BRITISH STANDARD

BS EN
62237:2005

Live working — Insulating hoses with fittings for use with hydraulic tools and equipment

The European Standard EN 62237:2005 has the status of a British Standard

ICS 13.260; 29.240.99; 29.260.99

BSI
British Standards

National foreword

This British Standard is the official English language version of EN 62237:2005. It was derived by CENELEC from IEC 62237:2003.

The CENELEC common modifications have been implemented at the appropriate places in the text. The start and finish of each common modification is indicated in the text by tags ⟦C⟩ ⟨C⟧. Where a common modification has been introduced by amendment, the tags carry the number of the amendment. For example, the common modifications introduced by CENELEC amendment A11 are indicated by ⟦C11⟩ ⟨C11⟧.

The UK participation in its preparation was entrusted to Technical Committee PEL/78, Tools for live working, which has the responsibility to:

— aid enquirers to understand the text;

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

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

The UK technical committee, PEL/78, actively participated in the development of EN 62237 but consistently opposed some of its provisions. In particular, the committee is concerned that the electrical test severely restricts the availability of non-conductive hoses used for live working. It is expected that the tests will be reviewed as part of the maintenance process for EN 62237.

The view of the committee is that this standard imposes more onerous test requirements than have previously been necessary for these applications, e.g. in SAE J343 and SAE J517, with the consequence that users will have a more limited choice of non-conductive hoses without any real increase in safety and those that meet the requirements attract an increase in cost.

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

Summary of pages

This document comprises a front cover, an inside front cover, page i, a blank page, the EN title page, pages 2 to 31 and a back cover.

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EUROPEAN STANDARD **EN 62237**

NORME EUROPÉENNE

EUROPÄISCHE NORM April 2005

ICS 13.260; 29.240.99; 29.260.99

English version

Live working – Insulating hoses with fittings for use with hydraulic tools and equipment
(IEC 62237:2003, modified)

Travaux sous tension – Conduits flexibles isolants avec raccords utilisés avec les outils et matériels hydrauliques (CEI 62237:2003, modifiée)

Arbeiten unter Spannung – Isolierende Schlauchleitungen zur Verwendung für hydraulische Geräte und Ausrüstungen (IEC 62237:2003, modifiziert)

This European Standard was approved by CENELEC on 2005-03-01. CENELEC 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 Central Secretariat or to any CENELEC 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 CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

CENELEC
European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Ref. No. EN 62237:2005 E

Foreword

The text of the International Standard IEC 62237:2003, prepared by IEC TC 78, Live working, together with the common modifications prepared by the Technical Committee CENELEC TC 78, Equipment and tools for live working, was submitted to the formal vote and was approved by CENELEC as EN 62237 on 2005-03-01.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2006-03-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2008-03-01

Annex ZA has been added by CENELEC.

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Endorsement notice

The text of the International Standard IEC 62237:2003 was approved by CENELEC as a European Standard with agreed common modifications.

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INTRODUCTION

This International Standard has been prepared in accordance with the requirements of IEC 61477.

〖C〉 *Text deleted* 〈C〗

LIVE WORKING – INSULATING HOSES WITH FITTINGS FOR USE WITH HYDRAULIC TOOLS AND EQUIPMENT

1 Scope

This International Standard is applicable to mobile insulating hoses with fittings used with hydraulic tools and equipment for live working at nominal voltages exceeding 1 kV r.m.s. at power frequency.

The use under D.C. conditions is not covered by this standard.

Insulating hoses with fittings are used to provide a connection between the hydraulic tool and the pump which are at different potentials. They are not considered as a fixed component of a live working device (e.g. aerial device). They can be connected and disconnected under negligible pressure. They can be directly handled by the user.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60060-1:1989, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60060-2, *High-voltage test techniques – Part 2: Measuring systems*

IEC 60212:1971, *Standard conditions for use prior to and during the testing of solid electrical insulating materials*

IEC 60417-DB:2002[1)], *Graphical symbols for use on equipment*

〖C〉 *Text deleted* 〈C〗

IEC 61477:2001, *Live working – Minimum requirements for the utilization of tools, devices and equipment*
Amendment 1:2002[2)]

1) "DB" refers to the IEC on-line database.

2) There exists a consolidated edition 1.1 (2002) that includes edition 1 (2001) and its Amendment 1 (2002).

3 Terms and definitions

〖C〗 For the purpose of this document, the following terms and definitions apply. 〈C〗

3.1
insulating hose with fittings
insulating and pressure resistant hose and fittings which are used to provide a connection between parts of hydraulic equipment at different electric potentials

[Definition 12.1.4 of IEC 60743]

3.2
insulating hose
insulating and pressure resistant hose without fittings

3.3
maximum operating pressure
pressure specified by the manufacturer which shall not be exceeded during the use of the insulating hose

3.4
insulating liquid (for hydraulic equipment)
insulating liquid which is used for the transmission of hydraulic energy between parts at different electric potentials

[IEV 651-11-02]

4 Requirements

4.1 Protection against corrosion

Metal parts shall be resistant to corrosion either by their own composition or by being suitably treated.

NOTE When two metallic materials are used, they should be selected in such a way as to avoid electrolytic action.

4.2 Finishing and mechanical protection

The various components shall be designed so that they do not create the potential for injury.

4.3 Insulating parts

Insulation is achieved by using a proper length of insulating hose. End fittings shall not impair the dielectric properties of the tool.

The insulating parts shall be characterized by a special colour that shows their insulating property.

NOTE Orange is a preferred colour to indicate insulating parts.

4.4 Conductive parts

All conductive parts fixed to insulating parts shall be easily identifiable.

The exterior surface of the insulating part that contains a conductive element shall be clearly marked by a line indicating the extreme position of the internal conductive part.

All conductive parts shall be designed and manufactured so as to limit the risk of short-circuits.

