Technical Specification
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Technical Specification for Plastic Ducts for Buried Electric Cables
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TECHNICAL SPECIFICATION FOR PLASTIC DUCTS FOR BURIED ELECTRIC CABLES

FOREWORD

This specification has been revised to meet the requirements of the Electricity Industry and the New Roads and Street Works Act 1991 for circular section plastic ducts for containment and protection of electric cables, normally installed underground.

This specification supplements or modifies the corresponding clauses in BS EN 50086-2-4: 1994 (incorporating Amendment No 1) and BS EN 50086-1: 1994 (incorporating Amendment No 1 and Corrigenda Nos 1 and 2). (Where there is no equivalent clause or subclause in BS EN 50086-2-4, refer to BS EN 50086-1.)

Where a particular clause or subclause of BS EN 50086-2-4 or BS EN 50086-1 is not mentioned in this specification, that clause or subclause applies as far as is reasonable. Where this specification states “addition”, “modification” or “replacement”, the relevant text of BS EN 50086-2-4 is to be adapted accordingly.

Note that when BS EN 50086 is withdrawn, it will be superseded by BS EN 61386.

1. SCOPE

Replacement

This specification defines the essential performance requirements and specifies limiting dimensions, colour and identification details for coilable and non-coilable, plain or corrugated wall, circular cross section, extruded plastics cable ducts. The ducts and fittings to be normally used for electric power and auxiliary cables in buried situations, and made from the following materials:

(a) Acrylonitrile-butadiene-styrene (ABS).
(b) Polyethylene (PE), High or Medium Density.
(c) Polypropylene (PP).
(d) Unplasticised polyvinyl chloride (uPVC).

2. NORMATIVE REFERENCES

This clause of BS EN 50086-2-4 is applicable except as follows:

Addition

New Roads and Street Works Act 1991


BS EN 50086-1:1994 (incorporating Amendment No 1 and Corrigenda Nos 1 and 2), Specification for conduit systems for cable management – Part 1: General requirements

BS EN 50086-2-4:1994 (incorporating Amendment No 1), Specification for conduit systems for cable management – Part 2: Particular requirements – Section 2.4: Conduit Systems buried underground

BS EN 61386-series: Conduit systems for cable management.
3. **DEFINITIONS**

This clause of BS EN 50086-2-4 is applicable except as follows:

**Addition**

**approval body**
an individual purchasing distribution network operator

**coilable cable duct**
a circular section pipe designed for direct burial, where the requirement for resistance to deformation at normal laying depths is secondary to that of flexibility; providing unrestricted access and withdrawal for small diameter service or auxiliary cables and capable of being coiled or bent to a minimum radius of 24 times the nominal inside diameter of the duct without undue distortion

**coupling**
a conduit fitting, as defined in BS EN 50086-1, designed to join or terminate one or more components of a conduit system

**effective length**
the length of the duct remaining when the socket length is subtracted from the overall length (see Fig. 8.1)

**plastic (cable) duct**
a cable conduit meeting the requirements of the Scope above

**non-coilable cable duct**
a circular section pipe, designed for direct burial, providing unrestricted access and withdrawal facilities for all types of electric cables under footpaths or carriageways at normal laying depths. Supplied in straight lengths, normally with separate couplings or, alternatively, in straight lengths with spigot and socket ends or with integral seal-ring couplings and chamfered spigot ends. (See Fig. 8.1(a) and 8.1(b))

**ovality**
the difference between the measured maximum inside diameter, and the measured minimum inside diameter in the same cross-section of pipe; measured in mm for the purposes of this specification. Outside diameter may be used by agreement between specifier and manufacturer

**production batch**
a separately identifiable quantity of production fully documented for the purposes of quality control, of length to be determined by the manufacturer (maximum = 24 hours), generally operating on 24 hour continuous production; for convenience, taking duct produced in a continuous extrusion run

**production run**
duration of manufacture of a unique works order

**routine tests**
tests that may be required on every individual unit or component, as specified, or at some regular frequency to be determined by the specifier. The results of these tests may be required by the specifier with each unit purchased, or retained for inspection, at a period to be determined
sample tests
tests that may be required on every production batch or number of production batches, as
specified, or at some regular frequency to be determined by the specifier. The results of
these tests may be required by the specifier with each batch purchased, or retained for
inspection, at a period to be determined

specifier
representative of a distribution network operator

type tests
a series of one-off tests to ensure the satisfactory performance of the product design, under
extremes of operating stress, and of endurance, as may be appropriate, to be determined by
the specifier. (Refer to Table 16.4.)

