BRITISH STANDARD

BS EN
10288:2002

Steel tubes and fittings for onshore and offshore pipelines — External two layer extruded polyethylene based coatings

The European Standard EN 10288:2002 has the status of a British Standard

ICS 23.040.10; 23.040.40; 25.220.60

National foreword

This British Standard is the official English language version of EN 10288:2002.

The UK participation in its preparation was entrusted to Technical Committee ISE/16, Protective coatings and linings of metal pipes and fittings, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled "International Standards Correspondence Index", or by using the "Find" facility of the BSI Standards Electronic Catalogue.

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This British Standard, having been prepared under the direction of the Engineering Sector Policy and Strategy Committee, was published under the authority of the Standards Policy and Strategy Committee on 10 May 2002

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EUROPEAN STANDARD

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English version

Steel tubes and fittings for onshore and offshore pipelines - External two layer extruded polyethylene based coatings

Tubes et raccords en acier pour canalisations enterrées et immergées - Revêtements externes double couche à base de polyéthylène extrudé

Stahlrohre- und Formstücke für erd- und wasserverlegte Rohrleitungen - Im Zweischicht-Verfahren extrudierte Polyethylenbeschichtungen

This European Standard was approved by CEN on 26 December 2001.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Contents

Foreword

This document EN 10288:2002 has been prepared by Technical Committee ECISS/TC 29 "Steel tubes and fittings for steel tubes", the secretariat of which is held by UNI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2002, and conflicting national standards shall be withdrawn at the latest by October 2002.

During the 6 months enquiry, it appeared that two tests were omitted:

— long term performance;

— stress cracking.

After discussions, the conclusions were that there was insufficient data for standardization of test conditions and required properties.

ECISS/TC 29/SC 4 agreed to leave the standards as they are and to create an Ad Hoc Group to study these problems in order to be able to introduce these tests in the 5 years revision.

The annexes A, B, C, D, E, F, G, H, J and K are normative.

The annex L is informative.

This standard includes a Bibliography.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard defines the application of factory applied external two layer extruded polyethylene based coatings for the corrosion protection of tubes and pipeline components.

External extruded polyethylene coating can be used for the protection of buried or submerged tubes service at temperatures up to + 60 °C for type 1 and + 30 °C for type 2.

The coatings in this standard can be applied to longitudinally or spirally welded and to seamless steel tubes and components used for the construction of pipelines for conveying liquids or gases.

Tubes coated with this type of coating may be further protected by means of cathodic protection.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendments or revision. For undated references, the latest edition of the publication referred to applies (including amendments).

prEN 10224, *Steel tubes and steel fittings for the conveyance of aqueous liquids including water for human consumption - Technical delivery conditions.*

ISO 527-2:1993, *Plastics - Determination of tensile properties – Part 2 : Test conditions for moulding and extrusion plastics.*

ISO 1133, *Plastics - Determination of the melt mass-flow rate (MFR) and the melt volume-flow rate (MVR) of thermoplastics.*

ISO 1183, *Plastics - Methods for determining the density and relative density of non-cellular plastics.*

ISO 4287, *Geometrical Product Specification (GPS) – Surface texture : Profile method – Terms, definitions and surface texture parameters.*

ISO 4892-2:1994, *Plastics - Methods of exposure to laboratory light sources – Part 2 : Xenon-arc sources.*

ISO 8501-1, *Preparation of steel substrates before application of paints and related products – Visual assessment of surface cleanliness – Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings.*

ISO 11420, *Method for the assessment of the degree of carbon black dispersion in polyolefin pipes, fittings and compounds.*

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purposes of this European Standard, the following terms and definitions apply.

3.1.1
product manufacturer
supplier of the coating material in a condition suitable for application to the product to coat

3.1.2
coater
person responsible for applying the coating material to the components to coat in accordance with the provisions of this European Standard or the special requirements given in the tender specification and in the order

3.1.3
purchaser
company which buys the coated products

3.2 Symbols

R_z roughness parameter (the average roughness from five successive evaluation areas measured according to ISO 4287);

R_s specific electrical insulation resistance, expressed in ohms.square metres ($\Omega \cdot m^2$);

k correction factor.

4 Classification of coatings

The coating shall consist of two layers: an adhesive and an extruded polyethylene outer sheath. The type 1 adhesive can either be applied as a powder or by extrusion, the type 2 adhesive is applied by flood coating.

5 Information to be supplied by the purchaser

5.1 Mandatory

The purchaser shall state in his enquiry and order the following minimum information:

— tubes and components coated in accordance with this European Standard shall be designated by reference to this standard followed by the thickness class of the coating, the type and the category for type 1. If applicable, the reference to the standard for the tube to which the coating is applied shall be added to this designation;

EXAMPLE : 5 000 m of tube - EN 10224 of 406, 4-4, 0

external coating EN 10288 Class 1, Type 1, category A;

— maximum number and dimensions of repairs;

— maximum service temperature.

5.2 Options to be indicated by the purchaser

— definition of surface preparation (see Table 8);

— cut back at the ends (see Table 8);

— electrical insulation resistance (see Table 8);

— resistance to ultraviolet irradiation (see Table 8);

— thermal stability (see Table 8);

— cathodic disbondment (see Table 8);

— flexibility (see Table 8);

— scheme of procedure qualification;

— type of inspection document required, if different to the one of clause 9;

— colour of the top coat.

6 Documents

See 9.1.

7 Application of the coating

7.1 Surface preparation

Two kinds of surface preparation can be applied according to the type of coating.

7.1.1 Type 1

7.1.1.1 The tube and components shall be abrasive blast cleaned. The degree of cleanliness shall be Sa 2 1/2 in accordance with ISO 8501-1.

7.1.1.2 Prior to abrasive blast cleaning, the steel surface shall be dry and free from contamination (oil, grease, temporary corrosion protection, etc.) and surface defects (slivers, laminations, etc.) detrimental to the surface preparation or to the adhesion of the coating.

7.1.1.3 After blast cleaning, the surface of the tube shall be inspected. All slivers, laminations, weld spatter and other surface imperfections made visible by the blast cleaning process shall be removed.

After removal of these defects, the residual thickness of tube and components shall satisfy the minimum tolerance requirements specified by the relevant standard. All treated areas greater than 10 cm^2 shall be prepared to provide a profile to satisfy the provisions of 7.1.

7.1.1.4 Tube and components shall be maintained at least 3 °C above the dew point temperature prior to coating.

7.1.1.5 Contaminants (e.g. residual abrasive dust) shall be removed prior to coating.

Chemical treatment of the steel may be used in addition to abrasive blast cleaning, by agreement.

7.1.1.6 At the time of application, the temperature range at the surface of the tube to be coated shall be determined in agreement with the manufacturers of the products.

The temperature holding time of the tube shall not result in oxidation of its surface, detrimental to the good quality and adhesion of the coating.

The temperature of the tube shall be monitored using suitable means in order to make sure that the application conditions are fully satisfied.

7.1.2 Type 2

This method may only be used for type 2 coatings. Where a type 2 system is specified, a chemical cleaning and passivation process may be used as an alternative to blast cleaning.

7.2 Composition of the coating

The coating shall consist of two layers and shall be applied in the factory in accordance with the established procedure.

The constituent material data sheets shall contain the items required in Table 1.

7.2.1 Layer 1

7.2.1.1 Type 1

The layer shall be formed by a polymer intended to provide adhesion between the steel substrate and layer 2. Its thickness shall be uniform and its minimum value shall make it possible to satisfy the requirements of clause 8.

7.2.1.2 Type 2

The layer shall be formed by a mastic adhesive characterized by its ability to flow at relatively low ambient temperatures and which provides adhesion between the steel substrate and layer 2. Its thickness shall be uniform and its minimum value shall make it possible to satisfy the requirements of clause 8.

7.2.2 Layer 2

The layer shall be formed by the polyethylene outer sheath. The thickness shall be uniform with a minimum sufficient to meet the total system thickness requirements given in Table 2.

Pigments and additives may be added to the basic polyethylene, provided that all the required properties of the coating are obtained. The pigments shall be dispersed uniformly.

Unless otherwise agreed the coater can add pigments and additives to the basic polyethylene. The required properties shall be certified by a documented quality programme. The following tests shall be undertaken as a minimum:

— quantitative analysis of the raw-material components immediately before coating;

— determination of dispersion of pigments and additives in accordance with ISO 11420.

8 Requirements of the applied coating

8.1 General

The required properties of the applied coatings are given below:

— appearance and continuity;

— thickness of the coating system;

— cut back at the ends;

— holiday detection;

— impact resistance;

— peel force;

— indentation resistance;

— electrical insulation resistance;

— elongation at break;

— resistance to ultraviolet irradiation;

— thermal stability;

— cathodic disbondment;

— flexibility.

Other properties can be specified at the time of enquiry and order.

A summary of the required properties is given in Table 7.

8.2 Appearance and continuity

The appearance and continuity of the coating system shall be inspected visually over the total length of all tubes.

The coating shall be of uniform colour, have a smooth appearance and be free of holidays, defects and laminations detrimental to the quality of the coating.

8.3 Thickness of the coating system

Coating thickness shall be measured in accordance with the method defined in annex A.

Unless otherwise agreed by the purchaser, the minimum thickness of the coating system at any point shall correspond to the value given in Table 2 depending on the class (1, 2, 3) specified.

Table 1 - Content of data sheets and certificates

Items	Standard test reference	Layer 1	Layer 2
Date of issue		+ o	+ o
Name of manufacturer		+ o	+ o
Name and type of product		+ o	+ o
Factory of origin		o	o
Batch or production lot number		o	o
Shelf life		+	
Physical state of the delivered product		+	+
Packaging		+	+
Storage conditions		+	+
Sieve analysis		+ o (powder only)	
Density	ISO 1183 adhesive and PE	+ o	+ o
Melt index	ISO 1133	+ o	+ o
Recommended processing temperature		+	+
Content of pigment	ISO 11420		+ o
Dispersion of pigment	ISO 11420		o
Maximum service temperature		+	+
Elongation at break	ISO 527-2	+	+
Maximum moisture content		+	+
Softening point	ISO 306	+	+

NOTE 1 + Technical data sheet

NOTE 2 o Test certificate

Table 2 - Minimum thickness of the coating system

Tube diameter *D* mm	**Thickness** [a] mm		
	Classes		
	1	**2**	**3**
$D \leq 114,3$	1,5	1,8	2,5
$114,3 < D \leq 273$	1,8	2,0	2,7
$273 < D \leq 508$	2,0	2,2	2,9
$508 < D \leq 762$	2,2	2,5	3,2
$762 < D$	2,5	3,0	3,7

[a] The thicknesses given in this Table can be reduced by 10 % for submerged arc welded tubes, at the weld reinforcement.