4.5 Markings

Each insulating hose with fittings shall be marked with the following permanent markings:

– manufacturer's name or trademark:
– date of manufacture (month and year) and possibly identification number;
– maximum operating pressure (bar or MPa);
– insulating length of the insulating hose with fittings;
– symbol IEC-60417-5216(DB:2002-10) – Suitable for live working; double triangle (see Annex A);

NOTE The exact ratio of the height of the figure to the base of the triangle is 1,43. For the purpose of convenience, this ratio can be between the values of 1,4 and 1,5.

– [C〉 number of the relevant European Standard immediately adjacent to the symbol (EN 62237). 〈C]

The tolerance of the insulating length is ±50 mm.

Markings shall be clearly legible to a person with normal or corrected vision, without additional magnification.

The markings shall be resistant and shall not reduce the performance of the insulating hose with fittings.

4.6 Instructions for use

Each insulating hose with fittings shall be supplied with the manufacturer's written instructions for use and care. These instructions shall be prepared in accordance with the general provisions given in IEC 61477.

These instructions shall include as a minimum:

– characteristics of required insulating liquid(s),

NOTE When the insulating hoses with fittings are to be used at low temperatures, user and manufacturer should make sure that information on adequate insulating liquid(s) are included.

– minimum burst pressure;
– dimensions of the fittings, with tolerance ±1 mm;
– diameters (internal and external) of the insulating hose, with tolerance ±2 mm;
– minimum bending radius, with tolerance ±25 mm;
– weight;
– instructions for cleaning, storage and transportation;
– instructions for periodic testing, possible repair and disposal of the hose.

5 Type tests

5.1 General

In order to show compliance with this standard, the manufacturer shall provide evidence that the following tests have been carried out successfully.

Insulating hoses with fittings can be used indoors and outdoors. Unless otherwise specified for a particular test or measurement, the tests are carried out in a normal ambient atmosphere, (see IEC 60212):

– temperature range 15 °C to 35 °C;

– relative humidity 45 % to 80 %.

The insulating liquid used for the tests shall meet the characteristics specified by the manufacturer in the instructions for use (see 4.6). The references of liquid used for the type tests shall be recorded with the test results.

5.1.1 Preparation of test pieces

Before each test, the test pieces shall be prepared by cleaning using isopropanol (CH_3-CH(OH)-CH_3) and dried in air at room temperature for a period of not less than 15 min, before being filled up if the need arises. Before each electrical test, the parts of the test pieces to be in contact with electrodes shall be covered with conductive adhesive tape, this to be done after the humidity conditioning when the case arises.

Tests are carried out on three groups of test pieces:

Group I : the test piece is the whole insulating hose with fittings.

Group II : each test piece consists of an insulating hose, at least 600 mm long, filled with insulating liquid at atmospheric pressure, and made watertight with suitable stoppers, which let free the wall section of the hose (see Figure 1). Several test pieces may be formed from the same insulating hose with fittings. The hose from which the test pieces are cut shall be subject to, and pass the hydrostatic test defined in 5.4.1 before the cut is made.

Group III: each test piece consists of an insulating hose, at least 1 200 mm long, filled with insulating liquid at atmospheric pressure, and made watertight with suitable stoppers, which let free the wall section of the hose (see Figure 1). Several test pieces may be formed from the same insulating hose with fittings. The hose from which the test pieces are cut shall be subject to, and pass the hydrostatic test defined in 5.4.1 before the cut is made.

5.1.2 Number of test pieces and test plan

Each type test shall be carried out on three test pieces. If one or more test pieces fail during the type test, the test shall be considered as failed. Type testing requires 27 test pieces.

The tests shall be carried out following Table B.1, in the order indicated in the table. The group of test pieces to be used for the test is also given in Table B.1.

When differences between various designs of insulating hose with fittings are limited in number, tests that are unaffected by the differing characteristics of the hoses can be carried out on a single design of hose with fittings and the results can be used for the other designs.

5.2 Visual inspection and dimensional check

5.2.1 Visual inspection

Each component of insulating hose with fittings (to be used as test pieces of group I or from which group II and/or group III test pieces will be cut) shall be visually inspected to check for manufacturing faults and ensure it functions properly and does not create the potential for injury.

NOTE Visual inspection means visual inspection by a person with normal or corrected vision without additional magnification.

5.2.2 Dimensional check

Each insulating hose with fittings (to be used as test pieces of group I or from which group II and/or group III test pieces will be cut) shall be measured to ensure that insulating length, dimensions of the fittings, diameters of the insulating hose and minimum bending radius match the manufacturer's rated dimensions. The tolerances which are applied are those required in 4.5 and 4.6.

5.3 Electric tests

These tests are carried out in order to verify on one hand the ability of the insulating hose to withstand the electrical stress

– before exposure to humidity;
– after exposure to humidity;
– after infliction of a cut;

and on the other hand to verify the ability of the insulating hose with end fittings to withstand the maximum voltage rating.

5.3.1 Electric tests on insulating hoses

5.3.1.1 General test conditions

The a.c. tests and measurements shall be carried out at a frequency of 50 Hz or 60 Hz.

Conditioning in a humid atmosphere is carried out in accordance with IEC 60212.

The test location shall be at the standard atmospheric conditions given in Table I of IEC 60212, i.e. with a temperature range from 15 °C to 35 °C.

The measuring equipment shall be at least 2 000 mm from the high voltage (HV) electrode. The test arrangement is shown in Figure 2. The measuring leads, shunt and optional protective gap shall be shielded and earthed. The test piece shall be mounted approximately 1 000 mm above the ground on an insulating support. A voltage of 100 kV r.m.s. at power frequency shall be applied between the electrodes and the current passing through the test piece shall be measured, in accordance with IEC 60060-1 and IEC 60060-2.

The specified acceptable current are given in r.m.s. values. The phase difference between current and voltage is measured as follows:

– current (earth end): by passing it through a known impedance (lower than 10 000 Ω);
– voltage (line end): by means of an appropriate divider.

5.3.1.2 Test before exposure to humidity

This test shall be carried out on three group II test pieces.

After at least 24 h in the ambient atmosphere of the test area, the current I_1 is measured at an a.c. voltage of 100 kV r.m.s. at power frequency, applied for 1 min between the electrodes which are placed (300 ± 5) mm apart. The maximum current and the phase angle φ_1 between current and voltage are recorded.