4. GENERAL REQUIREMENTS

This clause of BS EN 50086-2-4 is applicable except as follows:

4.1. Replacement.

The protective properties of the joint between the duct and the duct fitting shall be not less
than IP4X as specified by BS EN 60529.

4.2. Addition.

Generally, bends shall have radii of 20 x inside diameter for bends in the duct run (11s &
22s); this formula shall not be applied to termination bends. The specifier shall determine the
radii of termination bends (typically 1200mm radii for 90 degree bends). In all cases, the
specifier shall ensure that each bend radius is adequate for the sidewall pressure applied by
the installed cable.

Addition

4.3. Material standards

The materials, from which the cable ducts and couplings are manufactured, shall have the
characteristics to meet the test requirements specified in Clauses 7 to 16 inclusive.

4.5 Type approval

4.3.1. Type approval shall be carried out whenever a new design or a change in design,
process technique or compound formulation is proposed.

4.3.2. Type approval shall involve the application of the full range of type tests, routine tests
and sample tests specified in Clauses 7 to 16 inclusive. Where design modifications
are concerned, only those tests agreed as necessary between the manufacturer and
the approval body shall be repeated.

4.3.3. To obtain product conformity to this specification all the type tests detailed in this
specification shall be witnessed by a representative of one of the distribution network
operators or by a representative from an approved/agreed independent accredited
test house. A test certificate shall be supplied, on request, to the specifier by
the manufacturer.
4.3.4. Approval for each duct, satisfactorily type tested, will be restricted to the size and material used in the test.

4.3.5. The manufacturer shall bear the costs of testing and provision of samples for approval, such samples becoming the property of the approval body.

4.4. Preparation for delivery

4.4.1. Coiling or drumming of coilable ducts (as specified by the specifier) shall be carried out at a temperature of less than 25 °C. The internal diameter of the coil, or the diameter of the drum barrel, shall not be less than 24 times the nominal inside diameter of the duct.

4.4.2. A means of identifying the production batch shall be attached to the coil drum, bundle or pallet, as appropriate.

5. GENERAL CONDITIONS FOR TESTS

This clause of BS EN 50086-2-4 is applicable except as follows:

Modification

5.1. Tests in accordance with this specification are type tests, routine tests and sample tests. These tests are defined above.

Addition

5.2. Samples for testing shall be of the same material as that used for the production run.

6. CLASSIFICATION

Replacement

6.1. Class 1 ducts: to give 450 N compression strength at 75 °C.

6.2. Class 2 ducts: to give 450 N compression strength at 50 °C.

6.3. Class 3 ducts: to give 450 N compression strength at 23 °C.

6.4. Class 4 ducts: G78 ducts; shall also be Class 1, 2 or 3 as defined above; shall have electrical insulating characteristics as defined by the specifier.

7. MARKING AND DOCUMENTATION

Replacement

7.1. Ducts, couplings and bends shall be coloured black or red, throughout their length. Ducts shall be suitable for storage outdoors for a minimum of 12 months without visible colour change or degradation of mechanical performance when compared to a new sample.
7.2. The duct shall be marked “ELECTRIC CABLE DUCT C_ MFR” as specified below:

   a) Class number shall be inserted after “C” (Class 4 duct shall be identified as 4/? (where ? is 1, 2 or 3));
   b) “MFR” shall be replaced by manufacturer’s reference;
   c) minimum print size of 6mm for ducts of 50mm outside diameter and less;
   d) minimum print size of 8mm for ducts of more than 50mm outside diameter;
   e) the marking shall be repeated three times per metre;
   f) the marking shall be on two print lines, 180° apart.

7.3. Each length of coilable cable duct shall, in addition, be indelibly marked, on one line only, with measurement increments in the form of consecutive length measurements, starting at 1 metre and thereafter, at 1 metre intervals, i.e. at the start of every third inscription.

7.4. Each length of non-coilable cable duct shall also have marked on it at 1 metre intervals its classification code (C1, C2, C3, C4/?; refer to Clause 6).

7.5. This clause of BS EN 50086-1 is applicable.

8. DIMENSIONS

8.1. Cable duct dimensions should be preferably according to Table 8.1 below.

8.2. Measurement

8.3. Sample selection

   One sample shall be taken from each production batch, one from the start of the batch, one from the end and one taken at random.

8.3.1. Preparation of coiled duct samples

   When test pieces from coiled ducts are to be measured, the following relaxation procedure shall be carried out first:

   a) Heat the test pieces in water or air maintained at 80 ± 1 °C for a minimum of 30 minutes.
   b) Allow to cool in air, without restraint, to 23 ± 1 °C before measurements are taken.

