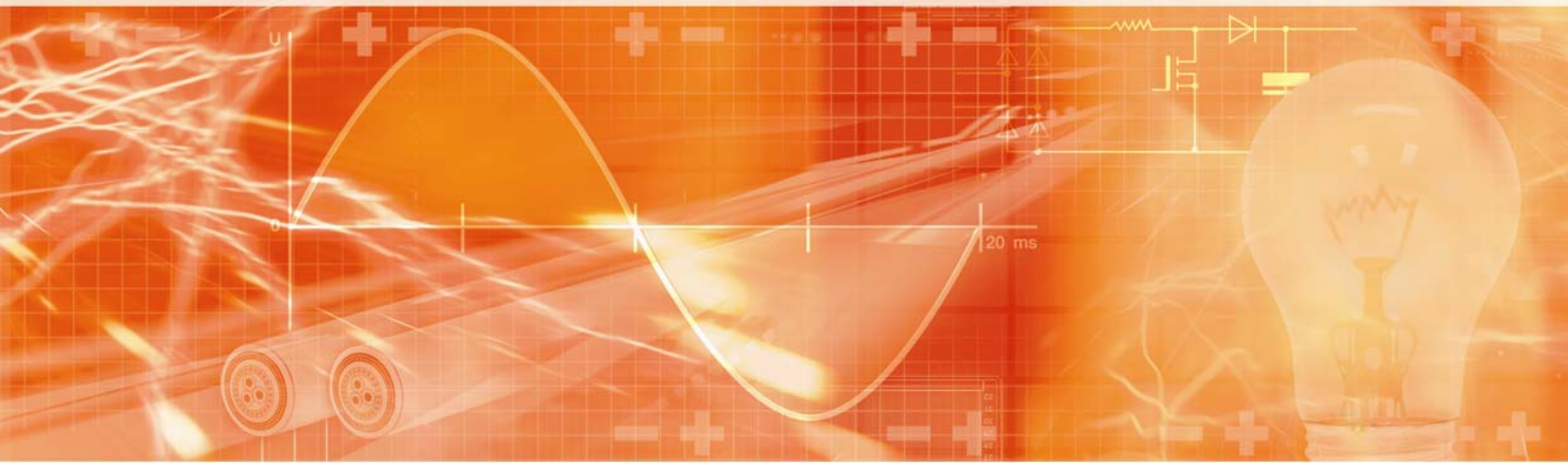
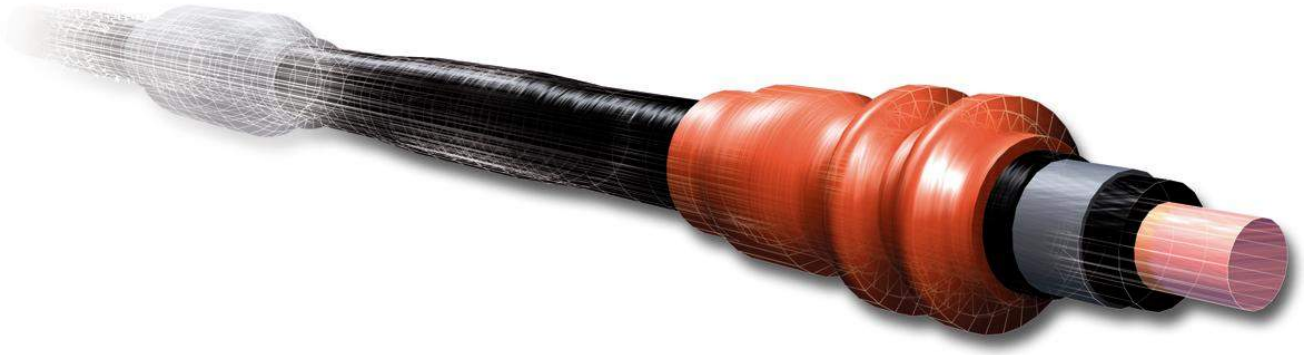
Cable fault location in power cables



Systematics for cable testing, diagnosis and cable fault location



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Contents:

Regarding the task to be performed, a distinction must be made between two main groups:

Testing, diagnosing and partial discharge measurement
Condition-oriented maintenance

Localising all types of cable faults
Result-oriented maintenance

1. Testing, diagnosing and partial discharge measurement

Objective of the cable test:

- Checking quality before running and fitting a cable
- Correcting weak points in the cable which can jeopardise the operation

During the cable test, flash-overs are generated at the weak points in a cable. These faulty points must then be localised (cable fault location). Depending on the insulation and the test object, the following voltage forms are mandatory:

Paper-insulated lead-covered cable (PILC)	DC voltage AC voltage 50 – 60 Hz VLF (0.1 Hz)
PE/XLPE cable	AC voltage 50 – 60 Hz VLF (0.1 Hz)
Components	DC voltage and AC voltage 50 – 60 Hz

Objective of the dielectric diagnosis and partial discharge measurement:
A non-destructive check for testing the condition of the insulation in cables and fittings and localising faulty points.

Dielectric diagnosing

- Integral check of how the cable has aged by means of IRC analysis (isothermal relaxation current analysis) in PE and XLPE cable insulation types
- Integral check of the moisture content by means of RVM analysis (return voltage measurement) in paper-insulated lead-covered cables

Partial discharge measurement (PD measurement)
Recording, location and evaluation of partial discharges (PD) in the insulation and fittings of medium voltage cables.
Remark: These subjects are dealt with separately in the following articles.

