

Introduction Off-Line VLF - 50 Hz AC Testing

Compiled by John Sherriff | January 2019 | Rev 1

The scope

What is VLF Hipot Testing?

Withstand or hipot testing is used as a pass/fail test of the insulation during installation, acceptance, or maintenance testing.

The main focus of the very low frequency (VLF) withstand cable test, which essentially is a type of AC hipot test conducted at a frequency rate of 0.01 to 1.00 Hz.

Due to a significant drop in the operation frequency compared to AC hipot testing, done at 50 or 60 Hz, a VLF hipot tester is much smaller than a typical AC hipot test set, and thus is widely applicable for field usage.

Main VLF Hipot Testing Parameters

IEEE 400.2 guide stipulates that the test voltage should be 2.0 to 3.0 times the cables' normal line to ground voltage. Since maintenance testing is done on service age cables, the recommended voltage is 80 per cent of that used for installation /acceptance testing. If there is a need to perform several test cycles, it may be reasonable to decrease the testing voltage by a further 20 per cent.

The table below reflects the IEEE 400.2 guidelines as to the optimal testing sinewave voltage for 5 kV to 35 kV cables.

Cable rms voltage	Installation rms / peak voltage	Acceptance rms / peak voltage	Maintenance rms / peak voltage
5 kV	9 / 13 kV	10 / 14 kV	7 / 10 kV
8 kV	11 / 16 kV	13 / 18 kV	10 / 14 kV
15 kV	18 / 25 kV	20 / 28 kV	16 / 22 kV
25 kV	27 / 38 kV	31 / 44 kV	23 / 33 kV
35 kV	39 / 55 kV	44 / 62 kV	33 / 47 kV

The advised testing time is 60 minutes at 0.1 Hz on new cables, and 30 minutes at 0.1 Hz on service age cables; it is recommended that the withstand testing time during maintenance testing should be extended to 60 minutes at 0.1 Hz if the circuit in question is of special importance.

Conclusion | Although VLF withstand testing is attributed to destructive cable testing as it causes severe defects to initiate treeing and break down the insulation, the VLF test nevertheless does not harm good insulation. So, VLF hipot testing performed with alternating sinusoidal voltage best meets the testing purpose of locating and removing several defects in insulation that is mostly of good quality.

A VLF hipot is simply an AC output instrument but at a lower frequency. The lower the frequency output, the lower the current and power required to test high capacitance loads like cables.

Don't overcomplicate it. It's a simple AC withstand test.

VLF is the easiest, cost effective, most certain way of testing AC integrity of the cable insulation system.

Advantages

The strong points of VLF cable testing include the following:

- VLF cable testing is applicable for extruded polyethylene, laminated paper, and mixed insulation.
- The small size of the VLF test set is perfect for field testing.
- VLF hipot testing can be done on both new and service age cables, which means that it can be used for installation, acceptance, and maintenance testing.
- With the right voltage and testing time, VLF testing is not destructive for less severe insulation defects that could remain dormant for a long time and not impede the cable performance. Yet, it is efficient for locating more severe insulation defects that are likely to cause cable faults in the nearest future.

Combined with standard cable diagnostics equipment, the VLF test set can be used for diagnostic testing.

Disadvantages

At the same time, the difficulties associated with VLF hipot testing are these:

- VLF testing with very high testing voltage at a frequency below 0.01 Hz may cause space charges in extruded polyethylene insulation.
- This test works best when eliminating a few defects from otherwise good cable insulation. Cables with several defect locations could be problematic, as the test does not identify all defects with one test.
- VLF AC Hi-pot is not a diagnostic test. It is a green light test that indicates it is acceptable to energise the cable. It does not provide data points that can be used to assess the health of the cable.
- VLF cable testing is done on offline cables only.