Electricity Specification 400R10

Issue 3       June 2016

Cold-Pour Resin Compound for Encapsulating Joints on LV, 11kV and 33kV Cables

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Approved for issue by the Technical Policy Panel

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## Issue and Amendment Summary

<table>
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<tr>
<th>Amendment No.</th>
<th>Date</th>
<th>Brief Description and Amending Action</th>
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<tr>
<td>0</td>
<td>14/10/97</td>
<td>Initial issue.</td>
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<td></td>
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<td>Prepared by: DPH.</td>
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<td>Approved by the Standards Steering Group and signed on its behalf by:</td>
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<td>0</td>
<td>01/09/04</td>
<td>Issue 2</td>
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<td></td>
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<td>Specification updated with new test requirements added.</td>
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<td></td>
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<td>Prepared by: D. P. Horsman.</td>
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<td>-</td>
<td>23/06/16</td>
<td>Issue 3</td>
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<td></td>
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<td>Prepared by: J Scott</td>
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<td></td>
<td></td>
<td>Approved by the Technical Policy Panel and signed on its behalf by Steve Cox, Head of Engineering</td>
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</table>
COLD-POUR RESIN COMPOUND FOR ENCAPSULATING JOINTS ON LV 11kV AND 33kV CABLES

1. SCOPE

Encapsulations are required for all types of LV, 11kV and 33kV joints.

Resin encapsulated joints shall consist of a cold-pour fast-curing compound contained in a plastic joint shell.

The compound shall be suitable for mixing and pouring in all ambient environmental temperatures between \(-10^\circ C \) and \(30^\circ C\).

A two part polyurethane or methacrylate-based compound shall be offered. Alternative types of compound may also be offered.

Customer disruption must be kept as low as possible. To improve industry key aspects of customer disruption, the ease of resin mixing will be taken into consideration to provide a minimal time in jointing activities.

2. DEFINITIONS

Approval: Sanction by the Electricity North West Underground Circuits Manager that specified criteria have been satisfied.

Contract: The agreement between Electricity North West and the Contractor for the execution of the Works including therein all documents to which reference may properly be made in order to ascertain the rights and obligations of the parties under the said agreement.

Contractor: The person or person's firm or company, including personal representatives, successors and permitted assigns, who's Tender, has been accepted by Electricity North West.

Guarantee: A document serving as security for the materials supplied/Contract works for the specified period.

Specification: The Specifications and schedules (if any) agreed by the parties for the purpose of the Contract.

Sub-Contractor: Any person (other than the Contractor) named in the Contract for any part of the Works or any person to whom any part of the Contract has been sub-let with the consent in writing of the Electricity North West Underground Circuits Manager, and the legal representatives, successors and assigns of such person.

Supplier: Any person or person's firm or company who supplies goods to Electricity North West or to its Contractor.

Tender: An offer in writing to execute work or supply goods at a fixed price.
Tenderer: The person or person's firm or company, including personal representatives, successors and permitted assigns, invited by Electricity North West to submit a Tender.

3. GENERAL REQUIREMENTS FOR APPROVALS AND TESTING

3.1 Product not to be Changed

No change in the product, packaging or labelling shall be made after Approval has been granted without prior notice to the Electricity North West Underground Circuits Manager, and receipt of a written agreement to the proposed change from the Electricity North West Underground Circuits Manager.

3.2 Electricity North West Technical Approval

The Tenderer shall submit, with this Tender, proposals for testing which will demonstrate, to the satisfaction of the Electricity North West Underground Circuits Manager, compliance with this Specification. Such tests shall be carried out without expense to Electricity North West.

Alternatively, technical reports and other data may be submitted that the Tenderer considers will demonstrate, to the satisfaction of the Electricity North West Underground Circuits Manager, compliance with this Specification. Acceptance of this evidence shall be at the discretion of the Electricity North West Underground Circuits Manager but will not be unreasonably withheld.

Approval shall be ‘factory specific’ and is not transferable to another factory without the written Approval of the Electricity North West Underground Circuits Manager.

The Supplier and product shall comply with all the relevant requirements of Electricity North West documents EPD311 and CP311.

Approval may be withdrawn at any time by Electricity North West due to failures, defects, non conformances or any other issue which may affect the performance or lifetime of the cable system.

3.3 Quality Assurance

The Tenderer shall confirm whether or not Approval is held in accordance with a quality assurance scheme accredited under ISO 9000. If not, the Tenderer shall submit a statement of the quality assurance procedures employed to control the quality of the product, including the performance of Suppliers and Sub-Contractors.