8.3.2. Method

   The following measurements shall be made on each sample:

   a) The inside diameter of the duct shall be determined by the average of three measurements taken at 120 degrees to each other on the plane. The measurements shall be taken at the end of the duct.
Compliance shall be checked against Tables 8.1.

b) The ovality shall be determined as the difference between the measured maximum diameter and the measured minimum diameter. The measurement shall be taken at the end of the duct.

Compliance shall be checked against Table 8.2. (For duct dimensions not included, the table shall be used as guidance; the maximum ovality shall be agreed between specifier and manufacturer.)

c) The effective length of the ducting shall be measured in accordance with Fig. 8.1. The minimum length shall be the length as ordered.

**Figure 8.1 – Effective length of duct**

<table>
<thead>
<tr>
<th>Nominal inside diameter (mm) for each class of duct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1</td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>25</td>
</tr>
<tr>
<td>32</td>
</tr>
<tr>
<td>38</td>
</tr>
<tr>
<td>42</td>
</tr>
<tr>
<td>50</td>
</tr>
<tr>
<td>90</td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td>117</td>
</tr>
<tr>
<td>125</td>
</tr>
<tr>
<td>150</td>
</tr>
<tr>
<td>188</td>
</tr>
</tbody>
</table>
Table 8.2 – Ovality of ducts

<table>
<thead>
<tr>
<th>Nominal inside diameter (mm) *</th>
<th>Maximum Ovality (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>1.0</td>
</tr>
<tr>
<td>32</td>
<td>1.3</td>
</tr>
<tr>
<td>38</td>
<td>1.3</td>
</tr>
<tr>
<td>42</td>
<td>1.4</td>
</tr>
<tr>
<td>50</td>
<td>1.4</td>
</tr>
<tr>
<td>90</td>
<td>1.8</td>
</tr>
<tr>
<td>100</td>
<td>1.8</td>
</tr>
<tr>
<td>117</td>
<td>2.0</td>
</tr>
<tr>
<td>125</td>
<td>2.0</td>
</tr>
<tr>
<td>150</td>
<td>2.0</td>
</tr>
<tr>
<td>188</td>
<td>2.5</td>
</tr>
</tbody>
</table>

* Outside diameter may be used on agreement between specifier and manufacturer.

9. CONSTRUCTION

9.1. This clause of BS EN 50086-1 is applicable except as follows:

Addition

a) The cross-section of all ducts shall be circular, and the internal bore shall be smooth and substantially concentric with the external surface.
b) Both ends of all ducts shall be cleanly cut perpendicular to the central axis of the duct.
c) The material shall be free from cracks, inclusions, delaminations or other defects.
d) Any profiled surface of a cellular wall structure shall be complete, with no break in the cell walls.
e) Non-coilable duct sections shall be substantially straight.

9.2. This clause of BS EN 50086-1 is applicable except as follows:

Modification

Metallic fixings (screws, etc) shall not be used to fit covers to ducts, nor shall they be used in duct couplings.

9.3. This clause of BS EN 50086-1 is NOT applicable (as BS EN 50086-2-4).

9.4. This clause of BS EN 50086-1 is NOT applicable (as BS EN 50086-2-4).

9.5. This clause of BS EN 50086-1 is applicable.

9.6. This clause of BS EN 50086-1 is applicable.
10. MECHANICAL PROPERTIES

This clause of BS EN 50086-2-4 is applicable except as follows.

10.1.4 Replacement

Compliance is checked by the tests of 10.2, 10.3, 10.4 and additional tests of Clause 16 below.

Replacement

10.2.5 When reaching the deflection of 5%, the applied force shall be at least:

- 450 N (Class 1) at 75 °C (or equivalent force at 23 °C);
- 450 N (Class 2) at 50 °C (or equivalent force at 23 °C);
- 450 N (Class 3) at 23 °C.

10.3 Impact test at -5 °C

This clause of BS EN 50086-2-4 is applicable except as follows.

10.3.1 Modification. The number of samples tested shall be 14.

10.3.2 Modification. The impact energy values shall be as specified in Table 102, “Normal” column.

10.3.3 Addition.

Compliance shall be checked by the following flowchart:
10.4 Bending test

Addition

10.4.1a This test is not applicable to non-coilable ducts of 38mm inside diameter and less. (Coilable ducts above 38mm inside diameter are not pliable.)

Modification

10.4.2 The bending radius of each sample shall not exceed 24 times its normal internal diameter.

11 ELECTRICAL PROPERTIES

This clause of BS EN 50086-2-4 is applicable.