8.4 Cut back at the ends

The length of the cut back shall be (150 ± 20) mm and the coating shall be bevelled at the cut back forming a bevel angle of ≤ 30° unless otherwise specified by the purchaser.

When removing the coating, the surface of the tube shall not be damaged.

8.5 Holiday detection

Holiday detection shall be carried out in accordance with the method defined in annex B.

The coating shall be free from holidays.

8.6 Impact resistance

The minimum impact energy, in joules, shall be determined in accordance with the method defined in annex C and shall correspond to 5 J × *k* for each millimetre of nominal coating thickness. The values of *k* are given in Table 3.

Table 3 - Correction factor

Diameter mm	***k***
$D > 219,1$	1,00
$76,1 < D \leq 219,1$	0,85
$D \leq 76,1$	0,70

8.7 Peel force

8.7.1 Type 1

The level of adhesion is dependent on the test temperature.

Peel force shall be determined in accordance with annex D. The average and the minimum average values are defined in annex D.

Other test method can be used after agreement between the purchaser and coater.

The minimum requirements for the peel force shall be as given in Table 4, according to the category specified.

Table 4 - Minimum peel force

Category	Force (in N/10 mm) at room temperature (23 ± 2) °C		Force (in N/10 mm) at (60 ± 2) °C	
	Minimum average	Average	Minimum average	Average
A	20	30	5	10
B	30	40	5	10
C	60	80	15	20

NOTE 1 If the top coat cannot be peeled from the tube, the measured tensile force at yield should be recorded and the force of adhesion rated as greater than the tensile force at yield.

NOTE 2 Higher values may be agreed.

8.7.2 Type 2

Where the coating system is classified as type 2, the resistance to peeling shall be determined in accordance with the method defined in D.2.

The peeling resistance shall be such that the measured peel rate falls below the curve in D.2 - Figure D.5.

8.8 Indentation resistance

Indentation resistance shall be assessed by testing in accordance with the method defined in annex E.

The indentation shall not be more than the values given in Table 5.

Table 5 - Indentation

Type	Indentation at (23 ± 2) °C mm	Indentation at (60 ± 2) °C mm	Indentation at (30 ± 2) °C mm
Type 1	0,3	0,5	-
Type 2	0,3	-	0,3

8.9 Electrical insulation resistance

The specific electrical resistance of the coating, R_S, shall be measured in accordance with the method defined in annex F, after being immersed for 100 days. The coating shall satisfy the following requirements:

1) the R_S value after 100 days shall be equal or greater than 10^8 $\Omega \cdot m^2$;

2) when the R_S value after 70 days remains only a power of ten above the permissible 100 days value then the ratio:

$$\alpha = \frac{R_s(100 \text{ days})}{R_s(70 \text{ days})} \geq 0{,}8$$

8.10 Elongation at break

This test shall be carried out in accordance with the method defined in annex G, at (23 ± 2) °C. The value of the elongation at break shall be equal or greater than the value given in Table 6.

Table 6 - Elongation at break

Minimum %
350

8.11 Resistance to ultraviolet irradiation

This test shall be carried out in accordance with the method defined in H.1. The value of elongation, after exposure to radiation from a xenon lamp, shall be greater than 50 % of the original value measured from the same unexposed coating.

Alternatively, the melt flow index after exposure to radiation from a xenon lamp shall not vary by more than ± 35 % relative to the melt flow index of the unexposed coating.

8.12 Thermal stability

This test shall be carried out in accordance with the method defined in H.2. The melt flow rate after exposure to heat shall not vary by more than ± 35 % relative to the melt flow rate of the unexposed coating.

Table 7 - Summary of required properties

		Type 1				Type 2		
Handling temperature		- 40 °C + 60 °C				- 20 °C + 30 °C		
Service temperature		up to + 60 °C				up to + 30 °C		
Properties		**Requirements**						**Subclause**
Appearance and continuity								8.2
Thickness of the coating system		Table 2						8.3
Cut back		150 mm ± 20 mm						8.4
Holiday detection		free from holidays						8.5
Impact resistance		≥ 5 J × *k* per mm coating thickness						8.6
Peel force		**(23 ± 2) °C**		**(60 ± 2) °C**		See Figure D.5		8.7
Force N/10 mm		minimum average	average	minimum average	average			
Category	A	20	≥ 30	5	≥ 10			
	B	30	≥ 40	5	≥ 10			
	C	60	≥ 80	15	≥ 20			
Indentation resistance		**(23 ± 2) °C**		**(60 ± 2) °C**		**(23 ± 2) °C**	**(30 ± 2) °C**	
		≤ 0,3 mm		≤ 0,5 mm		≤ 0,3 mm	≤ 0,3 mm	8.8
Electrical insulation resistance		$\geq 10^8\ \Omega.m^2$						8.9
Elongation at break		≥ 350 %						8.10
Resistance to ultraviolet irradiation		A ≥ 50 % 0,65 ≤ ΔMFR ≤ 1,35						8.11
Thermal stability		0,65 ≤ ΔMFR ≤ 1,35						8.12
Resistance to cathodic disbondment		**average**		**maximum**		**average**	**maximum**	
		≤ 30 mm		≤ 40 mm		≤ 10 mm	≤ 15 mm	8.13
Flexibility		≥ 3 %						8.14

8.13 Cathodic disbondment

This test shall be carried out in accordance with the method defined in annex J.

The cathodic disbondment shall be determined as being the radial distance from the edge of the artificial defect to the edge of the area of coating that is easily removed.

The average value of six radial measured lengths and a single maximum radial shall not exceed the following values:

	Type 1	**Type 2**
Average in mm	30	10
Maximum in mm	40	15

One of the following conditions shall be applied:

— 2 days at (60 ± 2) °C - Type 1;

— 7 days at (40 ± 2) °C - Type 1;

— 28 days at (23 ± 2) °C - Types 1 and 2.

Other testing regimes may be used by agreement.

8.14 Flexibility

The coating shall be able to withstand bending with a radius of curvature equivalent to 3 % elongation, without visible damage (apparent cracks) or reduction in its initial properties at (23 ± 2) °C.

9 Inspection

9.1 Document

Inspection operations shall be carried out by the coater as agreed at the time of enquiry and order.

A representative appointed by the purchaser may witness these operations.

The results of these inspection operations shall be recorded by the coater and made available to the representative of the purchaser.

9.1.1 Standard

If the coater is qualified according to EN ISO 9001, a certificate 3.1.B according to annex K shall be issued, if not otherwise requested by the purchaser.

9.1.2 Special

If the coater is not qualified according to EN ISO 9001, a certificate 3.1.A or 3.1.C in accordance with annex K shall be issued, if not otherwise requested by the purchaser.

Inspection operations shall be carried out by the coater as agreed at the time of enquiry and order.

9.2 Sampling

The purchaser's representative or the coater's inspection representative shall select the tubes on which the specified tests shall be carried out.

The test pieces for destructive testing shall be taken, if possible, from the ends of tubes. Samples and test tubes shall be marked in order to be fully identifiable.

9.3 Nature and frequency of testing and control

The nature and the minimum frequency of the testing and control shall be in accordance with Table 8.

Table 8 - Nature and frequency of testing and control

Properties	Sub-clause	Method of test	Production Control	System and applicator approval [a]
Surface condition before blasting	7.1	-	every tube	3 tubes
Dimensions, shape and properties of blast cleaning products and checking of the blast cleaning process	7.1	-	twice per shift	3 tubes
Roughness of the blast cleaned surface	7.1	-	once per shift	3 tubes
Chemical preparation	7.1	visual	every tube	3 tubes
Visual condition of the blast cleaned surface	7.1	visual	every tube	3 tubes
Temperature of heating before coating	7.1	-	continuously	3 tubes
Appearance and continuity	8.3	visual	every tube	3 tubes
Thickness of the coating system	8.3	Annex A	1 per hour	3 tubes
Cut back	8.4	Visual	every tube	3 tubes
Holiday detection	8.5	Annex B	every tube	3 tubes
Impact resistance	8.6	Annex C	once per week [b]	3 tubes [b e]
Peel force	8.7	Annex D	Type 1 2 tests once per shift at 23 °C 2 tests once per week at 60 °C Type 2 2 tests once per shift at 23 °C	Type 1 at 23 °C and 60 °C 6 tests on at least 3 tubes Type 2 at 23 °C 6 tests on at least 3 tubes
Indentation resistance	8.8	Annex E	once per week [b]	3 tubes
Electrical insulation resistance [d]	8.9	Annex F	by agreement	3 tubes
Elongation at break	8.10	Annex G	once per week [b]	3 tubes
Resistance to ultraviolet irradiation	8.11	Annex H.1	by agreement	3 tubes
Thermal stability [d]	8.12	Annex H2	by agreement	3 tubes
Cathodic disbondment [d]	8.13	Annex J	by agreement	Type 1 3 tubes at (23 ± 2) °C at 28 days (40 ± 2) °C at 7 days (60 ± 2) °C at 2 days Type 2 3 tubes at (23 ± 2) °C at 28 days
Flexibility	8.14		none	3 tubes

[a] All tests detailed in the final column shall be undertaken at least every 3 years for the same system, material and significant technical process.
The system and applicator approval may be combined with a coating production run.

[b] Any tube from the beginning to the end of the production may be used for this test.

[c] Other scheme of procedure qualification may be requested by the purchaser.

[d] The delivery of tubes can be undertaken prior to the completion of the test.

[e] The maximum impact energy in accordance with annex C shall be determined.

9.4 Retests

9.4.1 Test results which are unsatisfactory and not attributable to the quality of the coating could result from:

— a defective sampling of the test piece;

— defective assembling or abnormal operation of the testing machine.

In such cases, the test shall be disregarded and repeated.

9.4.2 During production control tests, if the results of one or more tests are incorrect or inadequate, the following steps shall be taken:

— the tubes which are deemed defective shall be taken back by the coater;

— the test that failed shall be repeated on the two tubes before and after the tube that failed.

If the results from both tubes are satisfactory, the coating shall be considered acceptable. If not, the coating shall be considered unacceptable.