The right is reserved for the repeat of such tests, from time to time, that the Electricity North West Underground Circuits Manager may deem to be reasonably necessary to demonstrate continued compliance with the Specification.

The Tenderer shall submit, with the Tender, a list of tests and inspections which are carried out on the product prior to despatch which shall demonstrate, to the satisfaction of the Electricity North West Underground Circuits Manager, fitness for installation and service.
The Tenderer shall provide free of charge to Electricity North West such samples as may, in the opinion of the Electricity North West Underground Circuits Manager, be reasonably required for inspection and/or retention as quality control samples. The Electricity North West Underground Circuits Manager will confirm the requirement for samples at the time of Tendering.

The right is reserved for inspections to be made of Tenderer’s facilities, from time to time, as deemed reasonably necessary by the Electricity North West Underground Circuits Manager to ensure compliance with this Specification and any Contract of which it forms a part.

The Tenderer shall submit, with the Tender, such details of product packaging disposal, as will enable Electricity North West to comply with the requirements of BS EN ISO 14001 - Environmental Management Systems.

### 3.4 Formulation

The Tenderer shall submit, with the Tender, such details of the formulation and use of the product and associated substances as will enable Electricity North West to comply with the obligations of the Health and Safety at Work Act and the Control of Substances Hazardous to Health Regulations, in the use, storage and disposal of the product. The Tenderer may stipulate, prior to submission of such information, that it is to remain confidential, and the Electricity North West Underground Circuits Manager will, if requested, confirm agreement to this prior to receipt of the information.

### 3.5 Identification Markings

The Tenderer shall submit, with the Tender, details of markings which it is proposed to apply to the product or packaging to identify manufacturing batches or items. The forms and content of such markings shall be subject to the Approval of the Electricity North West Underground Circuits Manager, and shall in all cases include the Electricity North West approved description and commodity code number.

The Tenderer shall submit, with the Tender, such details of marking gross weight on components, assemblies and packages, as will enable Electricity North West to comply with the Health and Safety Manual Handling Operation Regulations, for components, assemblies and packages supplied with a gross weight over 1kg. The forms and content of such markings shall be subject to the Approval of the Electricity North West Underground Circuits Manager.

### 3.6 Minimum Life Expectancy

The minimum life expectancy of all products covered by this Specification is 60 years.

### 3.7 Product Conformity

Preference will be given to those Suppliers who can provide suitable Product Conformity Certification to a recognised or specified standard, or an equivalent certification.

### 3.8 Confirmation of Conformance

The Tenderer shall complete the conformance declaration sheets in Appendix J. Failure to complete these declaration sheets may result in an unacceptable bid.
4. TECHNICAL INFORMATION REQUIREMENTS

The properties of the compound shall be provided by completion of Appendix A.

Details shall be provided with the Tender of the surface preparation work recommended to obtain adequate adhesion of the compound to the various materials specified in Appendix C.

Positive confirmation that the polyurethane compound shall have no adverse effect on moulded ABS or PetG joint shells, polyethylene, PVC or XLPE insulation. Rubber insulation patch, heat shrink and cold shrink insulation shall be provided.

Where alternative types of compound are offered, the recommended material for the joint shells shall be specified.

Results from foaming and adhesion tests shall be provided.

Gelation and hardening times shall be provided. (The details shall include: volumes, temperature and time.)

Evidence shall be provided of the compound % shrinkage during cure. The maximum permitted shrinkage during curing shall be less than 1%.

The product shall conform to the tests described within the Electricity Network Association document Engineering Recommendation C81/6. Evidence shall be provided with the Tender of the Type Tests carried out.

Joint failure investigation works are undertaken by Electricity North West Engineers. The Supplier shall detail the recommended cutting tools and PPE required to section / cut and remove resin from the joint to establish the reason for joint failure.

Technical data sheets shall be provided with the Tender.

5. REQUIREMENTS FOR FINGERPRINTING, TYPE AND ROUTINE TESTS

5.1 Requirements for Fingerprinting Tests at the Supplier’s Premises

These are a series of one-off type tests, which are carried out to ensure the satisfactory performance of the product design, under extremes of operating stresses, and of endurance, as may be appropriate, to be determined by the Electricity North West Underground Circuits Manager.

These may or may not be destructive tests.

5.2 Requirements for Type Tests at the Supplier’s Premises

A series of one-off type tests shall be carried out to ensure the satisfactory performance of the product, under extremes of operating stresses, and of endurance, as may be appropriate, to be determined by the specifier.

