Needs for standardisation of condition monitoring methods

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IAEA co-ordinated research programme 2
Round robin test 1998

- 14 cable manufacturers
- Sheath materials: PVC, CSPE, EVA, SiR
- Insulation materials: PVC, PE, EPDM, EPR, CSPE, XLPE, EVA, SiR
- Unaged/ thermally aged identical samples sent to 12 laboratories for condition measurements
- Thermal ageing: PE 100°C, XLPE 110°C, others 120°C, ageing time 1008 hours

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Methods tested

• Tensile (elongation at break): 9 laboratories
• Indenter: 6 laboratories
• OIT: 5 laboratories
• OITP: 4 laboratories
• TGA: 4 laboratories
• Torque: 1 laboratory

Laboratories noted as A, B, C, …
IAEA round robin test. Tensile test, PVC sheath

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IAEA round robin test. Tensile test, PVC insulation

![Graph showing mean elongation for different samples A to G, comparing as-received and aged conditions.](graph.png)

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IAEA round robin test. Tensile test, PVC, $e/e_0$

**PVC sheath**

**PVC insulation**

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IAEA round robin test. Tensile test, $e/e_0$
EVA sheath/XLPE insulation

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IAEA round robin test. Indenter test, PVC sheath

as-received

mean modulus, N/mm

aged

mean modulus, N/mm

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IAEA round robin test. Indenter test, PVC insulation

![Graph showing mean modulus for as-received and aged PVC insulation.](image)

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IAEA round robin test. Indenter test, PVC, m/m₀

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IAEA round robin test. Indenter test, $m/m_0$
EVA sheath/XLPE insulation

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IAEA round robin test. Indenter test, $m/m_0$
EVA sheath/XLPE insulation

EVA sheath, force range 6-9N

XLPE insulation, force range 6-9N

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IAEA round robin test. OITP measurements

![Bar chart showing PE insulation mean OITP, °C for as-received and aged samples.](chart.png)

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IAEA round robin test. OITP measurements

PE insulation

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IAEA-TECDOC-1188

Volume II p. 68:

"The main conclusion that has come out of this series of round-robin tests has been the need for more detailed specification of the test procedures for condition monitoring methods"
IAEA TECDOC 1188 Recommendations on parameters needed to be specified/standardised

**Tensile tests**
Type of test machine used
Calibration procedure
Method of gripping samples and type of grip face
Test temperature
Cross-head speed
Method of measuring elongation

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Indenter tests

Test temperature
Probe speed
Force range used for analysis (standard ranges)
Calibration procedure
(Grip force?)

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**OIT tests**

Type of instrument used
Method of calibration
Sample weight and preparation method
Type of sample pan (open or closed)
Oxygen flow rate used
Temperature profile used to reach oxidation temperature
Method of establishing baseline (data plot)
Method of establishing oxidation onset

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**OITP tests**

- Type of instrument used
- Method of calibration
- Sample weight and preparation method
- Type of sample pan (open or closed)
- Oxygen flow rate used
- Temperature ramp rate and starting temperature
- Method of establishing baseline (data plot)
- Method of establishing oxidation onset

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TGA tests

Type of instrument used
Method of calibration
Sample weight and preparation method
Type of sample pan (open or closed)
Oxygen flow rate used
Temperature ramp rate and starting temperature
Method of establishing oxidation onset

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Where to find IAEA-TECDOC-1188

- www.iaea.org
- Click on Publications
- Click on Scientific & Technical Publications
- Write under Search: Assessment and management of ageing of major
- Find TECDOC 1188 part I as item 6 and part II as item 5. The full text can be opened