If the coating is rejected, the coater shall recoat tubes and components in accordance with a procedure approved by all parties and present the recoated tube or components for acceptance again.

10 Repairs

Tubes or components with localized defects (porosity, surface defects) as well as those which have been subjected to destructive control tests may be repaired.

The coating materials that can be used for repairing defects shall satisfy two conditions:

— be suitable for protecting onshore and offshore pipelines in the required service conditions (e.g. working temperature);

— be compatible with and adhere to the polyethylene coating applied previously.

The application conditions for repair materials shall be those defined in the manufacturer's technical data sheet or as agreed between the parties involved (manufacturers of the polyethylene coating and the user of the material).

The completed repair shall satisfy the values specified in the manufacturer's technical data sheet.

The maximum number of repairs permitted and the dimensions shall be defined by the purchaser (see 5.1).

After application, repair shall be verified in accordance with 8.5. The repair shall be free from holidays.

11 Marking

Marking shall be undertaken on each tube or components shall include the following:

— identification;

— code or name of the producer of the steel (if known);

— application code, if it differs from the preceding code;

— reference to the steel standard (if known);

— reference to this European Standard followed by the thickness class, the type and the category for type 1;

— maximum service temperature.

Marking shall be carried out using a suitable method such as stencil painting or printing, making possible legible and indelible identification and using durable materials.

12 Handling, transportation and storage

12.1 Handling

Coated tubes and components shall be handled without causing damage to the ends of the tubes or to the coating. The direct use of steel ropes or slings or of any equipment which could damage the coating and the ends shall be prohibited.

12.2 Transportation to the storage area

During transportation to the storage area at the coater's works, the coater shall take all relevant precautions to avoid damage to the tubes and components and to the coating.

12.3 Storage

Storage shall be carried out so that the coating does not deteriorate. In particular, the coating on stacks of tubes which are intended to be stored for a long period shall be protected from the action of ultraviolet irradiation using a suitable method.

12.4 Loading of tubes and components for delivery

During loading of tubes and components in the factory, the coater shall take the reasonable precautions to make sure that loading is carried out correctly in order to avoid damage to the tubes and to the coating during transportation.

The coater shall be responsible for the supply of correctly coated tube and components as detailed in the tender documentation.

Annex A
(normative)

Inspection of thickness

A.1 General

The test consists of measuring, by means of a non destructive process, the thickness of the applied coating.

A.2 Apparatus

A magnetic, electromagnetic or ultrasonic thickness measuring instrument with an accuracy of ± 10 % shall be used. The instrument shall be appropriate for the range of coating thickness to be measured and shall be calibrated.

A.3 Procedure

Before thickness measurements are carried out the instrument shall be adjusted and verified on a steel tube surface using a calibrated shim of the same thickness range as the coating. The surface profile and cleanliness of the steel tube surface shall be representative of the production tube.

For measuring thickness of more than 1 mm, the surface profile of the tube is not relevant.

On each tube to be tested, the total of 12 measurements shall be carried out.

For submerged arc welded tubes an additional four thicknesses measurements shall be undertaken on the weld area.

The measurements points shall be distributed along four equally spaced longitudinal lines at the intersection with three equally spaced circumferential lines and at a distance of at least 200 mm from the end of the coating.

A.4 Results

A calculation of the arithmetic mean from the measured values shall be made.

NOTE In case of dispute of the result at one point, the recalibration of the instrument should be undertaken and five measurements at this point should be carried out again. The arithmetic mean of the result of the five measurements should be calculated.

Annex B
(normative)

Holiday detection test

B.1 General

The test consists of looking for any porosity in the coating using a scanning electrode energized by a high-arc-voltage.

Porosity shall be detected by a spark occurring between the steel of the tube and the electrode at the defect, accompanied by a sound and light signal provided by the holiday detector.

B.2 Apparatus

The apparatus shall consist of:

— adjustable high-voltage holiday detector, equipped with a sound and light signal;

— scanning electrode in the form of a metal brush, or conductive rubber conforming to the shape of the tubes;

— conductors which are used to connect the tube to the holiday detector.

B.3 Procedure

Connect the instrument to the coated tube, switch it on with a continuous movement with the surface of the coating to be inspected ; the rate of the relative movement of the electrode shall not be limited but it shall be demonstrated that a defect of a diameter one millimetre can be detected.

Complete the circuit between the holiday detector and the coated tube.

At the time of the test, the voltage shall be set at 10 kV/mm of nominal thickness of coating and not exceeding 25 kV.

B.4 Results

The tube or components identification and the number of holidays shall be recorded.

Annex C
(normative)

Impact test

C.1 General

The test consists of verifying the strength of the coating by the impact of a punch of defined shape falling directly onto the coating from a fixed height and at a fixed temperature. This test shall not be carried out on tubes of diameter less than 50 mm.

C.2 Apparatus

The apparatus shall consist of a drop weight testing machine comprising:

— a straight guide made of steel, aluminium or plastic, rigid and non-deformable, of inside diameter between 40 mm to 60 mm, of length at least 1,30 m and incorporating a smooth and even inside surface. The guide shall be provided with:

  — a support and levelling devices (for example, two spirit levels for the horizontal plane and a plumb line for the vertical plane);

  — a graduated rod which makes it possible to determine the drop height to an accuracy of 5 mm.

  Other guides may be used by agreement;

— a hard steel punch, with a hemispherical head, free from notches, porosity or other surface irregularities and with a diameter of 25 mm. A small metal rod of diameter 6 mm shall be fixed perpendicular to the flat face of the head and in its centre, where this rod shall be long enough to hold the additional weights required for the tests. The punch shall be equipped with a suitable system for raising to the required height ; the accuracy of the mass of this assembly shall be (1 ± 0,005) kg;

— a sufficient number of additional weights, formed by metal discs (preferably made of stainless steel) to outside diameter approximately 24 mm and incorporating a central hole of a suitable diameter ; the mass of each disc shall be known with an accuracy of ± 5 g.

C.3 Procedure

The test shall be carried out at a temperature in the range of 15 °C to 25 °C. If provision has been made to perform this test outside this temperature range, the method described shall be adapted, after agreement, if necessary, between the coater and purchaser.

The coated tube shall be placed on a rigid, and stable, horizontal support, and if necessary, the tube interior shall be supported to reduce its elastic response.

Before carrying out an impact test, the holiday detection test shall be undertaken (see annex B) to identify the defective points and to avoid making the impact at these locations; if the number of faults found is too high, another coated test piece shall be taken.

For each point of impact, the drop weight testing machine shall be arranged perpendicular to the coating surface so that the loaded punch can fall freely without friction or resistance.

C.3.1 Basic Method

Ten impacts shall be carried out allowing the weight corresponding to the energy laid down in 8.7 and Table 3 to fall from a height of 1 m. The points of impact shall be selected so as to avoid, as much as possible, any protruding welds. Furthermore, the distance from the points of impact to the end of the tube shall be at least 1,5 *D* (*D* is the outside diameter of the tube in millimetres) and at least 50 mm between the axes of the impacts.

The holiday detection test shall then be undertaken at each location (see annex B).

C.3.2 Alternative Method

Depending on the result obtained (number of perforations obtained from the ten impacts made), a further series of ten is carried out with increasing or decreasing weights, so as to be able to plot a curve of the number of perforations with respect to the impact energy. The point of inflection is determined, with an accuracy of 1 Joule per millimetre of coating thickness, as the part of the curve where there is a rapid increase in the number of perforations (in practice five or six well distributed tests are adequate).

The hard steel punch shall be checked every 30 impacts. If damaged, it shall be changed.

C.4 Results

The basic method gives a Pass at the specified impact energy if no holiday are recorded on any of the ten impacts.

The iterative method gives the maximum impact energy, in joules per millimetre, to which the coating may be expected to withstand and is defined as the point of inflection of the graph.

Annex D
(normative)

Peel force test

D.1 Measurement of the peeling force on a coated sample (type1)

D.1.1 General

The method consists of measuring the force required for peeling the coating from the metal substrate of the tube at a constant rate of pull.

D.1.2 Apparatus

The apparatus shall consist of:

— a tensile testing machine with which it is possible to record the peeling force and which operates at a rate of pull of 10 mm/min;

— a cutting tool (e.g. knife);

— a test piece holder with which it is possible to rotate the tube without friction about its axis and which can be fitted in the jaws of the tensile testing machine.

D.1.3 Procedure

The test shall be performed at temperatures of (23 ± 2) °C and (60 ± 2) °C. If provision has been made to perform this test outside this temperature range, the method described shall be adapted, after agreement, if necessary, between the coater and purchaser.

The temperature shall be measured by means of an adapted probe, on the external surface of the tube at the root of the peeled strip (evaluation on 100 mm).

A sample of minimum length of 160 mm shall be cut in the circumferencial direction from the coated tube. From this sample, a strip of coating 20 mm to 50 mm wide perpendicular to the axis of the tube shall be isolated.

The strip shall be separated over a circumferential length of approximately 20 mm.

The tube shall be arranged on its support and shall be secured to one of the gripping jaws of the testing machine. The separated part of the coating shall be held in the other jaws and it shall be verified that the tensile force is applied in the plane passing through the axis of rotation of the support.

The peeling force shall be graphically recorded over the agreed length using a constant peeling rate set to 10 mm/min.

D.1.4 Results

The peel force, in newtons/10 mm, shall be calculated from the recorded data to determine the average and minimum average as defined in Figures D.3 and D.4.

The average peel force shall be the arithmetic mean taken over 100 mm length. Where this value is not automatically determined, the arithmetic mean may be estimated from the 20 mm bands across the 100 mm length (M_1 to M_9 in Figure D.3).

The minimum average shall be the lower value from the following two determinations :

— the lowest arithmetic mean from a 20 mm band (M_1 to M_9);

— the arithmetic mean from a 10 mm band centred on the absolute minimum value. See Figure D.4 (M_{10}).

D.2 Measurement of the peel strength on large diameter tube (type 2)

D.2.1 General

The method consists of measuring the force required for peeling the coating from the metal substrate of the tube at a constant rate of pull.

D.2.2 Apparatus

The apparatus shall consist of:

— a portable tensile test machine, which shall be fixed directly on the tube which makes it possible to record the peeling force, on a minimum strip length of 100 mm and which can operate at a pulling rate of 10 mm/min;

— a cutting tool (e.g. knife).