These may or may not be destructive tests.
5.3 Requirement for Routine Tests at the Supplier’s Premises

These tests may be required to be carried out on every individual unit or component, as specified, or at some regular frequency to be determined by the Electricity North West Underground Circuits Manager.

The results of these tests may be required to be supplied to Electricity North West with each unit purchased or retained for inspection, at a period to be determined by the Electricity North West Underground Circuits Manager.

6. SCHEDULE OF TESTS

6.1 General Requirements

The resin compound shall meet all the requirements given in this Specification.

A test for foaming (Routine test) shall be carried out in accordance with the method of Appendix G.

A test for determining the low temperature mixing and pouring characteristics of cold-pour resin compound (Type test) shall be carried out in accordance with the method of Appendix D.

An adhesion test (Type test) between sheath and the resin compound shall be carried out in accordance with the method of Appendix H.

6.2 Applicable Standards

The resin compound shall comply with BS 7933-1.

The Supplier shall declare the Standards to which individual tests are carried out.

6.3 Material Properties

The resin compound shall comply with the requirements for Resin Categories I and I-W (Fingerprinting tests) and Resin Categories MI and MI-W (Type tests). The Fingerprinting and Type test requirements, respectively, are as given in BS 7933-1.

6.3.1 Additional Fingerprinting Information

6.3.1.1 Resin Base

- polyol type
- appearance (colour)
- viscosity
- relative density
- flash point
6.3.1.2 Hardener

- shelf life
- appearance (colour)
- viscosity
- relative density
- flash point

6.3.1.3 Fillers

- type and description (e.g. ground calcite, sand, glass microspheres, etc)
- flash point

6.3.1.4 Molecular Sieve

- type (whether 3A, 4A, 5A or 13X type)
- proportion (by weight of whole kit)

6.3.1.5 Mixed Compound

- mixing ratio on a weight basis (resin: hardener: filler if three part or resin: hardener if two part, with or without filler)
- viscosity (same method as used for resin and hardener)
- pot life

6.3.2 Foaming Test

No significant foaming shall be observed.

6.3.3 Adhesion Test

After ageing the parting force (determined by the method of Appendix H) shall exceed 3kN.

7. PACKAGING

The compound shall be supplied in packs which contain all the component parts in one sealed container. (Polythene bags for mixing resin and foil packs for mixing polyurethane resin shall meet the requirements of Appendices E and F respectively.)

Each pouch / pack shall be flexible to enable mixing of the resin and shall be robust enough to prevent bursting during mixing and transportation. Each container shall include the Supplier’s approved mixing instructions.

The size of a pack shall be given as the volume of mixed compound, which can be poured from it in two minutes at 10°C.
The preferred pack size is 2.0 litres. A top-up pack size of 1.0 litre shall also be provided.

Alternative packs sizes may be offered by the Tenderer.

Each pack shall be marked with the following:

- Manufacturer’s name and compound reference number.
- Pack size.
- Manufacturer’s batch number.
- Use by date.
- Electricity North West Commodity Code Number (a six digit number).
- Approved description.
- Health and Safety Marking and Handling Instructions.

The container of each separate component of the compound shall be marked with the following:

- Manufacturer’s name and component reference number.
- Pack size.
- Gross weight of component and container.
- Manufacturer’s batch number.
- Use by date.
- Disposal instructions.

The resin component shall not contain any substance, which by its inclusion requires the application of a ‘toxic’ label description as defined in the following paragraph.

The packaging and labelling shall comply with Regulation EC No 1272 of the European parliament on classification, labelling and packaging of substances and mixtures.

The foil pack label shall state ‘unharmful when mixed’ in bold black lettering to reduce problems in disposing as waste.

The packaging shall prevent the component from absorbing atmospheric moisture during storage indoors and outdoors.

A sample pack, complete with proposed labelling, shall be submitted with the Tender for Approval.
8. **SAFETY AND HANDLING**

Information concerning formulation, safety and handling of the components and containers shall be supplied under each of the headings given in Appendix B.

9. **DOCUMENTS REFERENCED**

All references to documents listed below are to the latest versions, unless stated otherwise.

- Health and Safety at Work Etc Act.
- Regulation EC No 1272 of the European parliament on classification, labelling and packaging of substances and mixtures.
- Control of Substances Hazardous to Health Regulations.

- **BS EN ISO 9000:** Quality management systems.
- **BS EN ISO 14001:** Environmental management systems. Requirements with guidance for use.
- **BS 7933-1: HD 631.1 S2:** Electric cables. Accessories. Material Characterisation. Fingerprinting and type tests for resinous compounds.
- **ENA Engineering Recommendation C81/6.**
- **EPD311:** Approval of Equipment.
- **CP311:** Equipment Approval Process.