12 THERMAL PROPERTIES

This clause of BS EN 50086-2-4 is not applicable.

13 FIRE EFFECTS

This clause of BS EN 50086-2-4 is applicable.

14 EXTERNAL INFLUENCES

This clause of BS EN 50086-2-4 is applicable with the following modification:

The protective properties of the joint between the duct and the duct fitting shall be not less than IP4X as specified by BS EN 60529. (This IP rating means that only Clauses 14.1 and 14.1.1 of BS EN 50086-1 are applicable.)

15 ELECTROMAGNETIC COMPATIBILITY

This clause of BS EN 50086-2-4 is applicable.
### 16 TESTS

**16.1 Summary of tests and requirements**

*Table 16.1 – Summary of tests and requirements*

<table>
<thead>
<tr>
<th>Test Title</th>
<th>Type</th>
<th>Minimum test frequency</th>
<th>Clause reference(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual inspection</td>
<td>Routine test</td>
<td>Continuous, recorded at least once every two hours minimum.</td>
<td>9.1</td>
</tr>
<tr>
<td>Measurement of dimensions (diameter/wall thickness)</td>
<td>Sample test</td>
<td>Recorded every two hours minimum.*</td>
<td>8</td>
</tr>
<tr>
<td>Measurement of dimensions (length and ovality)</td>
<td>Sample test</td>
<td>Recorded every 24 hours or change of length.</td>
<td>8</td>
</tr>
<tr>
<td>Resistance to deformation at 23 °C</td>
<td>Sample test</td>
<td>Recorded every 24 hours minimum.**</td>
<td>10.2 (Compression test)</td>
</tr>
<tr>
<td>Impact test at -5 °C</td>
<td>Sample test</td>
<td>Recorded every 24 hours minimum.**</td>
<td>10.3</td>
</tr>
<tr>
<td>Heat reversion test</td>
<td>Sample test</td>
<td>Recorded every production run minimum and every tool change.</td>
<td>16.5</td>
</tr>
<tr>
<td>Marking durability</td>
<td>Type test</td>
<td>Refer to Clause 4.5.</td>
<td>7.5</td>
</tr>
<tr>
<td>Duct system assembly, by means other than threads</td>
<td>Type test</td>
<td>Refer to Clause 4.5.</td>
<td>9.6</td>
</tr>
<tr>
<td>Bending radius of coilable ducts</td>
<td>Type test</td>
<td>Refer to Clause 4.5.</td>
<td>10.4</td>
</tr>
<tr>
<td>Degree of protection - Ingress of foreign objects</td>
<td>Type test</td>
<td>Refer to Clause 4.5.</td>
<td>14.1.1</td>
</tr>
<tr>
<td>Vicat softening test</td>
<td>Type test</td>
<td>Refer to Clause 4.5.</td>
<td>16.1</td>
</tr>
<tr>
<td>Static friction coefficient test</td>
<td>Type test</td>
<td>Refer to Clause 4.5.</td>
<td>16.3</td>
</tr>
<tr>
<td>Resistance to deformation at 75 °C (Class 1), 50 °C (Class 2) or 23 °C (Class 3).</td>
<td>Type test</td>
<td>Refer to Clause 4.5.</td>
<td>16.4</td>
</tr>
</tbody>
</table>

* For large diameter coils, this is done per coil (some coils can take in excess of two hours to manufacture).

** Polyolefin ducts do not necessitate 24 hour testing for impact and compression. These shall be tested a minimum of once per Production Run.
16.2 Vicat softening test

16.2.1 Sample selection

Sufficient material is required to provide two test pieces each 10 mm square and 3 mm thick.

16.2.2 Method


16.2.3 Compliance

The Vicat softening temperature shall not be less than 75 °C using a load of 0.98kg

16.3 Static friction coefficient test

16.3.1 Sample selection

Duct samples of a particular material or design of any one diameter shall be deemed to represent all diameter increments in the range.

Duct samples for test shall be selected at random and cut into 1 m lengths. Coilable duct specimens shall be from stock which is straight and has not been coiled.

Test specimens shall be cleaned and marked at six equidistant points around the circumference.

16.3.2 Apparatus

The variable inclined plane and sled shall be as detailed in Fig. 16.1(a) and (b), respectively.

The sled shall be made from cold rolled mild steel stock.

16.3.3 Method

Test specimens shall be placed on the inclined plane in such a manner that there will be no motion of the duct relative to the plane during the test.

