MV/HV CABLE TESTING using VLF TECHNOLOGY

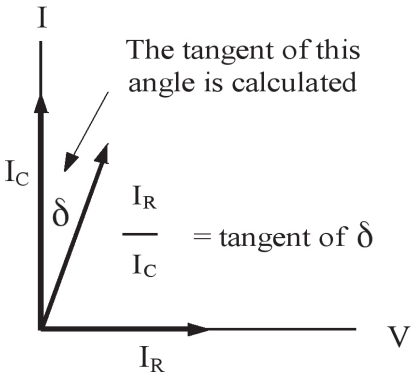
VLF Withstand – VLF Tan Delta – VLF Partial Discharge

High Voltage, Inc. offers VLF test equipment for all cables rated up to 220 kV.

VLF Diagnostic field testing of cables is common, has been since over 20 years. All three technologies shown are very well proven for testing MV cables. Any VLF model from HVI can be used to perform the three tests described. Withstand and Diagnostic field-testing of medium and high voltage cable is very practical using HVI VLF technology along with commercially available Tan Delta and Partial Discharge measuring devices. The use of multi-ton, very expensive power frequency resonant equipment is no longer necessary. VLF products from HVI are far smaller, lighter, easier to transport, and less expensive: **everything needed to bring factory cable testing methods to the field.** These tests are performed off-line, providing the most information possible. Test procedures and test specifications are within IEEE, IEC, and other standards.

VLF Withstand Testing

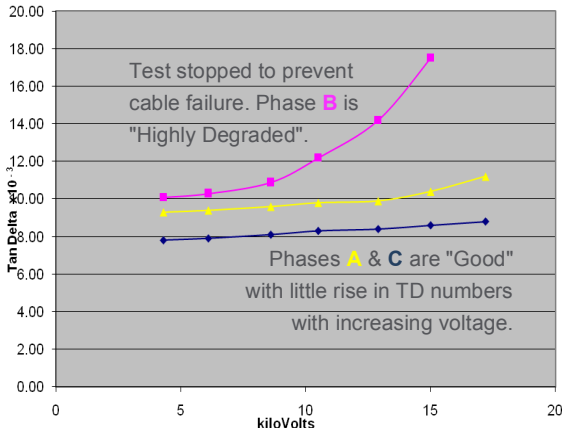
The most basic use of the VLF is to perform a go/no-go withstand test to expose defects that cannot hold the test voltage. If a cable can't hold ~1.5 – 3 times normal voltage, depending on cable class, find out now. Let failure occur during downtime, make the repair, and not worry about that cable for many years. It is very useful following installation, repair, or to insure critical cables are sound. In situations where the user can tolerate a failure during the test, it is the simplest and most certain way to test a cable. Any defect severe enough to be driven to partial discharge is brought to failure. Lesser defects and good insulation remain dormant under the over voltage stress and are unaffected. It is the ultimate diagnostic test.



Tangent Delta/ Dissipation Factor/ Loss Angle Testing

When a possibly destructive withstand test cannot be tolerated, a nondestructive diagnostic test is preferred. The first technique and the most common is a **Tan Delta test. This is a "global" test of the cable, providing the condition from end to end.** Using a VLF as the voltage source and a separate divider to make the measurements, the voltage is raised while measuring the Tan Delta of the cable. If a cable is perfect, it behaves like a capacitor where there is a phase shift of 90° between the voltage and current. The more degraded the insulation and accessories are, the more this angle becomes less than 90°, as resistive leakage current is added. This change in the angle is easily measured and assumptions can be made about the degree of degradation. For example, if the curve trends sharply upward as the voltage is raised, the cable is highly degraded. Test many cables and rate them as **Highly Degraded, Moderately Degraded,** or **Good.** This, and other data and cable history, is used to help **prioritize cable replacement, injection**, and/or what **other tests** may be of value.

Tan δ Curve – Note "Tip-Up" of one Phase



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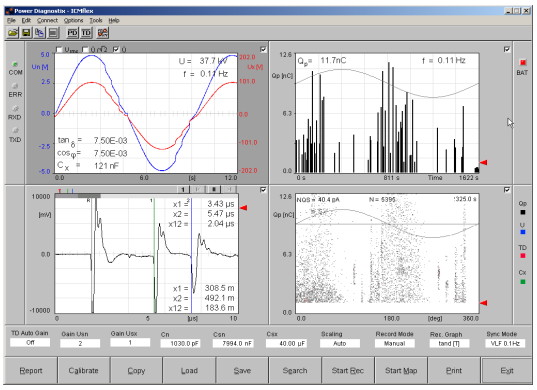
Partial Discharge Testing



Sample PD Screen Shot:
Location and Amplitude
Power Diagnostic Systems Guide

Partial Discharge testing using VLF is very common and long proven and accepted. The obvious advantage to using VLF rather than power frequency systems is the **smaller size, lower weight, far less power consumed, and price.** PD testing attempts to locate defects and their severity along the cable path. While TD testing provides the overall health of the cable**, PD testing finds individual locations of electrical discharge.** The operator then makes a determination whether the level of PD is worrisome or acceptable. Any PD in the insulation at levels near or slightly above operating voltage is unacceptable, whereas accessories can survive with rather high levels of PD. Also measured are the Partial Discharge Inception Voltage (**PDIV**) and the PD Extinction Voltage (**PDEV**). Knowing where PD ignites relative to normal operating voltage, and where the PD extinguishes when voltage is lowered, provides valuable data used in the interpretation. PD testing is of great value, although the most expensive and difficult to perform.

Conclusion

All three methods of testing provide useful, but different information. None are alone suited for every situation. Ideally, the data gained using all three technologies should be studied before making maintenance decisions. The cost of running and powering the test, the cost to buy the equipment, the ease of the test, the ease of interpretation, the skill of the operator necessary, the availability of the equipment, the cable design, age, ease of repair, the data needed to make cable maintenance decisions, and whether cable failure during the test is permissible are all vital in selecting what tests are best for your cable system.

No other company can offer as much for cable testing and fault locating than HVI.
All three methods have been used for years and are well proven for testing cables. Use one, two, or all three methods to learn as much as possible about your cable's insulation quality.
For more information on VLF technology, refer to other HVI publishing's.

200kV VLF Withstand, VLF TD & VLF PD Test Truck
Built by Inducor Ingenieria S.A. Argentina

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