10. **KEYWORDS**

Contractor; control; joint; safety
## APPENDIX A

### SCHEDULE OF TECHNICAL PARTICULARS OF COLD-POUR RESIN COMPOUND

<table>
<thead>
<tr>
<th>Question</th>
<th>See Note</th>
<th>Unit</th>
<th>Typical Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Manufacturer’s ref. no. for compound</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Properties of resin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1 Type of resin and ref. no.</td>
<td></td>
<td></td>
<td>Filled Polyol 4854-006</td>
</tr>
<tr>
<td>2.2 Appearance</td>
<td></td>
<td></td>
<td>Buff coloured liquid</td>
</tr>
<tr>
<td>2.3 Viscosity at 15°C</td>
<td>Poise</td>
<td>140</td>
<td></td>
</tr>
<tr>
<td>2.4 Specific gravity</td>
<td>°C</td>
<td>1.41</td>
<td></td>
</tr>
<tr>
<td>2.5 Flash point</td>
<td>°C</td>
<td>&gt;200</td>
<td></td>
</tr>
<tr>
<td>2.6 Details of fillers (state if supplied in separate pack)</td>
<td></td>
<td></td>
<td>Primary filler ground calcite. Secondary filler selected washed dried silica sand (separate package in bucket offer).</td>
</tr>
<tr>
<td>3. Properties of Hardener</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1 Type of hardener or ref. no.</td>
<td></td>
<td></td>
<td>Polymeric aromatic Di isocyanate (MDI) 1/62 - 231</td>
</tr>
<tr>
<td>3.2 Appearance</td>
<td></td>
<td></td>
<td>Dark/brown liquid</td>
</tr>
<tr>
<td>3.3 Viscosity at 15°C</td>
<td>Poise</td>
<td>3.35 at 20°C</td>
<td></td>
</tr>
<tr>
<td>3.4 Specific gravity</td>
<td>°C</td>
<td>1.24 at 25°C</td>
<td></td>
</tr>
<tr>
<td>3.5 Vapour pressure at 25°C</td>
<td>M Bar</td>
<td>$6.6 \times 10^5$</td>
<td></td>
</tr>
<tr>
<td>3.6 Vapour density (Air = 1)</td>
<td>°C</td>
<td>18.3</td>
<td></td>
</tr>
<tr>
<td>3.7 Flash point</td>
<td>°C</td>
<td>&gt;200</td>
<td></td>
</tr>
<tr>
<td>3.8 Effects of heat/fibre</td>
<td></td>
<td></td>
<td>Not readily combustible will evolve harmful vapour above 60°C</td>
</tr>
<tr>
<td>4. Compound Properties</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.1 Appearance</td>
<td></td>
<td></td>
<td>Viscous straw coloured liquid</td>
</tr>
<tr>
<td>4.2 Mixing ratio (wt/wt)</td>
<td></td>
<td></td>
<td>Resin: Hardener: Secondary Filler 100: 20: 164</td>
</tr>
<tr>
<td>4.3 Mixed specific gravity</td>
<td></td>
<td></td>
<td>1.8</td>
</tr>
<tr>
<td>4.4 Mixed viscosity at 15°C</td>
<td>Poise</td>
<td>360 at 20°C</td>
<td></td>
</tr>
<tr>
<td>4.5 Pot life at 25°C</td>
<td>Min</td>
<td>15 at 20°C</td>
<td></td>
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### 4. Performance Properties

<table>
<thead>
<tr>
<th>Question</th>
<th>See Note</th>
<th>Unit</th>
<th>Typical Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.6 Gelation time (BS 2782) at (a) 20°C (b) 0°C</td>
<td>(3)</td>
<td>Min</td>
<td>(a) 15 (b) 60</td>
</tr>
<tr>
<td>4.7 Complete hardening time at (a) 20°C (b) 0°C</td>
<td>(4)</td>
<td>Hr</td>
<td>45 mins at 20°C 4 hrs at 0°C</td>
</tr>
<tr>
<td>4.8 Rise in temperature during cure (BS 6910 pt 1)</td>
<td></td>
<td>0°C</td>
<td>30 K from 20°C 5l sample</td>
</tr>
<tr>
<td>4.9 Volume shrinkage during cure</td>
<td></td>
<td>%</td>
<td>0 - 2%</td>
</tr>
<tr>
<td>4.10 Electric breakdown Voltage of liquid mix (BS 148)</td>
<td></td>
<td>MV/m</td>
<td>5</td>
</tr>
<tr>
<td>4.11 -3% Mix-and-pour test</td>
<td>App E</td>
<td>Min</td>
<td>5 for a similar joint</td>
</tr>
</tbody>
</table>

