

BS EN 13411-4:2011



BSI Standards Publication

Terminations for steel wire ropes — Safety

Part 4: Metal and resin socketing

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National foreword

This British Standard is the UK implementation of EN 13411-4:2011. It supersedes BS EN 13411-4:2002+A1:2008 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee MHE/2, Wire ropes.

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

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Compliance with a British Standard cannot confer immunity from legal obligations.

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English Version

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- Teil 4: Vergießen mit Metall und Kunstharz

This European Standard was approved by CEN on 19 February 2011.

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Foreword

This document (EN 13411-4:2011) has been prepared by Technical Committee CEN/TC 168 “Chains, ropes, webbing, slings and accessories - Safety”, the secretariat of which is held by BSI.

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of an identical text or by endorsement, at the latest by September 2011, and conflicting national standards shall be withdrawn at the latest by September 2011.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 13411-4:2002+A1:2008.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

This second edition incorporates both technical and editorial amendments, with the following main changes made with respect to the previous edition:

- enhance approved socket dimension criteria negating need for type testing and move data into informative Annex F;
- add definition for ‘socketing manufacturer’;
- re-draft hazards clause;
- re-draft standard in accordance with rules of ISO/IEC Directives, Part 2 and CEN Guide 414.

EN 13411, under the general title “Terminations for steel wire ropes — Safety”, consists of the following parts:

- Part 1: Thimbles for steel wire rope slings;
- Part 2: Splicing of eyes for wire rope slings;
- Part 3: Ferrules and ferrule-securing;
- Part 4: Metal and resin socketing;
- Part 5: U-bolt wire rope grips;
- Part 6: Asymmetric wedge socket;
- Part 7: Symmetric wedge socket;
- Part 8: Swage terminals and swaging.

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

Introduction

This European Standard is a type C standard as stated in EN ISO 12100.

The machinery concerned and the extent to which hazards, hazardous situations and events are covered are indicated in the scope of this standard.

When provisions of this type C standard are different from those which are stated in type B standards, the provisions of this type C standard take precedence over the provisions of the other standards, for machines that have been designed and built according to the provisions of this type C standard.

The methods of socketing described in this standard are based on established procedures and following them is considered to result in a rope termination having an efficiency of 100 % based on the minimum breaking force of the rope.

It is assumed that the socket is:

- suitable for heating without changing the characteristics of the socket material when the socketing medium is molten metal;
- strong enough for the rope; and
- suitable for the purpose for which it is intended.

1 Scope

This European Standard specifies the minimum requirements for the molten metal and resin socketing of steel wire ropes within the scopes of EN 12385-4:2002+A1:2008; EN 12385-5:2002; EN 12385-6:2004; EN 12385-7:2002; EN 12385-8:2002; EN 12385-9:2002 and EN 12385-10:2003+A1:2008.

The European Standard is applicable only to those requirements that ensure that the socketing is strong enough to withstand a force of at least 100 % of the minimum breaking force of the rope (i.e. socket termination efficiency factor $K_T = 1,0$).

NOTE Rope terminations made by socketing in accordance with this European Standard can be used for determining the breaking force of wire ropes in accordance with EN 12385-1:2002+A1:2008, Annex A.

Socketing by the methods and materials described in this standard are for use within the temperature limits given in normative Annex E.

This European Standard deals with all significant hazards, hazardous situations and events relevant to metal and resin socket terminations, when they are used as intended and under conditions of misuse which are reasonably foreseeable (see Clause 4).

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.

EN 59, *Glass reinforced plastics — Measurement of hardness by means of a Barcol impressor*

EN 1774:1997, *Zinc and zinc alloys — Alloys for foundry purposes — Ingot and liquid*

EN 12385-1:2002+A1:2008, *Steel wire ropes — Safety — Part 1: General requirements*

EN 12385-2:2002+A1:2008, *Steel wire ropes — Safety — Part 2: Definitions, designation and classification*

EN ISO 75-2:2004, *Plastics — Determination of temperature of deflection under load — Part 2: Plastics, ebonite and long-fibre-reinforced composites (ISO 75-2:2004)*

EN ISO 604, *Plastics — Determination of compressive properties (ISO 604:2002)*

EN ISO 3838, *Crude petroleum and liquid or solid petroleum products — Determination of density or relative density — Capillary-stoppered pycnometer and graduated bicapillary pycnometer methods (ISO 3838:2004)*

EN ISO 12100:2010 *Safety of machinery — General principles for design — Risk assessment and risk reduction (ISO 12100:2010)*

3 Terms and definitions

For the purpose of this document, the terms and definitions given in EN ISO 12100, EN 12385-2:2002+A1:2008 and the following apply.