During the test, there shall be no sign of flashover or puncture of any of the test pieces. The current I_1 measured shall not exceed 10 µA. The phase angle φ_1 shall be larger than 80°.

5.3.1.3 Test after exposure to humidity

This test shall be carried out on three group II test pieces.

The test pieces shall be placed in a chamber and subjected to the following conditioning: 168 h/23C/93 % according to Table I of IEC 60212.

At the end of this period, the test pieces shall remain in an atmosphere of 93 % relative humidity and be tested upon return to the ambient conditions of the test area. After the test pieces have been lightly wiped with a dry cotton cloth, the current I_2 and phase angle φ_2 are measured under the same conditions as I_1 and φ_1.

During this test, there shall be no sign of flashover or puncture of any of the test pieces. The current I_2 measured shall not exceed 50 µA. The phase angle φ_2 shall be larger than 40°.

5.3.1.4 Test after the infliction of a cut on hoses

This test shall be carried out on three group II test pieces.

NOTE A cut of the external surface should affect only its electrical withstand. If the cut was too severe, the hose would burst.

A cut shall be made on the surface of each test piece in the longitudinal way. The surface shall be cut until the meshed fibres of the hose are reached. The dimensions of the cut shall be:

– length: (20 ± 2) mm

– width: $(0{,}1\ ^{+0{,}1}_{0})$ mm

For hoses without fibre reinforcement or construction, the cut shall consist of a cut made with a knife, and having a length of (20 ± 2) mm and a depth equal to 50 % of the wall thickness.

The cut shall be inflicted at a minimum distance of 30 mm from one of the electrodes (see Figure 3).

The test pieces shall be completely immersed in the horizontal position in water having a resistivity of (100 ± 15) Ω·m (IEC 60060-1) and be subjected to this conditioning for 24 h/23C/water (IEC 60212). Each test piece shall be taken out of the water and the liquid film removed by wiping with a clean and dry fibre free absorbent cloth.

The test specified in 5.3.1.2 shall be carried out again within a period of not more than 5 min following the drying of the hose. This time the current is not measured.

During the test, there shall be no sign of flashover or puncture of any of the test pieces.

5.3.1.5 Dielectric wet test

This test shall be carried out on three group III test pieces. It shall not use material within 100 mm of the end of the hose. The electrodes, made with three or four turns of copper or aluminium soft wire from 3 mm to 4 mm in diameter, shall be (1 000 ± 5) mm apart.

The test location shall be at the standard ambient conditions of IEC 60212, with a temperature range from 15 °C to 35 °C.

The test arrangement is shown in Figures 4 and 5. The test piece shall be inclined at an angle of (45 ± 5)°, and the rain shall make an angle of (90 ± 5)° with the test piece.

A voltage of 100 kV r.m.s. at power frequency shall be applied between the electrodes. The test piece shall not be pre-wetted before voltage application; spray and voltage shall be applied simultaneously for 1 h.

The wet test is carried out in accordance with the following procedure:

– average precipitation rate: 1,0 mm/min to 1,5 mm/min;
– water resistivity: (100 ± 15) Ω·m.

The test shall be considered successful if there is

– no flashover, sparkover or puncture,
– no tracking or erosion on the surface observed with the naked eye.

5.3.2 Dielectric test on insulating hose with fittings

Under consideration.

5.4 Mechanical tests

5.4.1 Hydrostatic test

This test shall be carried out on all insulated hoses with fittings.

All hoses, according to type or use, shall be hydrostatically tested to the maximum operating pressure plus 50 % for a period of (60 ± 5) s with each style or type assembly fitting attached.

There shall be no evidence of leakage, failure or distress to the complete assembly.

5.4.2 Fatigue test

This test shall be carried out on three group I test pieces.

The insulating hoses shall withstand simultaneously cycles of pressure increase and cycles of folding on the part of the hose where the metallic fitting is fixed. The testing device is described in Figure 6. The hose is linked to a hydraulic tool (shearing machine, press). The whole device is then fixed in order to make an end fixture for the metallic fitting.

5.4.2.1 Test procedure

The hydraulic cycle is defined as follows:

– pressure increase until the maximum operating pressure is reached in (45 ± 5) s;
– pressure maintained at the maximum operating pressure for (10 ± 5) s;
– decompression in (5 ± 3) s.

The total duration of hydraulic cycle shall be (60 ± 5) s.

During the hydraulic cycle, 40 bending cycles shall be applied to the hose with a mass equal to (10 ± 0,5) kg. The insulating hoses shall withstand 75 pressure increase cycles and 3 000 bending cycles.

After these cycles:

– the pressure shall be gradually increased to the maximum operating pressure and held constant for $(3\ ^{+0,1}_{0})$ min;
– the pressure shall be then gradually increased to 1,5 times the maximum operating pressure and held constant for $(3\ ^{+0,1}_{0})$ min;
– after this, the pressure shall be increased until the hose bursts. The increase is between 1,5 MPa/s and 2,5 MPa/s.

5.4.2.2 Acceptance criteria

No defects shall occur when the pressure is kept at the maximum operating pressure and at 1,5 times this pressure.

NOTE Failure is often indicated by leakage or swelling.

The burst pressure, after fatigue test, shall be greater than or equal to twice the maximum operating pressure.

5.4.3 Mechanical impulse test

This test shall be carried out on three group I test pieces.

Impulse testing shall be conducted with a new hose assembly (hose and fittings). The hose, bent to its minimum bend radius, shall be subjected to mechanical impulse with suitable equipment:

– hoses of less than 25,4 mm inside diameter shall be bent 180°;
– hoses of 25,4 mm inside diameter and over shall be bent 90°.

The test assembly free length of hose measured between fittings shall be calculated using the following formula:

$$L_{90} = \pi \frac{R}{2} + 2D_0$$

$$L_{180} = \pi R + 2D_0$$

where

L_{90} is the 90° bend free length;

L_{180} is the 180° bend free length;

R is the minimum bend radius;

D_o is the outer diameter of the hose.