### 5. Performance Properties

<table>
<thead>
<tr>
<th>Question</th>
<th>See Note</th>
<th>Unit</th>
<th>Typical Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1 Tensile strength</td>
<td></td>
<td>N/mm²</td>
<td>2.0</td>
</tr>
<tr>
<td>5.2 Modulus of elasticity</td>
<td></td>
<td>N/mm²</td>
<td>30</td>
</tr>
<tr>
<td>5.3 Extension of break</td>
<td></td>
<td>%</td>
<td>13</td>
</tr>
<tr>
<td>5.4 Impact strength</td>
<td></td>
<td>kJ/m²</td>
<td>11</td>
</tr>
<tr>
<td>5.5 Extension of break</td>
<td></td>
<td>%</td>
<td>No Data</td>
</tr>
<tr>
<td>5.6 Thermal conductivity</td>
<td></td>
<td>WK⁻¹m¹</td>
<td>0.6</td>
</tr>
<tr>
<td>5.7 Moisture permeability</td>
<td></td>
<td>g cm⁻¹ cm² mmHg</td>
<td>3.0 x 10⁻⁶ (Tropical)</td>
</tr>
<tr>
<td>5.8 Heat distortion temperature</td>
<td></td>
<td>K</td>
<td>30</td>
</tr>
<tr>
<td>(a) 20 gm load</td>
<td></td>
<td>K</td>
<td>80</td>
</tr>
<tr>
<td>5.9 Coefficient of thermal expansion</td>
<td></td>
<td>K</td>
<td>(expansion) 6 x 10⁻⁴/K</td>
</tr>
<tr>
<td>5.10 Volume resistivity</td>
<td></td>
<td>Ωm</td>
<td>10¹¹ Ωm at 80°C</td>
</tr>
<tr>
<td>5.11 Dielectric strength</td>
<td></td>
<td>MV/m</td>
<td>8 at 80°C</td>
</tr>
<tr>
<td>5.12 Surface resistivity</td>
<td></td>
<td>Ωm</td>
<td>10¹² Ω per square</td>
</tr>
<tr>
<td>5.13 Adhesion to PVC at 15°C</td>
<td></td>
<td>N/mm²</td>
<td>0.6 Solvent wiped</td>
</tr>
<tr>
<td>5.14 Adhesion to XLP at 15°C</td>
<td></td>
<td>N/mm²</td>
<td>0.5 Solvent wiped</td>
</tr>
<tr>
<td>Question</td>
<td>See Note</td>
<td>Unit</td>
<td>Typical Answer</td>
</tr>
<tr>
<td>----------</td>
<td>----------</td>
<td>------</td>
<td>----------------</td>
</tr>
<tr>
<td>5.15 Adhesion to EPR at 15°C</td>
<td>(8)</td>
<td>N/mm²</td>
<td>0.4 Solvent wiped</td>
</tr>
<tr>
<td>5.16 Adhesion to lead at 15°C</td>
<td>(8)</td>
<td>N/mm²</td>
<td>0.3 Solvent wiped</td>
</tr>
<tr>
<td>5.17 Adhesion to Al at 15°C</td>
<td>(9)</td>
<td>N/mm²</td>
<td>0.4 Solvent wiped</td>
</tr>
<tr>
<td>6. Storage life (specify storage conditions)</td>
<td></td>
<td>month</td>
<td>12 at 10 – 50°C (Protect from frost)</td>
</tr>
</tbody>
</table>

Notes:

1. (4.4) - Immediately after mixing.
2. (4.5) - Maximum length of time after commencement of mixing for which material may be kept in its mixing vessel before pouring into the joint.
3. (4.6) - Time required for the curing mixture to reach a gelatinous state as defined by the test method.
4. (4.7) - Time for material to achieve 90% of its final mechanical properties.
5. (5.2) - 1% secant modules.
6. (5.4) - Notched Izod, or comparable Charpy test.
7. (5.5) - By extrapolation to 50% loss of tensile or flexural strength after 20,000 hr.
8. (5.12 - 5.17) - 25mm square lap joint, between two strips of substrate, pulled to put joint area in shear. Specify surface preparation of substrate.
9. (6) - Properties given in sections 1 to 4 when measured before and after storage period shall not differ by more than 20%.
APPENDIX B