3.1

socket

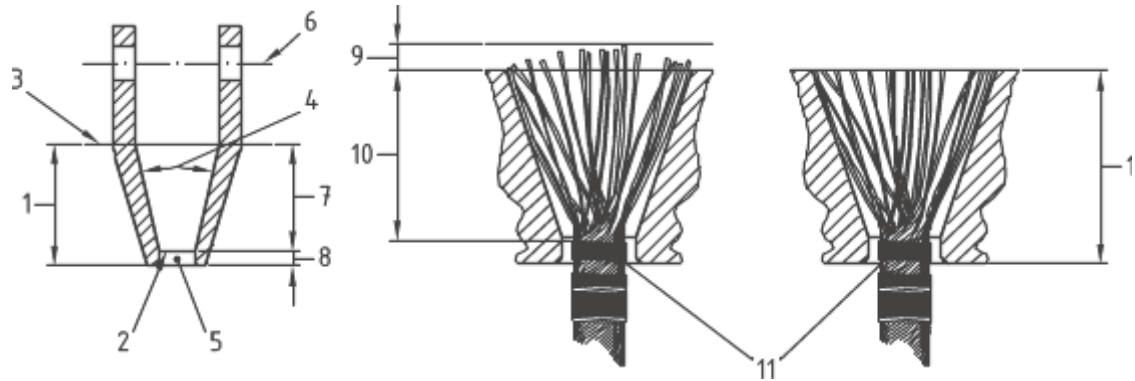
type of wire rope termination incorporating a socket basket

3.2

socket basket

area of a socket in which a brushed rope end is secured using a socketing medium

NOTE Descriptions of further elements of the socket geometry are shown in Figure 1.



Key

- 1 length of tapered basket plus any parallel portion(s) including any radius at rope entry
- 2 small end of tapered basket
- 3 large end of tapered basket
- 4 included angle of tapered basket
- 5 bore (internal diameter at rope entry)
- 6 pin hole centre line
- 7 length of tapered basket
- 8 length of parallel portion including any radius at rope entry
- 9 protruding wires
- 10 length of brush
- 11 root of brush

NOTE Some sockets can have baskets with an extended parallel portion at the large end of the tapered basket.

Figure 1 — Nomenclature of typical parts of socket and brush

3.3

serving

wrapping, usually of wire or strand, for the purpose of securing a rope end to prevent its unlaying

3.4

permanent serving

serving applied prior to socketing and remaining in place at least until the socketing operation has been completed

3.5

temporary serving

serving applied and subsequently removed at various stages of the socketing operation

3.6

gelling

change in condition of resin from liquid to a semi-solid, jelly-like composition

3.7

hooking

procedure whereby the end of a wire forming part of a brush is bent backwards to form a hook

3.8

socketer

competent person carrying out the socketing

3.9

competent person

designated person, suitably trained, qualified by knowledge and experience and with the necessary instructions to ensure that the required operations are correctly carried out

3.10

socketing system

method of attachment comprising instructions and materials for the socketing of wire ropes with molten metal or resin

3.11

socketing system designer

person or organization that designs the socketing system and assumes responsibility for type testing

3.12

socketing manufacturer

person or organization that manufactures socketed terminations in accordance with the socketing system designer's instructions

4 List of significant hazards

This clause contains all the significant hazards, hazardous situations and events for the molten metal and resin socketing of steel wire ropes within the scopes of EN 12385-4:2002+A1:2008; EN 12385-5:2002; EN 12385-6:2004; EN 12385-7:2002; EN 12385-8:2002; EN 12385-9:2002 and EN 12385-10:2003+A1:2008, as far as these hazards are dealt with in this European Standard, identified by risk assessment as significant for socket terminations that require action to eliminate or reduce risk.

In particular, the hazard caused by accidental release of a load due to failure of the socketed portion of a socketed rope termination puts at risk, either directly or indirectly, the safety or health of those persons within the danger zone.

In order to provide the necessary strength of the socketed portion of a socketed termination, this European Standard gives requirements for the method of socketing to ensure specified levels of performance are met.

Table 1 contains those hazards that require action to reduce risk identified by risk assessment as being specific and significant for socketed termination assemblies.

Table 1 — Hazards identified EN ISO 14121-1:2007, A.1 and A.4

| Type or group | Origin | Potential consequences |
|---------------------------|---|--|
| Mechanical hazards | <ul style="list-style-type: none"> - Acceleration, deceleration (kinetic energy) - Falling objects - Moving elements | <ul style="list-style-type: none"> - Impact - Crushing |
| Hazardous events | <ul style="list-style-type: none"> - Stability of the machine and/or parts of the machine - Mechanical strength of parts of | <ul style="list-style-type: none"> - Loss of stability - Break-up during |

| | | |
|--|-------------|-----------|
| | the machine | operation |
|--|-------------|-----------|

5 Safety requirements and/or protective measures

5.1 General

Machinery shall comply with the safety requirements and/or protective measures of this clause.

In addition, the machine (rope assembly terminated in accordance with this European Standard and which is designated for lifting purposes) shall be designed in accordance with the principles of EN ISO 12100 for relevant but not significant hazards which are not dealt with by this document.

Socketing shall be carried out by a person trained in socketing.

5.2 Preparation of rope and socket

5.2.1 General

The position of the wires and strands of the non-socketed portion of rope shall remain undisturbed during the socketing operation. Temporary servings or, alternatively, a mechanical device e.g. clamp(s), may be used for this purpose.