The insulating liquid shall be circulated through the hose at the specified temperature with a tolerance of ±3 °C. The impulse rate shall be between 30 cycles per minute and 75 cycles per minute at the maximum operating pressure. Circulation of the test fluid shall be at a rate, which will maintain a uniform temperature. Cooling or heating of the test chamber shall not be permitted.

The impulse pressure curve shall fall entirely within the shaded area of Figure 7 and shall conform as closely as possible to the curve.

The test shall be considered as passed if no defect occurs during the 60 000 cycles of the test duration.

NOTE Because of the phenomenon of lamination, the characteristics of the test fluid can deteriorate during the test. The test fluid can be changed several times during the test if it is necessary.

5.4.4 Leakage test

This test shall be carried out on three group I test pieces.

A new hose on which end fittings have been attached for not longer than 30 days shall be subjected to a hydrostatic pressure equal to (70 ± 5) % of the specified minimum burst pressure for a period of (5 ± 0,5) min. The pressure is then reduced to zero, after which the (70 ± 5) % minimum burst pressure shall be reapplied for another (5 ± 0,5) min.

There shall be no leakage or evidence of failure. This test is to be considered as a destructive test and the test piece shall be subsequently destroyed.

5.4.5 Change in length test

This test shall be carried out on three group I test pieces.

Measurements for the determination of elongation or contraction shall be conducted on a previously untested new insulating hose with fittings having at least 300 mm length of free hose between fittings.

The hose shall be attached to the pressure source and pressurized to the maximum operating pressure plus (20 ± 5) % for a period of $(30\ ^{+0,5}_{0})$ s, after which time the pressure shall be released. After letting the hose at rest for a period of (30 ± 5) s following pressure release, reference marks 250 mm apart shall be accurately placed on the hose outer cover, midway between the hose fittings. This length of 250 mm is considered the initial length. The hose shall then be re-pressurized to the above referenced pressure for a period of $(30\ ^{+0,5}_{0})$ s, after which time, while the hose is pressurized, the distance between the reference marks shall be measured. This length shall be the final length.

The change in length shall be calculated using the following formula:

$$\text{Change (\%)} = 100\,\frac{\text{final length} - \text{original length}}{\text{original length}}$$

The test shall be considered as passed if the change in length of the hose does not exceed 5 %.

5.4.6 Burst test

This test shall be carried out on three group I test pieces.

Insulating hoses on which the end fittings have been attached for not longer than 30 days shall be subjected to a hydrostatic pressure increased at a constant rate so as to attain the specified minimum burst pressure within a period of time not less than 15 s nor more than 45 s.

The specified minimum burst pressure for insulating hoses shall be four times the maximum operating pressure.

There shall be no leakage, hose burst, or indication of failure below the specified minimum burst pressure.

5.4.7 Cold bend test

This test shall be carried out on three group I test pieces.

Hose assemblies shall be subjected to a temperature of (–25 ± 2) °C for (24 ± 0,5) h in a straight position. After this time and while still at the specified temperature, the test piece shall be evenly and uniformly bent over a mandrel having a radius equal to the minimum specified bend radius. Bending shall be accomplished within a period of time not less than 8 s nor more than 12 s.

Hoses of less than 25,4 mm nominal inside diameter shall be bent 180° over the mandrel and hoses of 25,4 mm nominal inside diameter and larger shall be bent 90° over the mandrel.

After bending, the test pieces shall be allowed to reach room temperature. Then, they shall be visually examined for cover cracks and subjected to the leakage test (see 5.4.4).

There shall be no cover cracks or leakage.

5.4.8 Durability of marking

This test shall be carried out on three group I test pieces.

The durability of the markings shall be verified by rubbing the marking vigorously, for at least 1 min with a piece of lint-free cloth dampened with water and then rubbing it for a further minimum of 1 min with a lint-free cloth dampened with isopropanol (CH_3-CH(OH)-CH_3).

The test shall be considered as passed if the markings remain legible and the characters do not smear.

NOTE Markings made by molding or engraving need not be subjected to this test.

6 Quality assurance plan

〚C〛 Annex C provides pieces of information related to the quality assurance plan. 〚C〛

7 Modifications

Before carrying out any modification to any characteristic of an insulating hose with fittings, during the execution of an order, the manufacturer shall obtain the agreement of the customer.

Certain modifications may require new type tests, in whole or in part according to the degree of modifications.

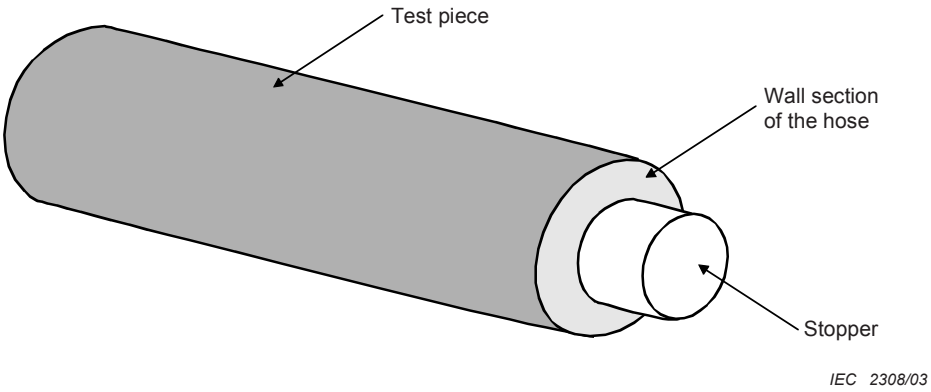


Figure 1 – Stopper for test piece (see 5.1.1)