HANDLING AND SAFETY DATA FOR COLD-POUR RESIN COMPOUND

1. General description of nature of hazards to health of:
   - Resin
   - Hardener
   - Mixed material

2. Safety precautions and personal hygiene for handling and use.

3. Physiological effects and first aid with regard to:
   - Skin contact
   - Eye contact
   - Inhalation
   - Ingestion

4. Storage and transport.

5. Action to be taken in case of spillage of:
   - Resin
   - Hardener
   - Mixed material


7. Disposal of waste material and empty containers.

8. Formulation.
APPENDIX C

MANUFACTURER’S RECOMMENDATIONS FOR PREPARATION OF SURFACES

Information is required under headings as follows:

1. PVC  Solvent wipe/abraid/solvent wipe.
2. XLPE  Clean and dry.
3. LEAD  Clean by scraping.
4. ALUMINIUM  Solvent wipe.
APPENDIX D

TESTING METHOD FOR DETERMINING THE LOW TEMPERATURE MIXING AND POURING CHARACTERISTICS OF COLD-POUR RESIN COMPOUND

1. MATERIALS

- Resin pack.
- Size 2 joint shell in accordance with Electricity North West Drawing No. 900000-53-243.
- 35mm diameter (nominal) through cable fitted inside shell as in a normal joint.
- 15mm diameter (nominal) Branch cable fitted inside shell as in a normal joint.

2. TEST PROCEDURE

The components shall be maintained at a temperature of -3°C or lower for at least 3 hours immediately prior to the test being carried out.

The resin compound shall be mixed in accordance with the manufacturer's instructions. The time from commencing the pouring of the components into the mixing container to the completion of mixing shall be recorded.

Immediately on completion of the mixing the compound shall be poured into the size 2 joint shell to within 10mm of the top of the filling hole the time shall be recorded.

The total time taken to complete the mixing and pouring of the compound shall not exceed 5 minutes.

When the compound has completely hardened the joint shell shall be removed. The pouring of the compound shall be considered satisfactory if the shell has been completely filled. There shall be no significant quantity of entrapped air, although it is recognised that the presence of some small air bubbles is to be expected.
APPENDIX E

POLYETHYLENE BAGS FOR MIXING RESIN

1. TECHNICAL REQUIREMENTS
   - The pouch shall prevent the components from absorbing atmospheric moisture during storage indoors and outdoors.
   - The pack shall have two separate compartments to keep the resin components apart prior to mixing. This is generally facilitated by a weak seal.
   - All the materials shall be contained within the pack that is suitable in size and shape so as to ensure a totally enclosed mixing process.
   - The pouch shall be designed to prevent the spillage of resin during mixing.
   - The edge of the bag to be sealed with a double seal.

2. POURING METHOD/ DISPOSAL
   - You shall be able to cut the pack with a pair of scissors to enable the mixed quantity of resin to be easily poured from the pack into the joint box assembly without risk of injury, danger or spillage.
   - The remaining pack may only contain inert mixed resin, which hardens and can then be easily disposed of as standard waste.

3. PACKAGING
   The plastic bags shall be supplied packed in each resin pack (bucket). The packs shall be packed in sealed plastic buckets suitably strong enough to avoid crushing when stacked on a pallet at the recommended height.

3. STORAGE
   Materials shall be suitable for storage in either Electricity North West Stores or in Electricity North West vehicles for a period of at least twelve months without any deterioration.

4. REQUIREMENTS FOR APPROVALS, TESTING AND QUALITY ASSURANCE
   Type Approval, Quality Assurance, Formulation and Labelling shall be in accordance with the requirements of this Specification.

5. NON-COMPLIANCE WITH THE TECHNICAL REQUIREMENTS OF THE SPECIFICATION
   Tenderers are free to offer for evaluation items, which do not fully comply with the technical requirements of this Specification if in their opinion they consider them satisfactory technical alternatives to those stated.

   Any such alternative items shall however be accompanied with documentary evidence to support the Tenderers claim of compatibility.
APPENDIX F

FOIL PACK FOR MIXING POLYURETHANE RESIN

1. TECHNICAL REQUIREMENTS

The foil shall prevent the components from absorbing atmospheric moisture during storage indoors and outdoors.

The pack shall have two separate compartments to keep the hardener and resin/sand components apart prior to mixing. This is generally facilitated by a clip and rail or weak seal.

All the materials shall be contained within the foil pack that is suitable in size and shape so as to ensure a totally enclosed mixing process.

2. POURING METHOD/ DISPOSAL

You shall be able to cut the foil pack with a pair of scissors to enable the mixed quantity of resin to be easily poured from the foil pack into the joint box assembly without risk of injury, danger or spillage.

