.36)$  where W is the weight of the insulator in Kg's.

**(vi) Electro-mechanical test**

The test is carried out only on suspension or tension type of insulator. The insulator is Subjected to a  $2\frac{1}{2}$  times the specified maximum working tension maintained for one minute. Also, simultaneously 75% of the dry flash over voltage is applied. The insulator should withstand this test without any damage.

**(vii) Mechanical test**

This is a bending test applicable to pin type and line-post insulators. The insulator is subjected to a load three times the specified maximum breaking load for one minute. There should be no damage to the insulator and in case of post insulator the permanent set must be less than 1%. However, in case of post insulator, the load is then raised to three times and there should not be any damage to the insulator and its pin.

**(viii) Porosity test**

The insulator is broken and immersed in a 0.5% alcohol solution of fuchsine under a pressure of 13800 kN/m<sup>2</sup> for 24 hours. The broken insulator is taken out and further broken. It should not show any sign of impregnation.

**(ix) Puncture test**

An impulse over voltage is applied between the pin and the lead foil bound over the top and side grooves in case of pin type and post insulator and between the metal fittings in case of suspension type insulators. The voltage is 1/50  $\mu$  sec. wave with amplitude twice the 50% impulse flash overvoltage and negative polarity. Twenty such applications are applied. The procedure is repeated for 2.5, 3, and 3.5 times the 50% impulse flash over voltage and continued till the insulator is punctured. The insulator must not puncture if the voltage applied is equal to the one specified in the specification.

**(x) Mechanical routine test**

The string in insulator is suspended vertically or horizontally and a tensile load 20% in excess of the maximum specified working load is applied for one minute and no damage to the string should occur.