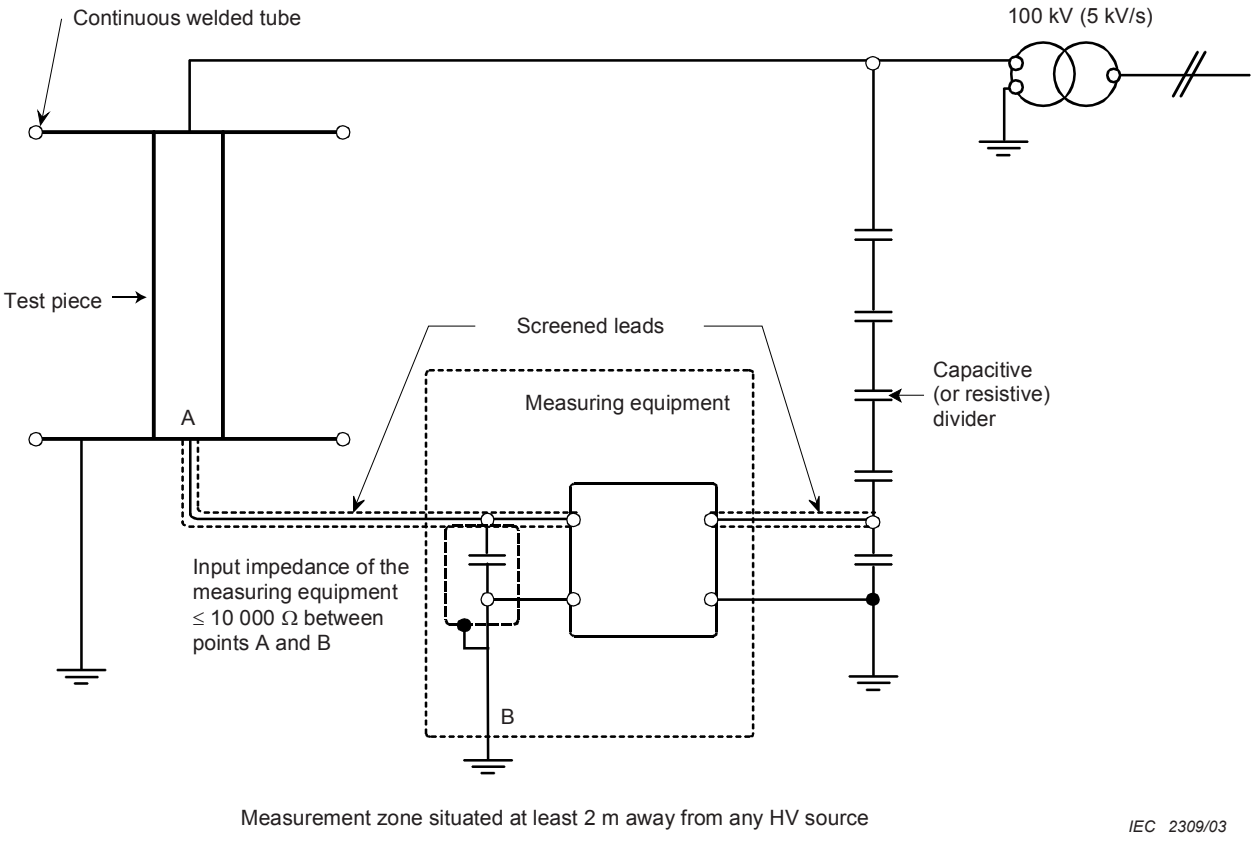
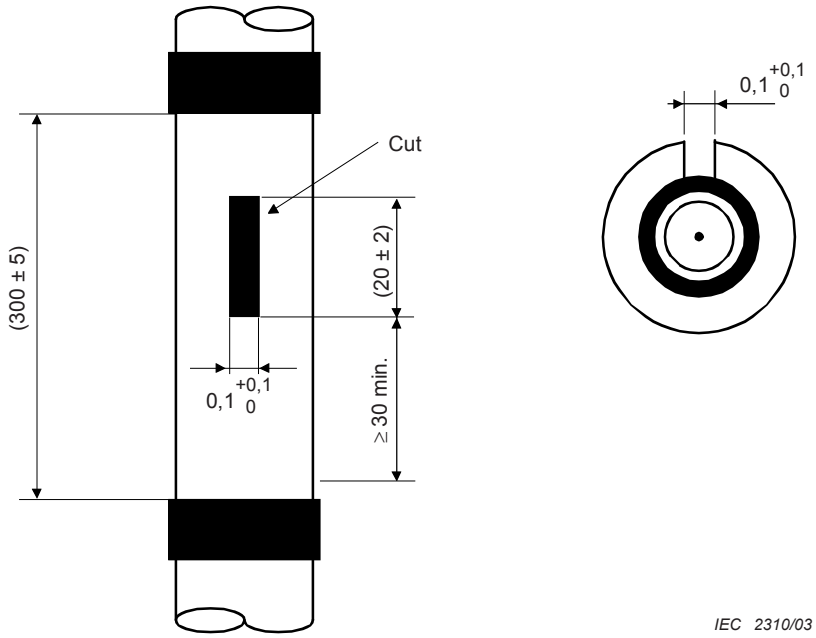
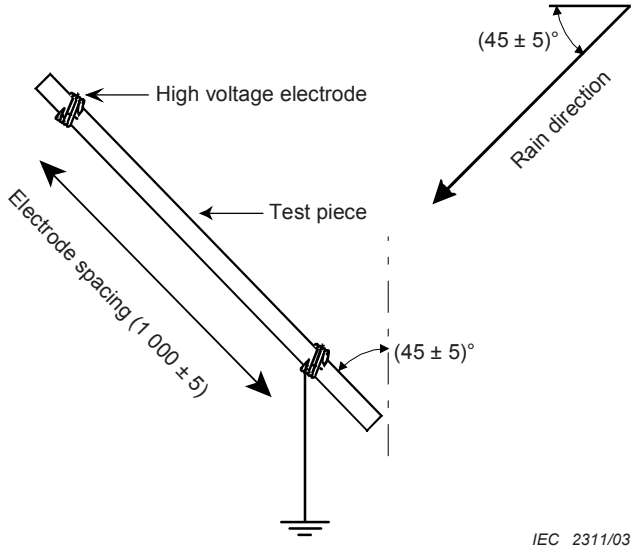


Figure 2 – Test set-up for electric tests (see 5.3.1.1)