D.2.3 Procedure

The test shall be performed at temperatures of (23 ± 2) °C and (60 ± 2) °C. If provision has been made to perform this test outside this temperature, the method described shall be adapted, after agreement, if necessary, between the coater and purchaser.

The temperature shall be measured by means of an adapted probe, on the external surface of the tube at the root of the peeled strip (evaluation on 100 mm).

A sample of minimum length of 160 mm shall be cut in the circumferencial direction from the coated tube. From this sample, a strip of coating 20 mm to 50 mm wide perpendicular to the axis of the tube shall be isolated. Where the strength of the coating is higher than the capacity of the machine, the width of the coating strip may be reduced.

The strip shall be separated over a circumferential length of approximately 20 mm.

The peeling force shall be graphically recorded over the tested length using a constant peeling rate set to 10 mm/min.

D.2.4 Results

The peel force, in newtons/10 mm, shall be calculated from the recorded data to determine the average and minimum average as defined in Figures D.3 and D.4.

The average peel force shall be the arithmetic mean taken over 100 mm length. Where this value is not automatically determined, the arithmetic mean may be estimated from the 20 mm bands across the 100 mm length (M_1 to M_9 in Figure D.3).

The minimum average shall be the lower value from the following two determinations:

— the lowest arithmetic mean from a 20 mm band (M_1 to M_9);

— the arithmetic mean from a 10 mm band centred on the absolute minimum value. See Figure D.4 (M_{10}).

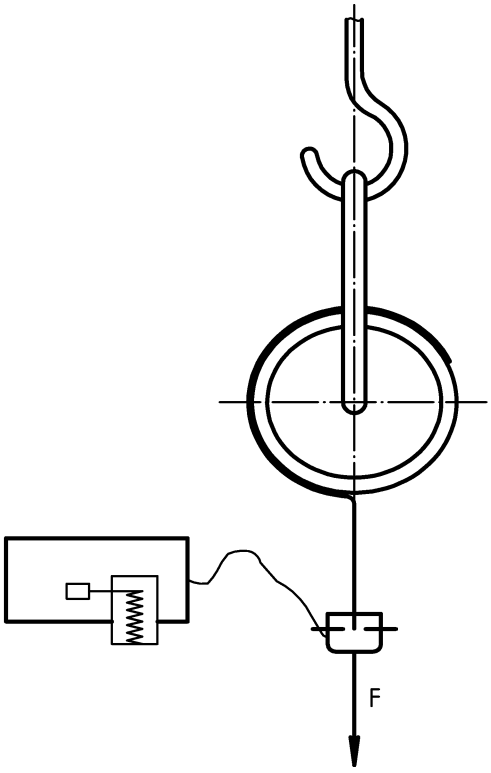


Figure D.1

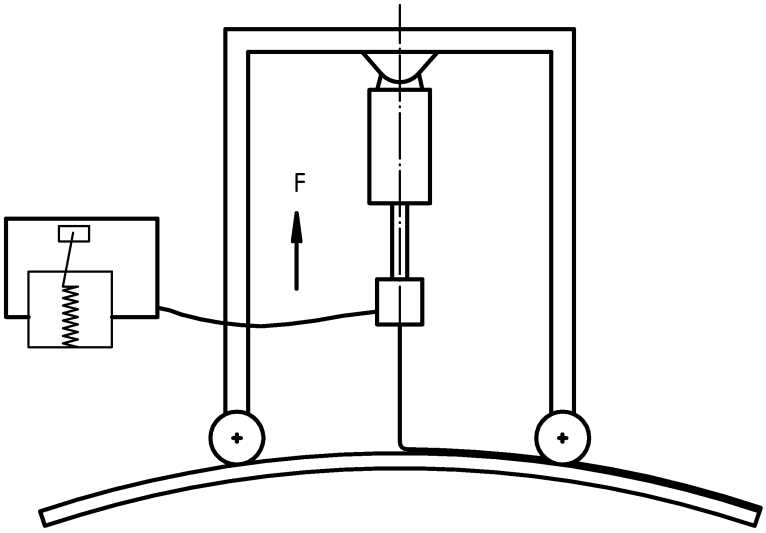
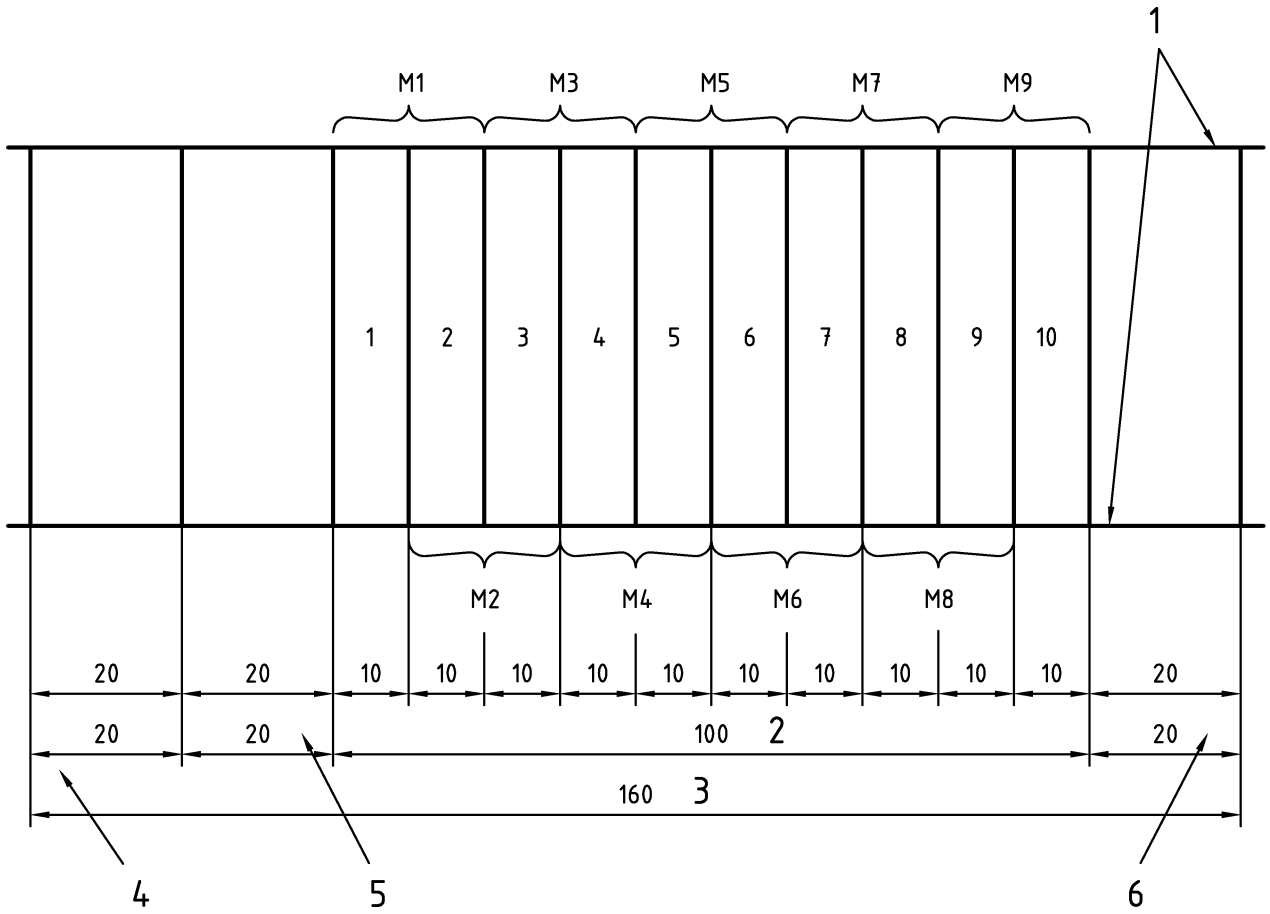


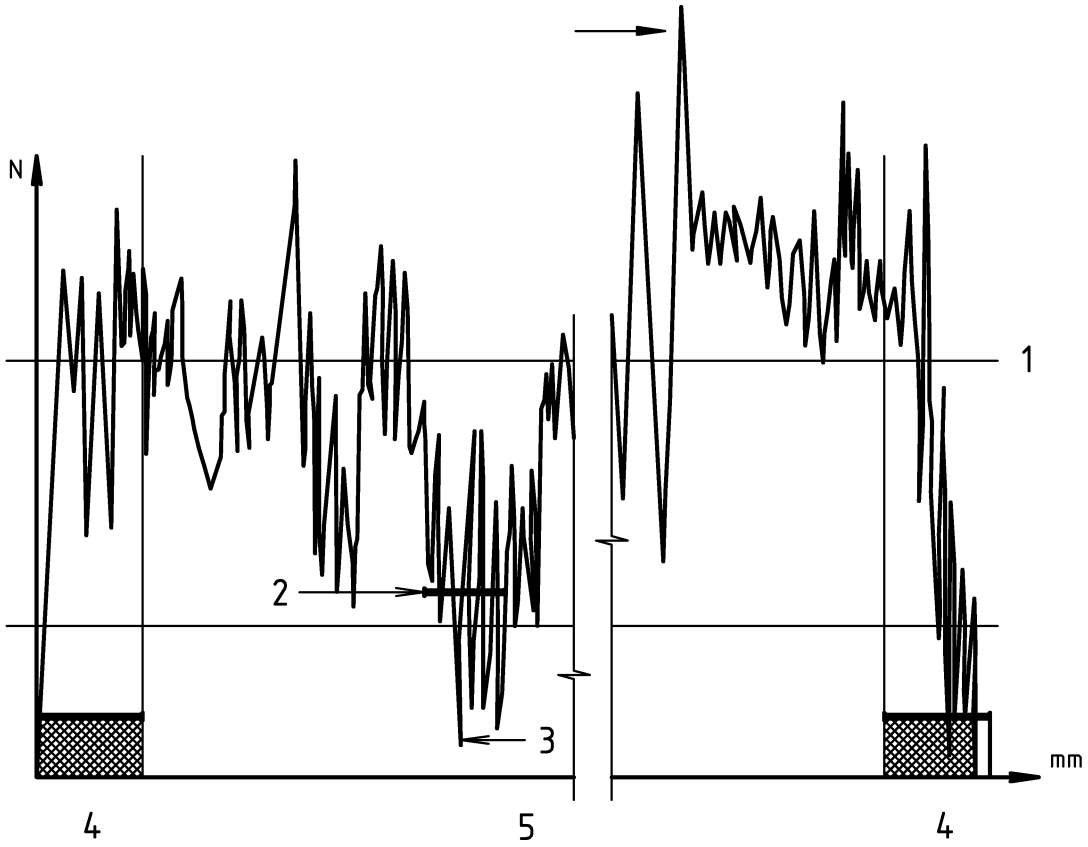
Figure D.2



Key

1 Parallel cut (20 mm to 50 mm wide)
2 (calculation of arithmetical peel force)
3 (cut in circumferential direction)
4 20 mm minimum length for attachment to grip
5 First
6 Last