The remaining foil pack may only contain inert mixed resin, which hardens and can then be easily disposed of as standard waste.

3. PACKAGING

The foil packs shall be packed in sealed plastic buckets that are strong enough to avoid crushing when stacked on a pallet at the recommended height.

The number of foil packs per carton will depend on the pack size: this shall be agreed between the Supplier and Electricity North West's Underground Circuits Manager.

Alternative methods of outer packaging will be considered provided they do not cause damage to the foil pack(s) or create potential health and safety problems.

4. STORAGE/TRANSPORT

Materials shall be suitable for storage in either Electricity North West stores or in Electricity North West vehicles for a period of at least twelve months without any deterioration.

Materials shall be suitable for transportation to and between Electricity North West stores without any deterioration.
5. REQUIREMENTS FOR APPROVALS, TESTING AND QUALITY ASSURANCE

Type Approval, quality assurance, formulation and labelling shall be in accordance with the requirements of this Specification.

6. NON-COMPLIANCE WITH THE TECHNICAL REQUIREMENTS OF THE SPECIFICATION

Tenderers are free to offer for evaluation items, which do not fully comply with the technical requirements of this Specification if in their opinion they consider them satisfactory technical alternatives to those stated.

Any such alternative items shall however be accompanied with documentary evidence to support the Tenderer's claim of compatibility.
APPENDIX G
ROUTINE TEST FOR FOAMING OF RESIN

1. GENERAL

The following test shall be carried out on every batch of resin.

2. TEST SEQUENCE

Mix one kit in accordance with the manufacturer’s instructions.

Determine the extent of foaming in a simple cup test.

3. TEST METHOD

3.1 General

Foaming sometimes occurs during the cure of resin kits. The most likely cause is an excessive amount of water.

The test (to be carried out in a laboratory at 20 to 25°C) is used to determine whether or not foaming will occur when the resin kit is mixed and poured as recommended by the manufacturer.

3.2 Test Specimen

The test requires a foamed polystyrene cup (12 oz capacity) and the resin.

A horizontal mark is made 20mm below the top of the cup and on the inside. A second mark is made 5mm above the first mark. Resin shall be mixed according to the manufacturer’s instruction. It shall be carefully poured into the cup, such that the resin just reaches the first mark. The resin shall then be left to cure for 4 hours.

One test specimen is required.

3.3 Foaming Assessment

After curing for 4 hours the test specimen shall be visually inspected for expansion of the resin.

To pass the test the resin shall not have risen above the upper mark.

If the test is passed foaming is insignificant.
APPENDIX H

TYPE TEST FOR ADHESION OF RESIN TO POLYMERIC SHEATH AFTER TEMPERATURE CYCLING IN WATER

1. TEST SEQUENCE

- Preparation of the test specimen from the same lot of resinous compound
- Thermal cycling in water (immersion in alternate 70°C and ambient water for 20 cycles)
- Mechanical test of specimens

2. TEST METHOD

2.1 General

The test is used to determine the effect of extended exposure to water on adhesion of resin to the PE and PVC sheaths of cables. The adhesion is measured by a mechanical test, in which the cable sample is pushed out of its resin collar by a solid cylinder, having almost the same diameter as the cable itself.

2.2 Test Specimens

Adhesion tests shall be carried out on the cable types shown in Table 1.

<table>
<thead>
<tr>
<th>Cable type</th>
<th>Sheath</th>
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<tr>
<td>11 kV, 185mm², solid Al, Cu wire screened, BS 7870-4.10</td>
<td>MDPE (red)</td>
</tr>
<tr>
<td>600/1000 V, 3 × 95mm², sectored solid Al, Cu wire Waveform, BS 7840-3.40</td>
<td>PVC (black)</td>
</tr>
<tr>
<td>600/1000 V, 1 x 35mm, solid Al, Cu wire CNE service cable, BS 7870 – 3.21</td>
<td>PVC (black)</td>
</tr>
</tbody>
</table>

These cable types have a diameter of approx. 15mm to 35mm.

Cable samples 195mm long shall be cut for the test.

The cable samples shall first be cleaned with water to remove dirt and then dried with clean cloths. Solvent shall not be used to clean the surfaces, because the polymer absorbs it and it could affect the adhesion result. Taking care not to handle the adhesion area, two types of preparation shall be carried out:

PVC: The preparation is abrasion by emery paper (Type P120), followed by removal of grit by a clean brush. The abrasion shall be sufficient to remove the shiny outer surface of the sheath.
**MDPE:** A propane torch with a yellow flame shall be played around the sample of cable for 30 seconds. The length of cable treated is to be 100mm – between two marks – within which the resin is to be cast. The effect of the flame treatment shall be to give a distinct shine to the surface of the sheath.