Dimensions in millimetres

Figure 3 – Preparation of specimen for test after the infliction of a cut (see 5.3.1.4)



Dimensions in millimetres

Figure 4 – Dielectric wet test – Typical test arrangement (see 5.3.1.5)

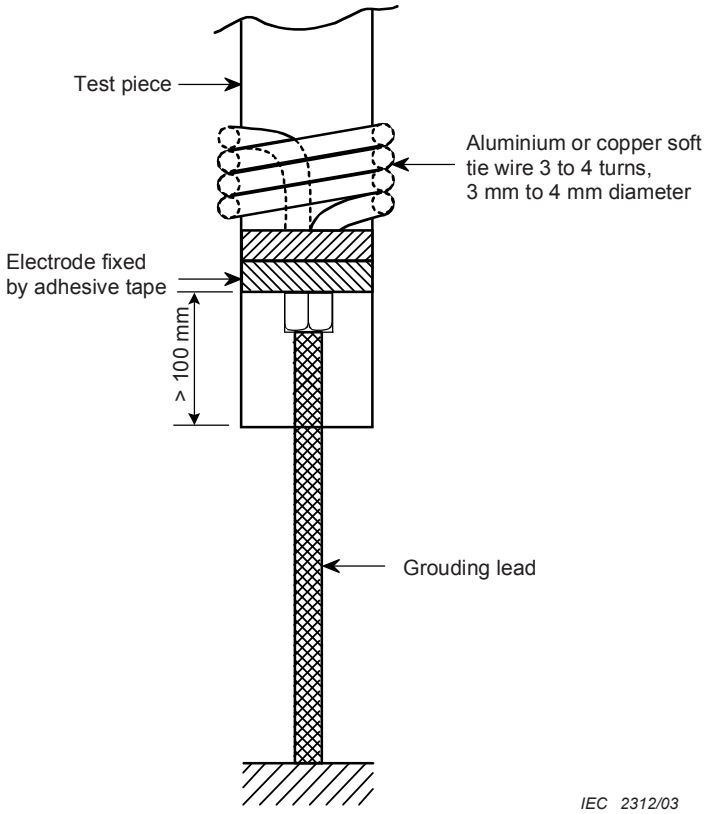


Figure 5 – Dielectric wet test – Details of electrode arrangement
(see 5.3.1.5)

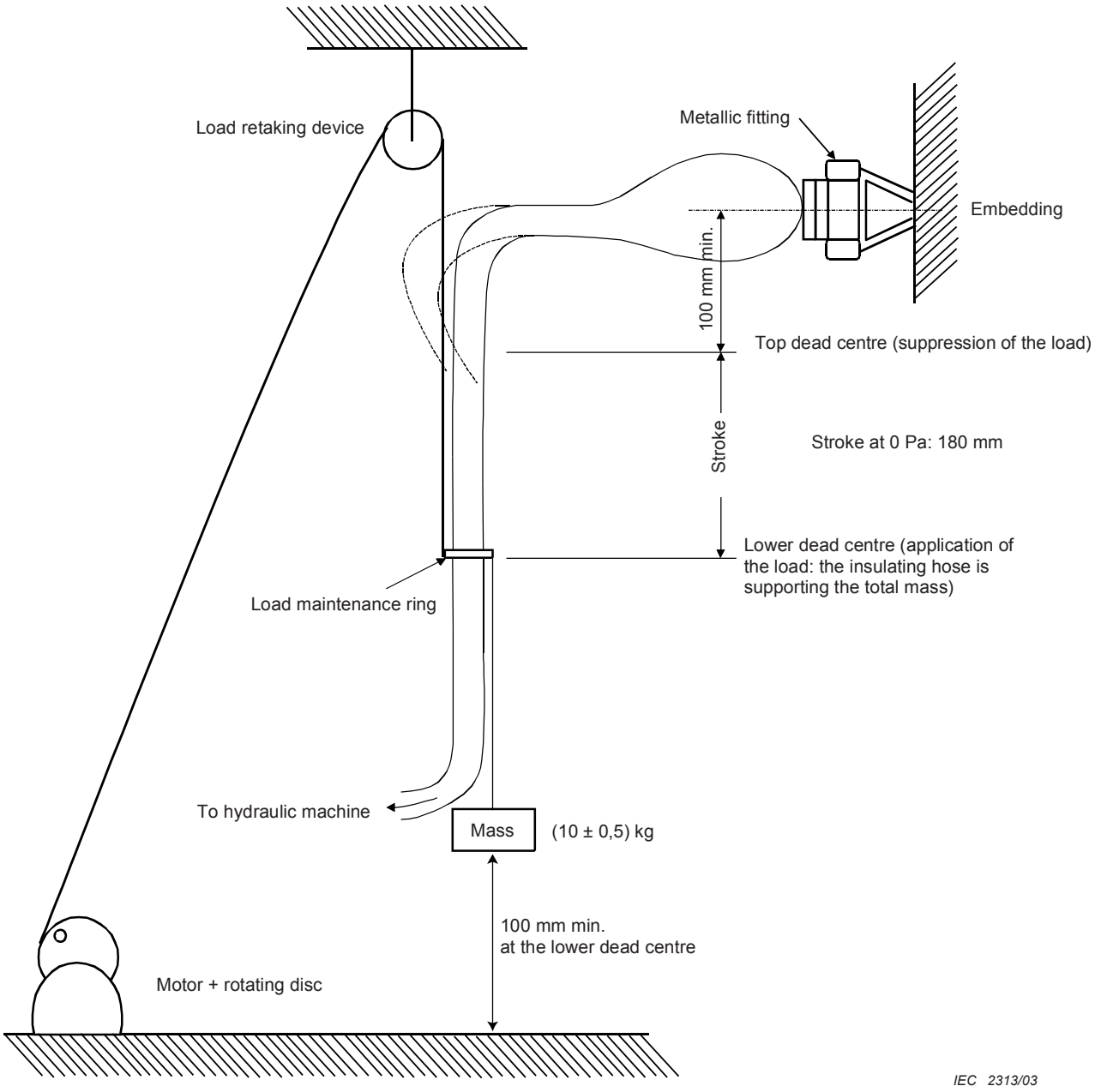
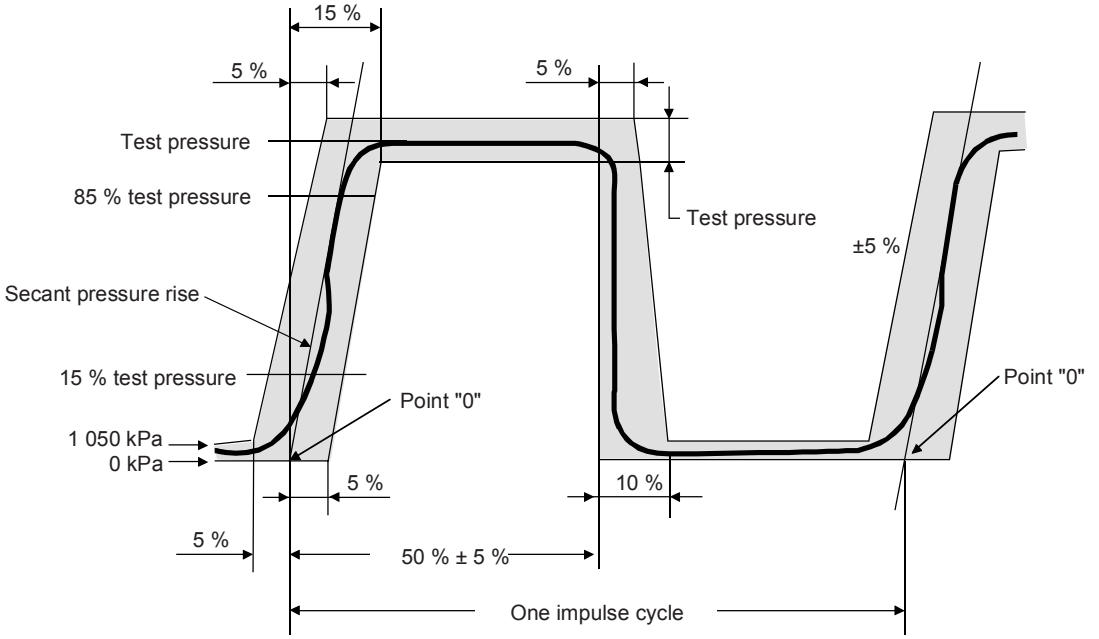