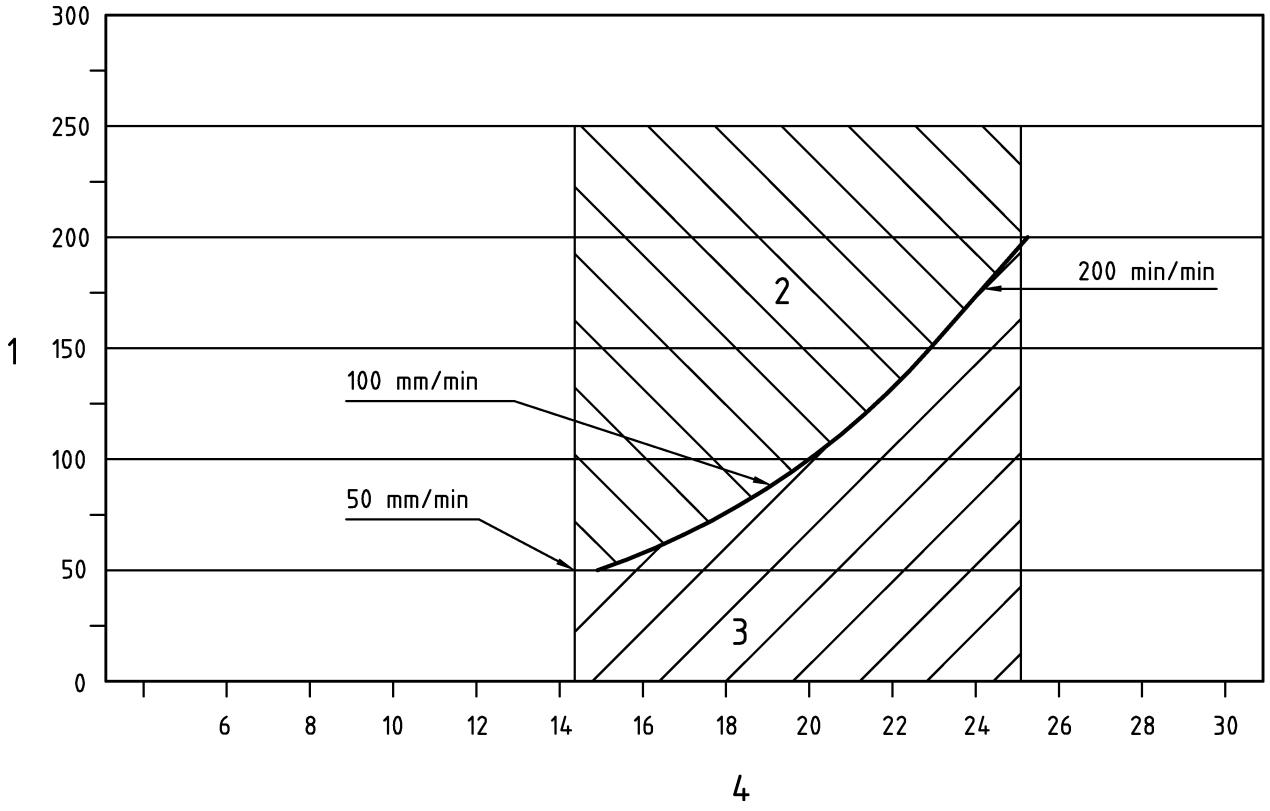
Figure D.3



Key

1 Average peeling force
2 Minimum average
3 Lowest recorded peel force (M_{10})
4 Neutralized 20 mm area
5 Minimum 100 mm

Figure D.4



Key

1 Peel rate (mm/min)
2 Fail
3 Pass
4 Temperature (°C)

Figure D.5

Annex E
(normative)

Indentation test

E.1 General

The test consists of measuring the indentation of a punch in the coating under fixed conditions of temperature and load.

E.2 Apparatus

The apparatus shall consist of :

— a chamber or a bath thermostatically controlled to ± 2 °C ;

— a penetrometer comprising :

  — a cylindrical punch of diameter 1,8 mm (cross-sectional area 2,5 mm^2) on the top of which is mounted a weight. The assembly, punch plus weight, shall produce a force of 25 N ;

  — a dial gauge or any other measurement system accurate to 0,01 mm.

E.3 Procedure

The test shall be performed three times on one polyethylene coating sample.

The test piece, equipped with the penetrometer shall be placed in the thermostatically controlled chamber and set to the test temperature. The test piece shall be allowed to stand for 1 h. The reading on the dial gauge shall be recorded.

The shock resistant punch with the mass giving 2,5 kg in total shall be loaded to the apparatus. The test shall be allowed to stand for 24 h. The reading of the dial gauge shall be recorded.

When sampling of the test piece is unpractical (e.g. in the case of large- diameter tubes), the test shall be carried out directly on the coated tube in air provided that the surface temperature of the coating is between 15 °C and 25 °C and the experimental assembly (tube + apparatus) is not exposed to any heat radiation or any vibration during testing.

E.4 Results

The indentation shall be the difference between the dial gauge reading before and after the 24 h test duration. The arithmetic mean of the three indentation measurements shall be calculated.

Annex F
(normative)

Specific electrical insulation resistance test

F.1General

The test consists of measuring, at regular intervals, the specific electrical insulation resistance of the coating, on a piece of tube immersed continuously for a given time in a saline solution.

F.2Apparatus

The apparatus shall consist of:

— a non metallic tank filled with demineralized water and sodium chloride to give a 0,1 mol/l NaCl solution;

— a counter electrode e.g. a copper electrode;

— a direct current supply minimum voltage 50 V;

— a suitable ohmmeter or voltmeter and ammeter;

— suitable conductors for electrical connections.

F.3Procedure

The test shall be carried out at the temperature of (23 ± 2) °C. If it is intended to perform this test at different temperatures, the method described shall be adapted, after agreement, if necessary, between the coater and purchaser.

At least 24 h after coating, a section of tube shall be used. A procedure in accordance with Figure F.1 or F.2 shall be carried out. The immersed test surface (S) shall be at least 0,03 m² and shall be recorded, in square metres.

At regular intervals from the 3rd day of immersion and at least once per week, the voltage U and the current I or the resistance R shall be measured. At the time of the measurement, using conductors, the positive pole of the current source or the ohmmeter shall be connected to the cylindrical section of the tube and the negative pole to the counter electrode, the minimum voltage of 50 V only being applied at the time of measurement.

The test shall be continued for 100 days.

F.4Results

The insulation resistance R_s in ohms.square metres of the coating, measured at time t, shall be expressed as:

$$R_S = \frac{US}{I}$$

where

S is the immersed test surface, expressed in square metres (m²);

U is the applied potential between the counter electrode and the steel tube, expressed in volts (V);

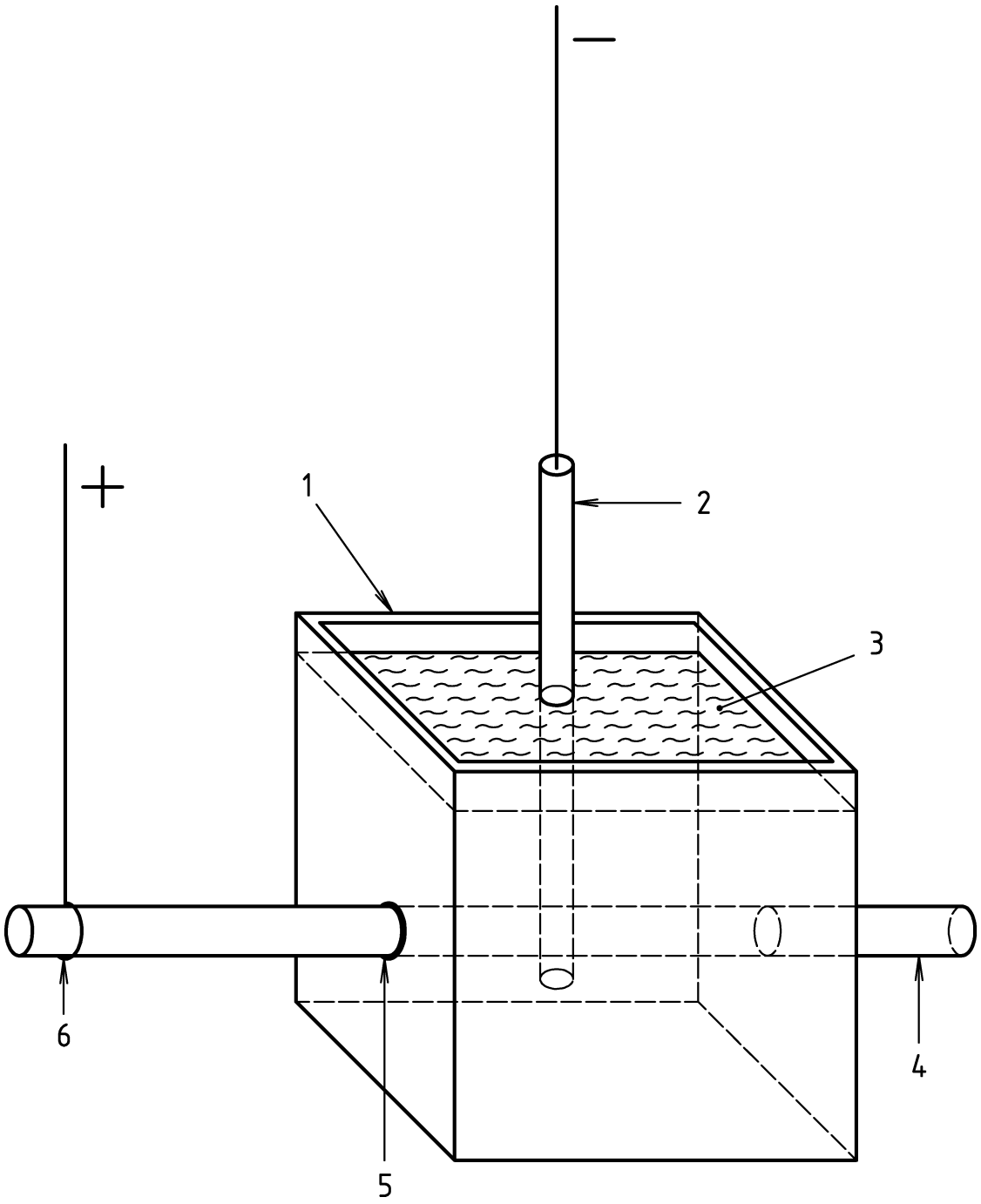
I is the current passing between the counter electrode and the steel tube, expressed in amperes (A).