2. Localising all different types of cable faults

The steps necessary for determining fault locations can be sub-divided into five main catagories.

1. **Fault classification** – identifying the type of fault

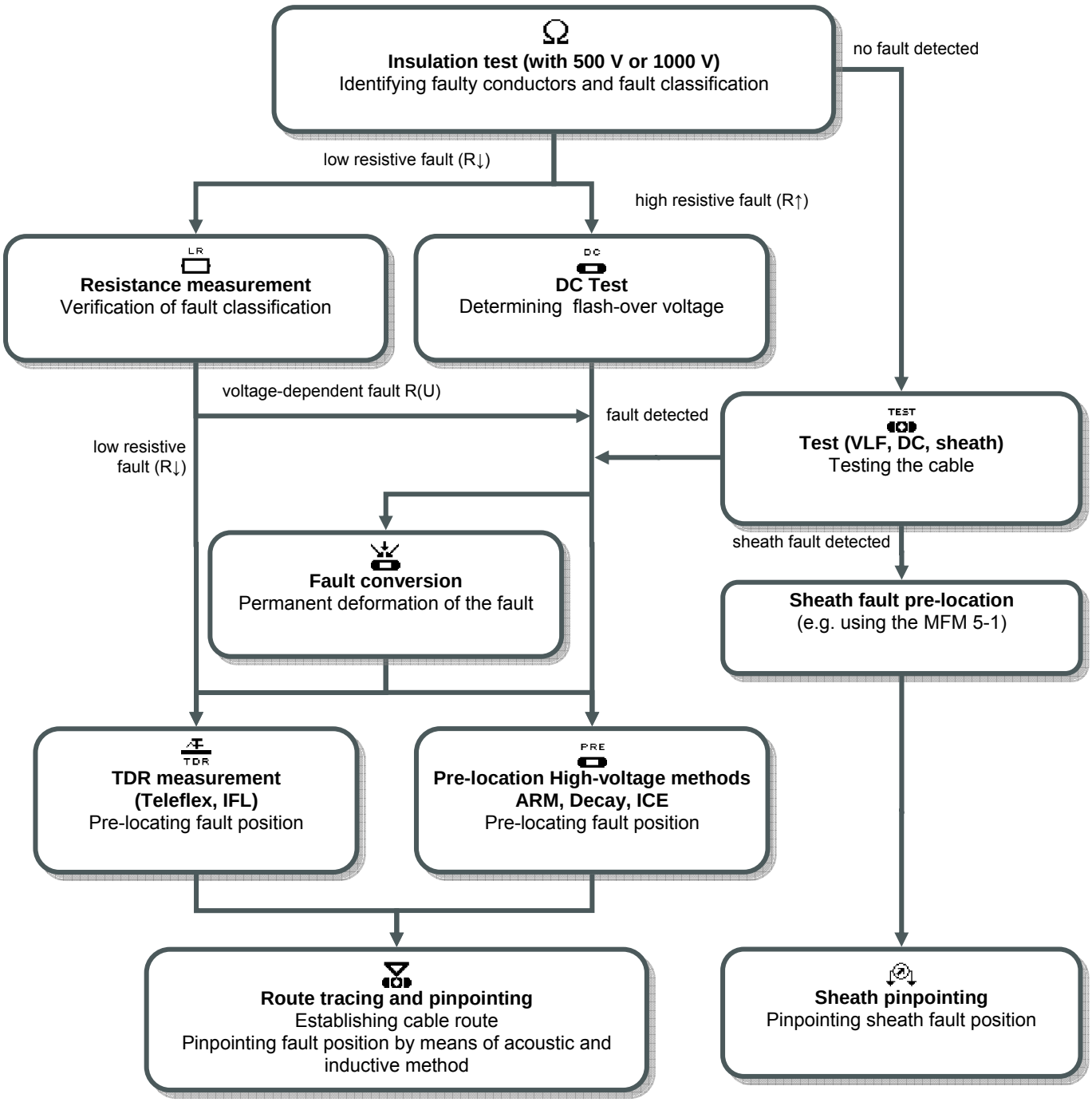
2. **Pre-location** – determining the distance to the fault

3. **Route tracing** – determining the route of the cable at the site

4. **Pinpointing** – determining the exact position of the cable the site

5. **Cable identification** – determining the faulty cable amongst several cables

The following diagram shows the common procedure for identifying and locating cable faults:



Measuring methods in cable fault location:

Insulation test, measuring the resistance of a fault

Testing

- DC test (determining the flash-over voltage)
- Sheath fault test
- VLF test (determining the flash-over voltage)

Pre-location

- Teleflex measurements (pulse reflection measurements, TDR measurements)
- ARM (Arc Reflection Method)
- ARM Plus (Arc Reflection Method Plus)
- ARM power burning
- Decay Plus (Arc Reflection Method – igniting the fault using DC generator)
- Decay (travelling wave method, oscillation method)
- Current catching (ICE)
- Three-phase current catching (ICE)
- ICE Plus (low-voltage networks only)
- High-voltage bridge method (pre-locating sheath faults)
- Voltage drop method (pre-locating sheath faults)

Fault conversion

- Burning
- Performance burning

Route tracing

- Line location
- Line routing

Pinpointing

- Audio frequency generator (twist field method, minimum turbidity method)
- Shock discharges (acoustic field method, acoustic pinpointing)
- Pinpointing sheath fault

Cable and phase identification

- Phase identification when earthed
- Phase identification and phase determination on live systems