Figure 6 – Testing device for the fatigue test (see 5.4.2)



Secant pressure rise – The straight line drawn through two points on the pressure rise curve: one point at 15 % of the test pressure and the other at 85 % of the test pressure.

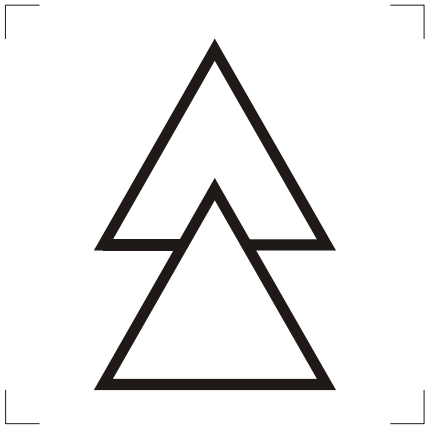
Point "0" – The intersection of the secant pressure rise with 0 pressure.

Pressure rise rate – The slope of the secant pressure rise expressed in kPa/s.

Figure 7 – Diagram of mechanical impulse test (see 5.4.3)

Annex A
(normative)

Suitable for live working; double triangle (IEC-60417-5216(DB:2002-10))



Annex B
(normative)

Chronology of the tests

Table B.1 gives the chronological order of the tests: for example, for the set n° 1, visual inspection shall be carried out at first, next dimensional check, next hydrostatic test, etc.

Table B.1 – Chronological order of the tests

Type of test	Subclause	Test set								
		1	2	3	4	5	6	7	8	9
		Group of test pieces								
		II	II	III	I	I	I	I	I	I
Visual inspection [a]	5.2.1	1	1	1	1	1	1	1	1	1
Dimensional check [a]	5.2.2	2	2	2	2	2	2	2	2	2
Test before exposure to humidity	5.3.1.2	4								
Test after exposure to humidity	5.3.1.3		4							
Test after the infliction of a cut on hoses	5.3.1.4	5								
Dielectric wet test	5.3.1.5			4						
Fatigue test	5.4.2				4					
Hydrostatic test [a]	5.4.1	3	3	3	3	3	3		3	3
Mechanical impulse test	5.4.3					5				
Leakage test	5.4.4						4			
Change in length test	5.4.5							3		
Burst test	5.4.6								4	
Cold bend test	5.4.7									4
Durability of marking	5.4.8					4				
Number of test pieces		Three	Three	Three	Three	Three	Three	Three	Three	Three

[a] For test pieces of group II and group III, the test is performed on the insulating hose(s) with fittings before the cut.

Annex C
[C] (informative) [C]

Quality assurance plan

C.1 General

This annex includes the details of the quality assurance plan for the products covered by this standard. The quality assurance plan defines the necessary tests to control the product quality and conformance to this standard.

The quality assurance plan includes three elements:

– routine tests,
– sampling plans,
– acceptance tests (see Annex D).

The tests specified in this annex were developed to address the level of defect (critical, major or minor) in a consistent manner (see IEC 61318). Table C.1 presents the type of tests and the nature of the associated defect(s).

Table C.1 – Information relative to defects

Types of defects	Tests
Critical	Visual inspection Hydrostatic test Dielectric test
Major	Test after the infliction of a cut on hoses Leakage test Burst test Cold bend test
Minor	Durability of marking

C.2 Routine tests

In order to show compliance with this standard, the manufacturer shall provide evidence to the customer that the routine tests have been carried out successfully on materials conforming to the following criteria:

– conformity of the constituent materials to those which underwent the type tests;
– consistency of the constituent materials.

NOTE The customer may request a certificate that this has been done.

C.2.1 Visual inspection

Each insulating hose with fittings shall be visually inspected to check for manufacturing defects.