At regular intervals from the 3rd day of immersion and at least once per week, the voltage U and the current I or the resistance R shall be measured.

Between the 70th and 100th day, the linear regression line shall be calculated from the measured values. The slope of the line shall be determined and compared to the value at the start of the test.

where

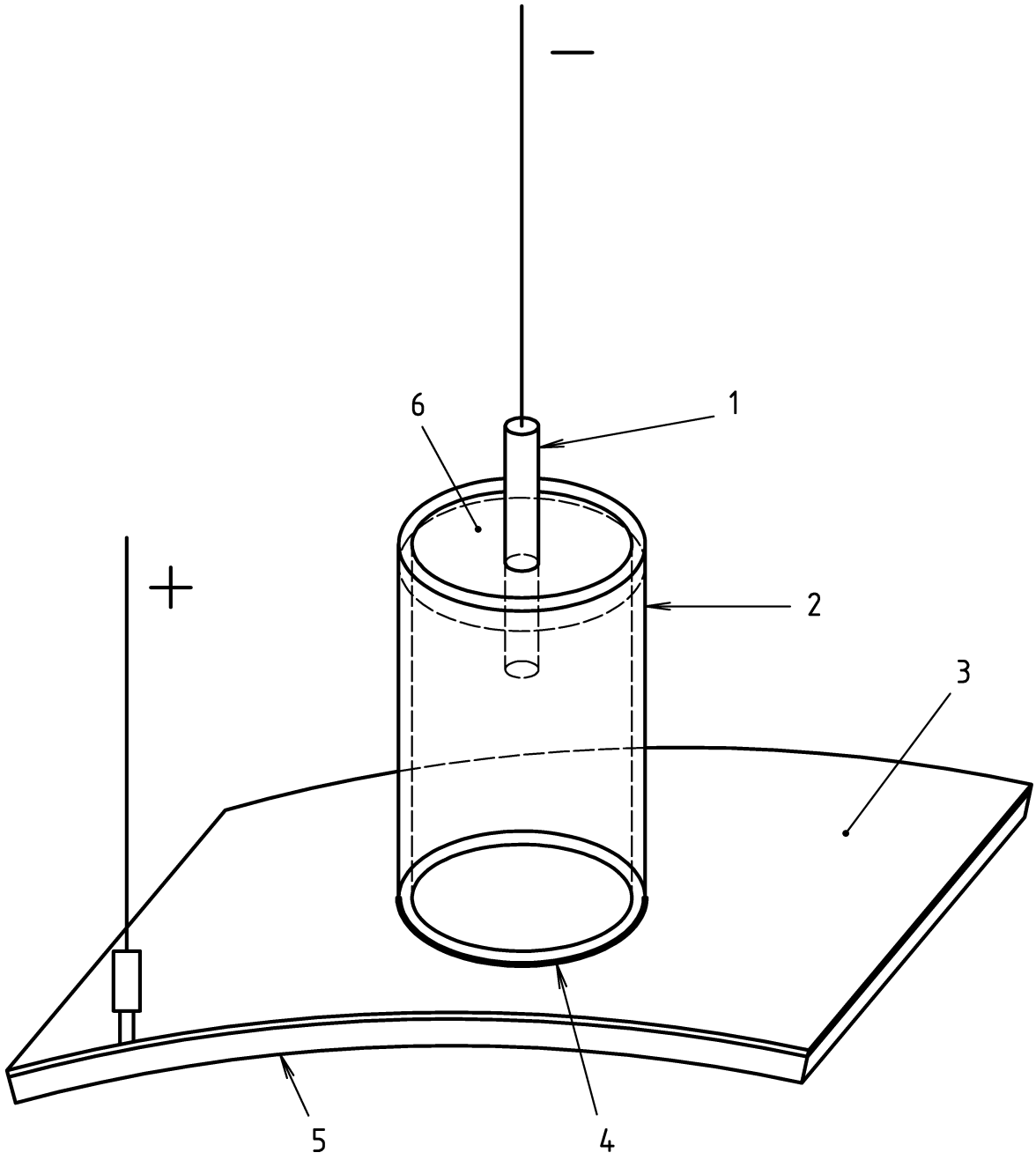
$$\alpha = \frac{R_S(100 \text{ days})}{R_S(70 \text{ days})}$$



Key

1 Tank in insulating material
2 Copper electrode introduced only at the time measurement
3 NaCl solution
4 Tube with anti-corrosion coating
5 Sealing
6 Steel tube

Figure F.1 - For small diameter



Key

1 Copper electrode introduced only at the time measurement
2 Tank in insulating material
3 Anti-corrosion coating
4 Sealing
5 Steel tube
6 NaCl solution

Figure F.2 - For large diameter tube

Annex G
(normative)

Elongation at break test

G.1 General

The test consists of measuring the elongation at break of a polyethylene sample taken from the tube in accordance with the requirements of ISO 527-2.

G.2 Apparatus

The apparatus shall consist of a tensile testing machine which makes it possible to record the force and which can operate at a constant speed.

G.3 Sampling

The test shall be carried out on a sample of polyethylene free from adhesive and taken from a tube in the extruded direction.

The polyethylene layer may be applied without adhesive in order to make sampling easier.

G.4 Procedure

The procedure shall be in accordance with ISO 527-2.

The size of the sample to be taken shall make it possible to make up five test specimens of type 1B, 5A or 5B (see Figures 1 and A.2 in ISO 527-2:1993).

The elongation at break for five test pieces shall be measured using a pulling speed as given in Table G.1:

Table G.1 — Pulling speed

Specimen type	**Pulling speed** mm/min	**Tolerance** %
1B	50	± 10
5A	25	± 10
5B	10	± 20

G.5 Results

The elongation shall be recorded as a percentage using the equation:

$$A_o = \frac{L_1 - L_o}{L_o} \text{ x } 100$$

where

— L_o is the initial distance between the gauge marks on the central part of the test specimen, expressed in millimetres (mm);

— L_1 is the distance between the gauge marks at break, expressed in millimetres (mm).

The arithmetic mean of five results (A_o) shall be determined.

Annex H
(normative)

Ultraviolet irradiation and thermal stability tests

H.1 Resistance to ultraviolet irradiation

H.1.1 General

The test consists of subjecting polyethylene test pieces taken from the tube coating to the continuous irradiation of a xenon lamp under given temperature and humidity conditions.

The change in the polyethylene shall be assessed by the variation in its elongation at break or in its melt flow rate.

H.1.2 Apparatus

The apparatus shall consist of an irradiation chamber equipped with a xenon lamp (see ISO 4892-2).

H.1.3 Sampling

The test shall be carried out on a sample of polyethylene free from adhesive and taken from a tube in the extruded direction.

H.1.4 Procedure

The size of the sample to be taken shall make it possible to make up 10 test specimens of type 1B, 5A or 5B (see Figures 1 and A.2 in ISO 527-2:1993).

The test pieces shall be cut in the direction of extrusion of the coating.

The test specimen shall be exposed under the following conditions:

— artificial weathering (see Table 1 - method A in ISO 4892-2:1994);

— black standard temperature BST (65 ± 3) °C;

— relative humidity (65 ± 5) %;

— spray cycle : (18 ± 0,5) min spray/(102 ± 0,5) min dry;

— total radiant energy 5 GJ/m²;

— continuous exposure.

The elongation at break between the gauge length of five irradiated test pieces shall be measured. The speed shall be in accordance with annex G.

An alternative procedure may be used. On a sample before and after irradiation taken on the conditions defined above, three melt flow rate measurements shall be carried out in accordance with ISO 1133.

H.1.5 Results

H.1.5.1 Elongation at break

The elongation (A_n) for each specimen shall be expressed as a percentage using the equation:

$$A_n = \frac{L_1 - L_o}{L_o} \text{ x } 100$$

where

L_o is the initial distance between the gauge marks on the central part of the test specimen, expressed in millimetres (mm);

L_1 is the distance between the gauge marks at break, expressed in millimetres (mm).

The arithmetic mean (A) shall be expressed as a percentage using the equation:

$$A = \frac{A_1 - A_o}{A_o} \text{ x } 100$$

where

A_o is the arithmetic average of five single values before exposure (see annex G), expressed in percent (%);

A_1 is the arithmetic average of five single values after exposure, expressed in percent (%).

H.1.5.2 Melt flow rate

The variation of the melt flow rate (ΔMFR) after exposure shall be expressed as a percentage using the following equation:

$$\Delta MFR = \frac{MFR_1 - MFR_0}{MFR_0} x100$$

where

MFR_o is the initial melt flow rate measured before exposure, expressed in percent (%).

MFR_1 is the melt flow rate measured after exposure, expressed in percent (%).

H.2 Thermal stability

H.2.1 General

The test consists of subjecting polyethylene test pieces taken from the coating to the effect of dry heat from a thermostatically controlled oven.

The change in the polyethylene shall be assessed by the variation in its melt flow rate.

H.2.2 Apparatus

The apparatus shall consist of a thermostatically controlled oven with air circulation which can maintain a test temperature within ± 2 °C.

H.2.3 Sampling

The test shall be carried out on a sample of polyethylene free of adhesive and taken from a tube.

H.2.4 Procedure

The test shall be carried out at the temperature of (100 ± 2) °C.

The test piece shall be placed in an oven set to this temperature and maintained for an exposure time of 2 400 h.

Three melt flow rate measurements shall be undertaken on the test piece in accordance with ISO 1133.

The arithmetic mean of the results obtained MFR_1 shall be calculated. The melt flow rate MFR_o shall be calculated in accordance with ISO 1133 on a test piece of identical shape which has not been placed in the oven.

