3.8 TESTING OF INSULATOR

To ensure the desired performance of an electrical insulator, that is for avoiding unwanted insulator failure, each insulator has to undergo numbers of insulator test. Before going through testing of insulator we will try to understand different causes of insulator failure. Because insulator testing ensures the quality of electrical insulator and chances for failure of insulation depend upon the quality of insulator.

(i) Cracking Of Insulator

The porcelain insulator mainly consists of three different materials. The main porcelain body, steel fitting arrangement and cement to fix the steel part with porcelain. Due to changing climate conditions, these different materials in the insulator expand and contract in different rate. These unequal expansion and contraction of porcelain, steel and cement are the chief cause of cracking of insulator.

(ii) Defective Insulation Material

If the insulation material used for insulator is defective anywhere, the insulator may have a high chance of being puncher from that place.

(iii) Porosity In The Insulation Materials

If the porcelain insulator is manufactured at low temperatures, it will make it porous, and due to this reason it will absorb moisture from air thus its insulation will decrease and leakage current will start to flow through the insulator which will lead to insulator failure.

(iv) Improper Glazing on Insulator Surface

If the surface of porcelain insulator is not properly glazed, moisture can stick over it. This moisture along with deposited dust on the insulator surface, produces a conducting path. As a result the flash over distance of the insulator is reduced. As the flash over distance is reduced, the chance of failure of insulator due to flash over becomes more.

(v) Flash Over Across Insulator

If flash over occurs, the insulator may be over heated which may ultimately results into shuttering of it.

(vi) Mechanical Stresses on Insulator

If an insulator has any weak portion due to manufacturing defect, it may break from that weak portion when mechanical stress is applied on it by its conductor. These are the main causes of insulator failure. Now we will discuss the different insulator test procedures to ensure minimum chance of failure of insulation.

3.8.1 Types of Testing Of Insulators

Following are the different types of tests that are carried out on overhead line insulators.

1. Flashover tests
2. Performance tests
3. Routine tests

Flashover Tests Of Insulators

Three types of flashover tests are conducted before the insulator is said to have passed the flashover test.

1. Power frequency dry flashover test
2. Power frequency wet flashover test
3. Impulse frequency flashover test

Power Frequency Dry Flashover Test

The insulator to be tested is mounted in the same manner in which it is to be used. Then, a variable voltage source of power frequency is connected between the electrodes of the insulator. The voltage is gradually increased up to the specified voltage. This specified voltage is less than the minimum flashover voltage. The voltage at which surrounding air of the insulator breaks down and become conductive is known as flashover voltage. The insulator must be capable of withstanding the specified voltage for one minute without flashover.

Power Frequency Wet Flashover Test (Rain Test)

In this test also, the insulator to be tested is mounted in the same manner in which it is to be used. Similar to the above test, a variable voltage source of power frequency is connected between the electrodes. Additionally, in this test, the insulator is sprayed with

water at an angle of 45° in such a manner that its precipitation should not be more than 5.08 mm/min. The voltage is then gradually increased up to the specified voltage. The voltage is maintained at the specified value for 30 seconds or one minute and the insulator is observed for puncture or breakdown. If the voltage is maintained for one minute, this test is also called as one-minute rain test.

Impulse Frequency Flashover Test

This test is to ensure that the insulator is capable of sustaining high voltage surges caused by lightning. The insulator under test is mounted in the same manner as in above tests. An impulse voltage generator which generates a very high voltage at a frequency of several hundred kilohertz is connected to the insulator. This voltage is applied to the insulator and spark-over voltage is noted. The ratio of impulse spark-over voltage to spark-over voltage at power frequency is called as the impulse ratio. This ratio should be approximately 1.4 for pin type insulators and 1.3 for suspension type insulators.

3.8.2 Performance Tests Of Insulators

1. Temperature cycle test
2. Puncture voltage test
3. Mechanical strength test
4. Electro-mechanical test
5. Porosity test

Temperature Cycle Test

In this test, the insulator under test is first heated in water at 70° for one hour. Then the insulator is immediately cooled at 7° for another hour. This cycle is repeated three times. Then the insulator is dried and its glazing is thoroughly observed for any damages or deterioration.

Puncture Voltage Test

The purpose of this test is to determine the puncture voltage. The insulator to be tested is suspended in insulating oil. A voltage is applied and increased gradually until the puncture takes place. The voltage at which insulator starts to puncture is called

as puncture voltage. This voltage is usually 30% higher than that of the dry flash-over voltage for a suspension type insulators.

Mechanical Strength Test

In this test, the insulator under test is applied by 250% of the maximum working load for one minute. This test is conducted to determine the ultimate mechanical strength of the insulator.

Electro-Mechanical Test

This test is conducted only for suspension type insulators. In this test, a tensile stress of 250% of maximum working tensile stress is applied to the insulator. After this, the insulator is tested for 75% of dry spark-over voltage.

Porosity Test

In this test, a freshly manufactured insulator sample is broken into pieces. These pieces are then immersed into a 0.5% to 1% alcohol solution fuchsine dye under pressure of 150 kg/cm^2 for several hours (say 24 hours). After that, the pieces are removed from the solution and examined for the penetration of the dye into it. This test indicates the degree of porosity.

3.8.3 Routine Tests Of Insulators

1. High voltage test
2. Proof load test
3. Corrosion test

High Voltage Test

This test is usually carried out for pin insulators. In this test, the insulator is inverted and placed into the water up to the neck. The spindle hole is also filled with water and a high voltage is applied for 5 minutes. The insulator should remain undamaged after this test.

Proof Load Test

In this test, each insulator is applied with 20% in excess of working mechanical load (say tensile load) for one minute. The insulator should remain undamaged after this test.

Corrosion Test

In this test, the insulator with its metal fitting is suspended into a copper sulfate solution for one minute. Then the insulator is removed from the solution and wiped and cleaned. This procedure is repeated for four times. Then the insulator is examined for any metal deposits on it. There should be zero metal deposits on the insulator.