NOTE Visual inspection means visual inspection by a person with normal or corrected vision without additional magnification.

C.2.2 Dimensional check

Each insulating hose with fittings shall be measured to ensure that its dimensions match the manufacturer's rated dimensions.

C.2.3 Hydrostatic test

Before delivery, each insulating hose with fittings shall be hydrostatically tested to the maximum operating pressure plus 50 % for a period of 30 s.

There shall be no leakage, failure or distress to the complete assembly.

C.2.4 Dielectric test

The dielectric test presented below shall be carried out on each insulating hose with fittings, not filled with insulating liquid.

The insulating hose with fittings shall be submitted to an a.c. voltage of 100 kV r.m.s. at power frequency applied between the electrodes which are placed 300 mm apart, for 1 min. The maximum current measured shall not exceed 10 μA. During the test, there shall be no sign of flashover or puncture.

C.3 Sampling plans

C.3.1 General

The sampling procedure does not follow the guidance procedures defined in ISO 2859-1 because the nature of the product, the safety of the personnel involved and the quantity produced or supplied do not lend themselves to the integral application of the ISO standard. Since these important distinctions exist, special individual quality assurance measures are herein incorporated.

Each lot consists of insulating hoses with fittings of the same category (length, diameter, …)

C.3.2 Plan for major defects

The number of insulating hoses with fittings undergoing the tests and the acceptance criterion shall be in accordance with Table 1 of IEC 61318.

C.3.3 Plan for minor defects

The number of insulating hoses with fittings undergoing the tests and the acceptance criterion shall be in accordance with Table 3 of IEC 61318.

C.4 Procedure when testing is carried out in a laboratory other than the manufacturer's

If, during the conduct of the sampling tests, the insulating hose with fittings in a lot or batch is found to have a major defect, the testing shall be terminated and the manufacturer or supplier notified.

In such a case, the manufacturer or supplier may ask the customer or testing laboratory to submit proof that the test procedure and equipment conform to the applicable clauses of this standard.

When such a proof has been established, the manufacturer or supplier may request that his representative witness the testing of additional insulating hoses with fittings from the shipment.

All rejected lots shall be returned as directed by the manufacturer or supplier.

C.5 Records

The test results shall be made available to the customers for a time period according to IEC 61318.

Annex D
[C] (informative) [C]

Acceptance tests

An acceptance test is a contractual test to prove to the customer that the item(s) or product in question meet(s) the conditions of the customer's specification.

If the customer only requires that the product shall meet those of the governing standard the basic acceptance tests are those which are specified in the governing standard. The customer may request that they be repeated on his order.

The customer may request additional tests or increase the sampling size but shall include this in his own specification. The expansion of the acceptance testing beyond the tests required in the governing standard is subject to agreement between the customer and the supplier.

The customer shall include the acceptance test requirements in his own specification and may wish to witness the tests, have them witnessed by a third party or accept the results of the tests carried out by the manufacturer. The customer may prefer to perform the tests in his own laboratory or may specify that the tests be carried out in an independent laboratory of his choosing. This additional test expense is subject to agreement between the customer and the supplier.

Annex E
(informative)

In-service care

This annex is intended to help users by giving useful information on in-service care.

E.1 Storage and transportation care

All insulating hoses with fittings should be stored or transported in a box to prevent abrasive or bumping action against any surface that would damage the hose.

The dimension of the box should respect the bend radius of the insulating hoses with fittings.

In order to prevent the ingress of foreign particles when not in use, the ends of insulating hose with fittings should be fitted with a suitable device providing mechanical protection, such as an end-cap.

Storage facilities, such as hot line tool trailers, tool canisters or compartments on vehicles, etc., should be maintained in such a manner as to prevent the accumulation of water, dirt or any other foreign material.

E.2 Inspection and cleaning (daily procedure)

E.2.1 Inspection

Before each use, the surface of each insulating hose with fittings should be inspected for any defects that may cause it to fail during use such as deep cuts, scratches, or abrasions. If any such defects are found, the tool is removed from service and should undergo the dielectric tests described in C.2.4.

E.2.2 Cleaning

Before each use, the surface of each insulating hose with fittings should be cleaned with a clean and dry rag.

E.2.3 Maintenance of the surface finish

Before each use, it is important to make sure that the surface finish of each insulating hose with fittings maintains good hydrophobic properties. The surface finish should be treated according to the manufacturer's instructions for use.

NOTE The use of a clean rag impregnated with silicone is often the appropriate solution.

E.3 Repair

If the insulating hose with fittings can be repaired, the manufacturer should provide instructions for repair which should include the following as a minimum:

– who is authorized to carry out the repair,

– which material can be used,
– which test(s) should be carried out after the repair is complete.

E.4 Periodic testing

Periodic testing should be performed taking into consideration the applicable national or regional regulations and the manufacturers' instructions for use.

E.5 Insulating liquid compatibility

When it is necessary to interchange insulating hoses with fittings and/or pumps the compatibility of the insulating liquid should be confirmed.

Where insulating liquid is used to top up the liquid reservoir, the liquid should be of a type specified by the manufacturer.

Bibliography

IEC 60050(651):1999, *International Electrotechnical Vocabulary (IEV) – Part 651: Live working*

IEC 60743:2001, *Live working – Terminology for tools, equipment and devices*

ISO 2859-1:1999, *Sampling procedures for inspection by attributes – Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE Where an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60060-1 + corr. March	1989 1990	High-voltage test techniques Part 1: General definitions and test requirements	HD 588.1 S1	1991
IEC 60060-2	- [1)]	Part 2: Measuring systems	EN 60060-2	1994 [2)]
IEC 60212	1971	Standard conditions for use prior to and during the testing of solid electrical insulating materials	HD 437 S1	1984
IEC 60417	database	Graphical symbols for use on equipment	-	-
IEC 61477 A1	2001 2002	Live working - Minimum requirements for the utilization of tools, devices and equipment	EN 61477 A1	2002 2002

[1)] Undated reference.
[2)] Valid edition at date of issue.

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