The sled shall be wiped clean and placed inside the test specimen approximately 25 mm from the upper end. The angle of the inclined plane (angle alpha) shall be increased at a constant rate until the sled just begins to move. The angle alpha shall be measured and recorded at this point. The procedure, as above, shall be repeated with the specimen rotated one-sixth of a turn (making use of the markings applied in 16.3.1) for each five additional tests. The specimen shall then be turned end for end on the inclined plane, and the test repeated to obtain an additional six readings. Two additional duct samples shall be subjected to the same test. Prior to each test the sled shall be wiped clean.

The static coefficient of friction shall be defined as the tangent of the angle alpha.

The average of all the static friction coefficient readings obtained shall be calculated.

16.3.4 Compliance

*The static friction coefficient shall not exceed 0.27.*
Figure 16.1 – Friction test sled

16.4 Resistance to deformation at 75 °C (Class 1), 50 °C (Class 2) or 23 °C (Class 3)

16.4.1 The test shall be as described in 10.2 except that:

16.4.2 Nine samples shall be selected at random. Each sample shall consist of a (200 ± 5) mm length of duct accurately cut right-angles to its axis.

16.4.3 The samples shall be conditioned for one hour at (75 ± 2) °C (for Class 1 duct) or (50 ± 2) °C (for Class 2 duct) in an air circulating oven, the time being taken from the moment when the test temperature is re-attained after inserting the specimen.

16.4.4 Each sample shall be tested by completing the compression test as quickly as possible after removal from the air oven; the time between leaving the oven and first application of the load shall not exceed one minute.

16.4.5 When reaching the deflection of 5%, the applied force shall be at least 450 N (Class 1, Class 2 and Class 3). (The resistance to deformation at 23 °C, 50 °C or 75 °C is taken as the median value of the nine loads.)
16.5 Heat reversion test

16.5.1 Sample selection

One test specimen shall be taken from each production batch.

The test specimen shall consist of a length of pipe approximately 300 mm long. Two circumferential marks shall be inscribed on the test specimen, 100 mm apart, and in such a way that one of these marks is approximately 15 mm from the end of the specimen.

16.5.2 Apparatus

The apparatus shall consist of either:

a) Oil bath: a thermostatically controlled bath containing a heat transfer medium which shall be a mineral oil, free from aromatic hydrocarbons or silicone oil, or a polyethylene glycol, and which maintains the temperature of the heat transfer medium as tabulated below in Table 16.2.

or

b) Air circulation oven.

16.5.3 Method

One of two methods may be used, either:

a) Oil bath

Suspend the test specimen in the heat transfer medium by the end furthest from the inscribed marks in such a way that both inscribed marks are completely immersed. Care shall be taken to ensure that the specimen does not contact the sides or the bottom of the bath.

Keep the test specimen in the bath for a period of 1 hour, counted from the moment when the test temperature (Table 16.2) is re-attained after inserting the specimen, then remove it from the bath and allow it to cool down to room temperature. Measure the distance between the two inscribed marks along the surface of the pipe and calculate the percentage change in length.

or

b) Air circulation oven

The test specimen shall be supported in such a way as to leave it free of external stresses. Place the test specimen in the oven for a period of 1 hour, counted from the moment when the test temperature (Table 16.2) is re-attained after inserting the specimen, allow it to cool to room temperature and measure the distance between the inscribed marks as described in (a) above.

In both cases, the test specimen must be kept in the bath or oven for a period of one hour.
Table 16.2 – Heat reversion test temperature

<table>
<thead>
<tr>
<th>Material</th>
<th>Temperature in °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acrylonitrile Butadiene Styrene (ABS)</td>
<td>120 ± 2</td>
</tr>
<tr>
<td>Polypropylene (PP)</td>
<td>120 ± 2</td>
</tr>
<tr>
<td>Polyethylene (PE)</td>
<td>100 ± 2</td>
</tr>
<tr>
<td>Unplasticised Polyvinyl Chloride (uPVC)</td>
<td>150 ± 2</td>
</tr>
</tbody>
</table>

16.5.4 Compliance

To pass the test, the change in the measured length shall be less than the percentage of the original measured length, as tabulated below (Table 16.3) and the specimen shall be free from blistering. If the single test specimen fails the test, then the whole production batch shall be rejected.

Table 16.3 – Maximum allowed length change

<table>
<thead>
<tr>
<th>Material</th>
<th>Maximum Percentage Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABS</td>
<td>2.5%</td>
</tr>
<tr>
<td>PE</td>
<td>3%</td>
</tr>
<tr>
<td>PP</td>
<td>1%</td>
</tr>
<tr>
<td>uPVC</td>
<td>5%</td>
</tr>
</tbody>
</table>