Each resin encapsulated sample shall be prepared by pushing a cable sample through the bottom of a paper cup (with a hole cut in it). Plasticine is to be used to seal any gaps between the cup and the cable. Resinous compound shall be prepared and cured after pouring in accordance with the manufacturer’s instruction. The end result shall be a sample with the dimensions as shown in Figure 1.

![Figure 1: Cable sample encased in resin](image)

The diameter of the resin (at the bottom of the collar) shall exceed 70mm.

The upper part of the cable sample shall now be cut off flush with top surface of the resin collar.

The resin shall be allowed to cure overnight at ambient in the laboratory. The samples shall then transferred to pre-heated ovens set at 70°C and shall be conditioned at this temperature for 24 hours.

A set of 5 test specimens is required for each cable type.

### 2.3 Test Equipment

- Forced air oven with adequate temperature monitoring (for 70°C conditioning described in 2.2).
- Hot water bath sufficient to contain the test samples and to allow a temperature of $70 \pm 2^\circ C$ to be maintained.
- Cool water bath at a laboratory temperature of about 20°C.
- Mechanical testing machine, e.g. Instron, for compression loading of samples.
2.4 Ageing Procedure

The 5 test specimens, as prepared in 2.1, shall be aged in the manner to be described.

Successive immersion is to be carried out in hot (70°C) and cold water with the following cycle:

- 2.5 hours hot
- 2.5 hours cold
- 2.5 hours hot
- 16.5 hours (or 64.5 hours at weekends) cold.

At the end of the 2.5 hours hot immersion, the samples shall be allowed to cool naturally for 10 – 15 minutes, before transferring them directly to the cold water tank (at the laboratory ambient) for the next 2.5 hours, and so on. The short cooling period ensures that the samples do not suffer a shock during transfer to the cold water tank. The samples are to be handled gently during the transfer.

Twenty of the above cycles shall be carried out on the samples.

2.5 Adhesion Assessment

Test specimens shall be mounted in a steel jig as shown in Figure 2.

The flat plate has a hole drilled through it so that the cable can pass with a fairly close fit, but without snagging.

![Figure 2: Showing sample and arrangement for mechanical testing](image)

The solid metal cylinder diameter shall be as close as possible to the diameter of the cable. It will be found that when sufficient force is applied that the cylinder will slide easily through the resin collar, because the resin is distorted and automatically displaced slightly outwards. It is important that the diameter of the cylinder is not too small. If it is, the sheath distorts excessively and extrudes between the cylinder and the resin. On the other hand, if the cylinder is too big the result obtained may be the sliding force of the steel cylinder against the resin rather than the sheath against the resin.
The 5 cable samples to be tested are the aged samples subjected to the procedure given in 2.4.

The cable samples and jig shall be mounted in a compression testing machine and the cable samples shall be pushed at a speed of 50mm/minute. The force applied shall be recorded continuously. The force increases with time until a maximum value is attained. When the force is clearly in decline the test can be stopped. The parting force is taken to be the maximum value.

The parting force for purposes of compliance with this Specification shall be the median value of the five test results.

2.6 Test Report

The test report shall include the following information:

- Identification of the resinous compound tested.
- The parting force values for the five samples tested.
- The median value of the parting force.
- Observation on whether or not the resin parted cleanly from the cable sheath.
APPENDIX J

CONFORMANCE DECLARATION

SECTION-BY-SECTION CONFORMANCE WITH SPECIFICATION

The Tenderer shall declare conformance or otherwise for each product/service or range of products/services, section-by-section, using the following Conformance Declaration Codes.

Conformance Declaration Codes:

- **N/A =** Section is not applicable/appropriate to the product/service.
- **C1 =** The product/service conforms fully with the requirements of this section.
- **C2 =** The product/service conforms partially with the requirements of this section.
- **C3 =** The product/service does not conform to the requirements of this section.
- **C4 =** The product/service does not currently conform to the requirements of this section, but the manufacturer proposes to modify and test the product in order to conform.

**Manufacturer:**

**Product/Service description:**

**Product/Service reference:**

**Assessor details**

Name:

Company:

Signature:

Date:
## SECTION-BY-SECTION CONFORMANCE

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* Applicable specifications shall be stated in the Remarks column where alternatives are quoted within a section. The Remarks column shall also be used to indicate cases where the products or services exceed the quoted specifications.

**Additional Notes:**

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