H.2.5 Results

The variation of the melt flow rate (ΔMFR) after 2 400 h shall be expressed as a percentage, using the following equation:

$$\Delta MFR = \frac{MFR_1 - MFR_0}{MFR_0} \times 100$$

where

MFR_o is the initial melt flow rate measured before exposure, expressed in percent (%);

MFR_1 is the melt flow rate measured after exposure, expressed in percent (%).

Annex J
(normative)

Cathodic disbondment test

J.1 General

The test consists of assessing the resistance to disbondment of damage to the coatings when exposed to cathodic polarisation.

The test may be performed on the coated tube or component without cutting test specimens.

J.2 Apparatus

J.2.1 Electrical source

The source for the voltage and the current shall consist of a stabilised *DC* power unit [1)]. A cathodic polarization potential of – 1 500 mV to a saturated calomel reference electrode, (equivalent to U_H = - 1260 mV where U_H means the potential of the standard hydrogen electrode) shall be maintained.

— "*E*" is the potential of the "working electrode" with regards to the "reference electrode";

— "*V*" is the difference of potential between the "working electrode" and the "auxiliary electrode".

J.2.2 Electrolytic cell

For tests, typical test cell configurations are shown in Figure J.1 for large diameter tubes and in Figure J.2 for small diameter tubes.

The electrolytic cell shall comprise of:

a) a rigid plastic tube of an internal diameter of either 50 mm, or a minimum of 10 mm diameter more than the maximum disbonded area allowable from this standard. The height shall be such that the total volume of the electrolyte is equal or greater than 150 ml with a minimum height of the electrolyte of 70 mm;

b) a rigid plastic cover in which holes shall be drilled to allow the passage of the electrodes and any other measuring instruments deemed necessary, and to allow the escape of hydrogen.

J.2.3 Electrodes

J.2.3.1 Reference electrode

The saturated calomel reference electrode or a suitable type of reference electrode to give an equivalent potential (see J.2.1) shall be placed in an electrode holder situated in a glass tube with a porous diaphragm. The end of this assembly shall be placed approximately 10 mm from the surface of the coating and approximately 20 mm from the coating defect.

The reference electrode used shall be suitable for the test temperature required.

[1)] The current source should be capable of supplying 20 mA to each test area simultaneously.

J.2.3.2 Auxiliary electrode

The auxiliary electrode shall consist of an inert material, e.g. platinum wire of 0,8 mm to 1,0 mm diameter. It shall be immersed in the electrolyte [2)].

The ratio of the surface area of the anode and the cathode shall be greater than 1.

J.2.3.3 Working electrode (cathode)

The working electrode is represented by the artificial defect which shall be 6 mm in diameter, with a maximum depth of 0,5 mm in the steel substrate (see J.3.5 and Figure J.3).

J.2.4 Electrolyte

J.2.4.1 The electrolyte shall consist of a solution of 3 % NaCl concentration in distilled or deionised water. The solution shall be made from annalar grade sodium chloride.

J.2.4.2 The pH at the ambient temperature during the test shall be in the range of 6 to 8,5.

J.2.4.3 The height of the electrolyte in the cell shall be (75 $\pm$ 5) mm.

J.2.5 Test temperature

For test temperatures within the requirements of 8.13, the electrolyte shall not be cooled.

For test temperatures outside the requirements of 8.13, the test method shall be determined by agreement.

J.2.6 Heating equipment

Suitable heating equipment shall be used to establish and to maintain the test temperature of the sample.

If not heated in an oven the temperature shall be checked on the artificial defect by an appropriate mean; e.g. a temperature sensor.

J.3 Sampling

J.3.1 The test specimen shall be cold cut from a coated tube or components and shall have a minimum size of 80 mm $\times$ 80 mm, unless the test is performed on the body of the coated tube or component.

J.3.2 Tests samples shall not be taken from the weld area.

J.3.3 For each sample the thickness of the area of the coating subject to the test, shall be measured and recorded.

J.3.4 The integrity of the coating on all test samples shall be checked by holiday detection (see annex B).

J.3.5 A 6 mm diameter hole (see Figure J.3) shall be drilled through the coating in the center of the test specimen using a standard drill bit. The depth of the drilled hole in the steel substrate shall not exceed 0,5 mm. At the initiation of the test the total surface area subject to the test shall be free from residual coating.

J.3.6 The test area shall be degreased using a suitable solvent and then rinsed with potable water and subsequently dried.

[2)] To approximatly within 10 mm over the coating defect.

J.4. Procedure

The plastic tube forming the electrolytic cell shall be sealed using a suitable sealant, e.g. a chemically inert adhesive. The artificial defect shall be in the centre of the cell.

After the test the cell with the electrolyte shall be removed. The test specimen shall be rinsed with water and dried.

After drying the area of the coating subjected to the test it shall be examined according to the following procedure.

The steel surface without the removed coating shall be divided into 60° segments with radial lengths and shall be marked.

The disbondment shall be defined as the area of the coating which is easily peeled from the steel substrate.

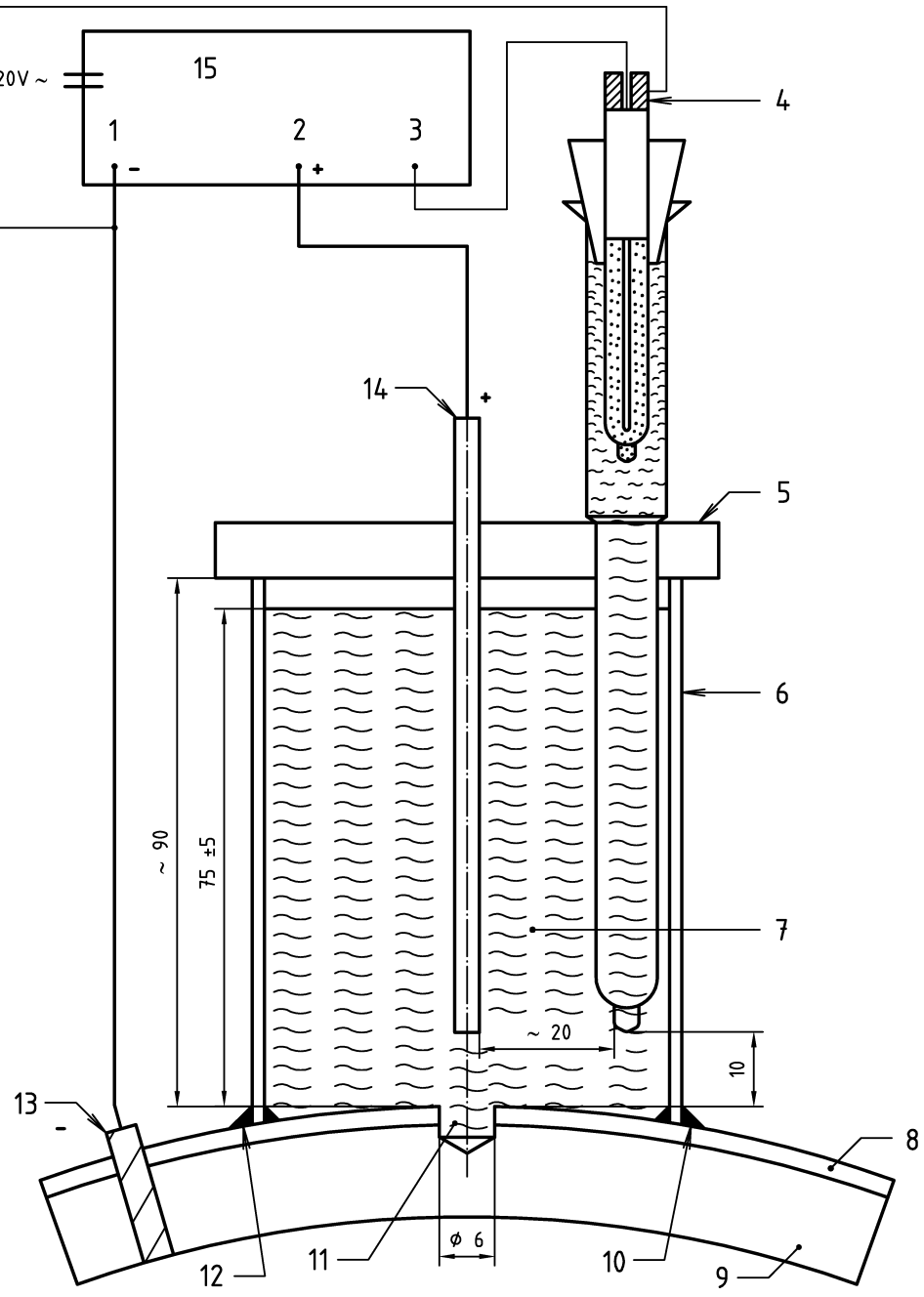
The radial lengths shall be determined from each of the 60° segments, from the edge of the artificial defect to the edge of the disbonded area of the coating.

J.5 Results

The result of the cathodic disbondment test is defined as the arithmetic mean value of the six single values for the radial lengths in millimetres and shall be rounded to the full millimetre.

The maximum value of disbondment which may not be part of the six values shall be recorded.

Dimensions in millimetres

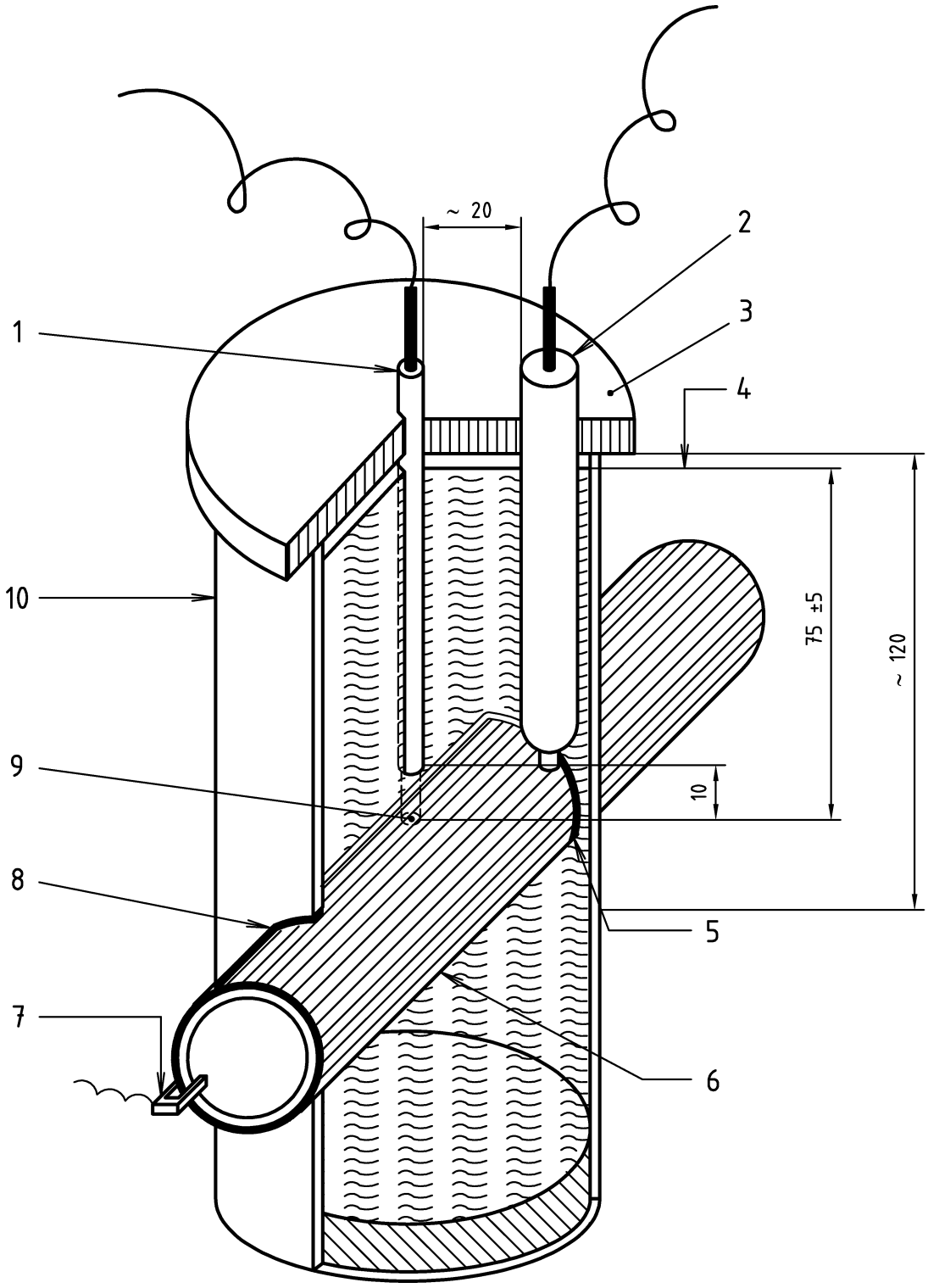


Key

1 Working electrode
2 Electrode (anode)
3 Electrode (reference)
4 Saturated calomel reference electrode
5 Plastic cover
6 Plastic tube, minimum internal ∅ 50 mm
7 Electrolyte ≥ 150 ml
8 Coating
9 Steel test piece
10 Sealing material
11 Artificial defect
12 Sealing material
13 Electrode (cathode)
14 Platinium electrode ∅ 0,8 mm to 1,0 mm (anode)
15 Potentiostat

Figure J.1 - Electrolytic cell

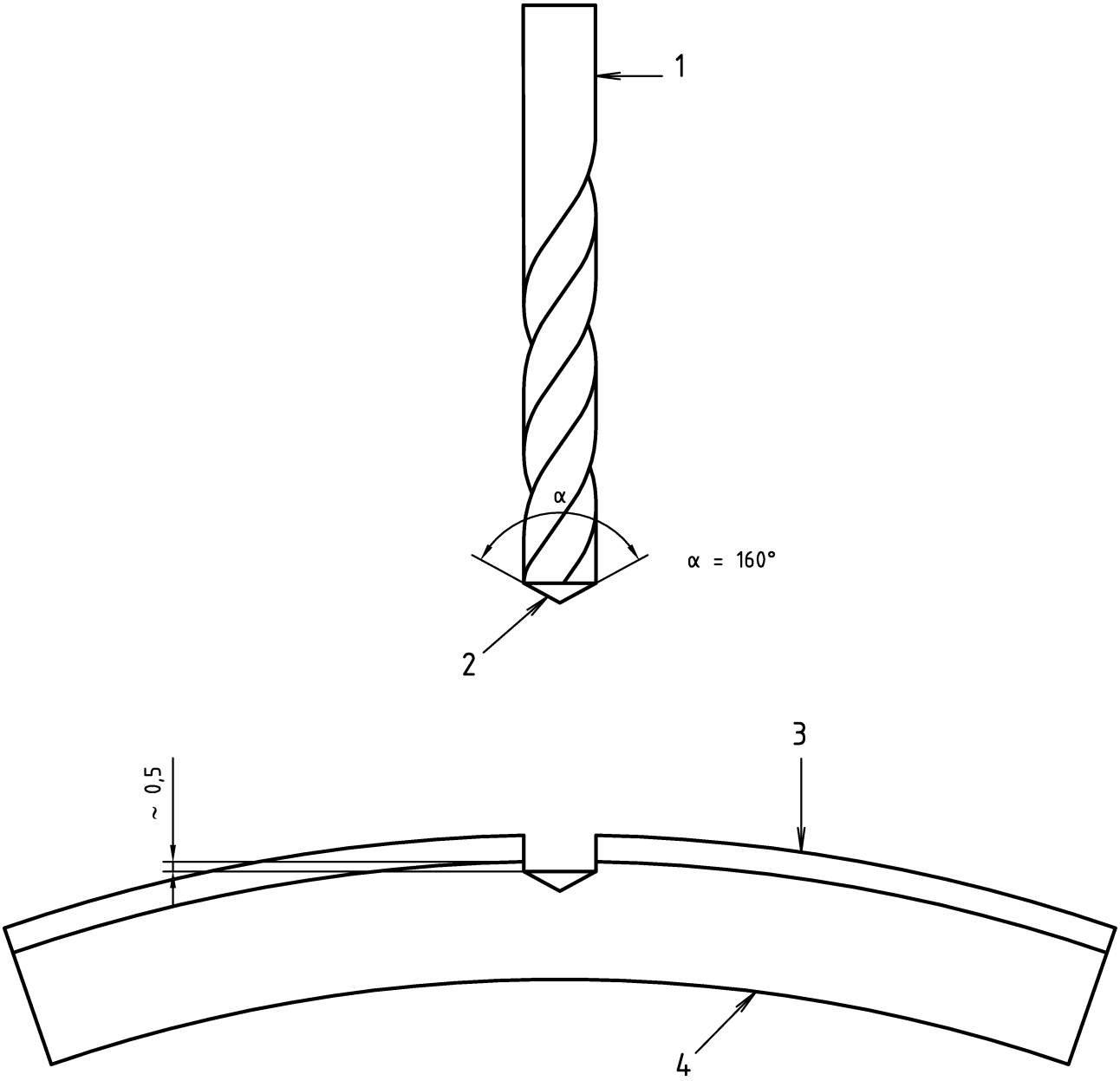
Dimensions in millimetres



Key

1 Platinium electrode ∅ 0,8 mm to 1,0 mm (anode)
2 Saturated calomel reference electrode
3 Plastic cover
4 Electrolyte level
5 Sealing material
6 Coated tube
7 Working electrode (cathode)
8 Sealing material
9 Artificial defect ∅ 6 mm
10 Plastic tube, minimum internal ∅ 50 mm

Figure J.2 - Electrolytic cell for small diameter tube



Key

1 Fluted and mill face mill ∅ 6 mm
2 Conic end
3 Coating
4 Steel

Figure J.3 - Production of artificial defect

Annex K
(normative)

Types of inspection documents

Types of inspection documents are given in Table K.1.

Table K.1

Standard designation	Document	Type of control	Contents of document	Delivery conditions	Document validated by
2.1	Declaration of compliance with the order	Non-specific	Without mention of test results	In accordance with the requirements of the order, and if required, also in accordance with official regulations and the corresponding technical rules	The manufacturer
2.2	Test report		With mention of test results carried out on the basis of non specific inspection and testing		
2.3	Specific test report	Specific	With mention of test results carried out on the basis of specific inspection and testing		
3.1.A	Inspection certificate 3.1.A			In accordance with official regulations and the corresponding technical rules	The inspector designated in the official regulations
3.1.B	Inspection certificate 3.1.B			In accordance with the specification of the order, and if required, also in accordance with official regulations and the corresponding technical rules	The manufacturer's authorized representative independent of the manufacturing department
3.1.C	Inspection certificate 3.1.C			In accordance with the specifications of the order	The purchaser's authorized representative
3.2	Inspection report 3.2				The manufacturer's authorized representative independent of the manufacturing department and the purchaser's authorized representative

Annex L
(informative)

A-Deviation

A-deviation: National deviation due to regulations, the alteration of which is for the time being outside the competence of the CEN/CENELEC member.

This European Standard does not fall under any Directive of the EC.

In the relevant CEN/CENELEC countries, these A-deviations are valid instead of the provisions of this European Standard until they have been removed.

Netherlands

— Besluit van 15 januari 1993, houdende regels met betrekking tot het opslaan van vloeistoffen in ondergrondse tanks (Besluit opslaan in ondergrondse tanks) ;

— Besluit van 12 maart 1996, houdende regels voor tuinbouwbedrijven met bedekte teelt (Besluit tuinbouwbedrijven met bedekte teelt milieubeheer) ;

— Commissie Preventie van Rampen door gevaarlijke Stoffen CPR 9-1 ;

— Commissie Preventie van Rampen door gevaarlijke Stoffen CPR 9-6 ;

— NEN 6902 d.d. september 1986 "Uitwendige bekleding met PE van ondergronds te leggen stalen buizen en hulpstukken".

With respect to subclause 8.3 "Thickness of the coating system" of this European Standard, the following will be applicable in the Netherlands:

— Class 1 coatings as defined in Table 2 will not be allowed in the Netherlands.

With respect to subclause 8.7 "Peel force" of this European Standard, the following will be applicable in the Netherlands:

— For pipes up to 200 mm outside nominal diameter, the requirements for the peel force at 23 °C will, in lieu of all the requirements stated in Table 4, be as indicated below for Types 1, 2 and 3:

  — absolute minimum 35 N/10 mm

  — minimum average 50 N/10 mm

Bibliography

EN ISO 9001, *Quality management systems – Requirements (ISO 9001:2000).*

ISO 8503-1, *Preparation of steel substrates before application of paints and related products – Surface roughness characteristics of blast-cleaned steel substrates – Part 1: Specifications and definitions for ISO surface profile comparators for the assessment of abrasive blast-cleaned surfaces.*

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