5.2.2 Length marking of rope

The rope shall be marked with the required length taking into account the length of the socket basket, the length of the brush to be formed, any additional brush length for the hooking of wires and, if used, the depth of any centralizing clamp.

5.2.3 Servicing

Temporary servings shall be used to hold the strands and wires in position during the cutting operation.

Temporary servings shall also be used, when required by nature of the rope construction e.g. spiral rope, to maintain the lay of the rope etc. beyond the portion being socketed.

The rope shall be served with a permanent serving as shown in Figure 2. The permanent serving shall be in position before cutting the rope. Unless specified otherwise by the socket manufacturer, the serving shall allow for penetration of the socketing medium between the served rope and the bore of the socket.

The material used for the permanent serving shall be tinned or galvanised soft wire or strand for zinc/zinc alloy coated wire rope, and uncoated (bright), tinned or galvanised soft wire or strand for uncoated (bright) wire rope.

5.2.4 Cutting of rope

The wire rope shall be cut by abrasive wheel, percussive or shearing methods, paying particular attention not to disturb the position of wires and/or strands below the permanent serving

If oxyacetylene or cutting methods that fuse the wire rope end – i.e. fuse & taper machine – are used, then the rope shall be trimmed back with a disc cutter to remove the heat affected zone.

5.2.5 Cleanliness of socket

Dirt, grease, scale or residues shall be removed from the inside of the socket basket

NOTE This does not preclude the use of a releasing agent when socketing with resin.

5.2.6 Inserting rope into socket

One of two procedures shall be used to insert the rope into the socket.

In the first method, the rope shall be inserted into the socket prior to the preparation of the brush.

In the second method, after the brush has been prepared in accordance with 5.2.8 to 5.2.10, it shall be closed and compacted to enable it to be inserted into the bore of the socket without damaging the rope.

5.2.7 Opening the brush

The temporary serving at the point of cut shall be removed and the strands fanned outwards to facilitate the brushing operation.

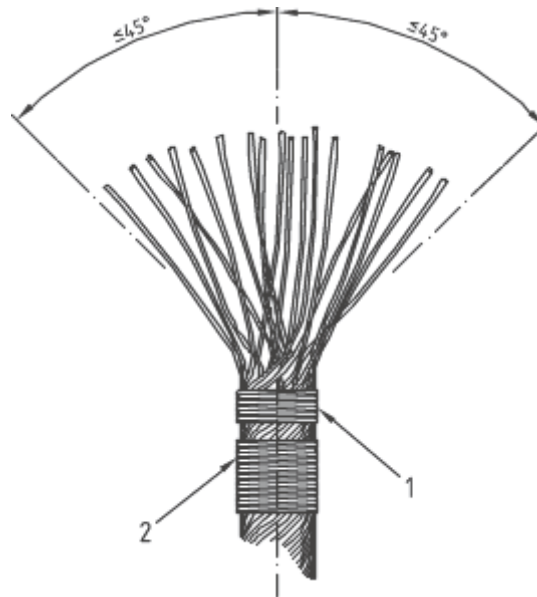
The rope (including any steel core where appropriate) shall be unlaidd into its constituent wires to form an open brush (see Figure 2).

The opening angle of the brush should not exceed 45° from the vertical (see Figure 2).

NOTE Wires should not be bent to an excessive angle at the permanent serving, since this can adversely influence the life of the socket assembly. Special care should be taken with locked coil rope due to the sensitivity of the locked coil wire section.

Any fibre core shall be removed from the whole length of the brush.

When socketing fibre core ropes using molten metal, the exposed end of the fibre core shall be protected from the effects of heat created by the molten metal so that the fibre core material does not ignite, melt or otherwise burn, smoke or smoulder. One method to achieve this may be to replace the fibre core with a false steel rope core over a length of $15 \times$ rope diameter ($15d$) beyond the socket and $>1d$ inside the socket.



Key

- 1 permanent serving
- 2 temporary serving

Figure 2 — Brush formation

5.2.8 Pre-treatment of the brush

The brush shall be degreased to remove all traces of lubricant. Degreasing shall be by either liquid or vapour methods. It is essential that when using solvents the solvent manufacturer's instructions are followed.

Care shall be taken to ensure that degreasing is confined to the brush.

The wire brush shall be completely dry before the socketing medium is poured into the socket.

NOTE When socketing with lead-based alloys the wires of a bright rope may be pre-treated for improved adhesion. An optional procedure is given in Annex D (informative).

5.2.9 Hooking

Where type testing shows that hooking is necessary, the dimensions and shape of the hooked portion shall be limited such that it shall not impede the flow of the molten metal or resin during socketing, nor reduce the embedded length of the brush in the socketing medium.

NOTE Ropes with coarse constructions i.e. 1 x 7, normally require hooking to insure compliance with this European Standard.

5.2.10 Positioning and alignment of brush, rope and socket

The brush shall be re-shaped into a form approximating the shape of the socket basket.

The socket shall be drawn over the brush until the root of the brush protrudes into the tapered portion at the small end by no more than $0,5 d$.

The wires shall be evenly distributed within the socket basket.

The distance between the end of the brush and the large end of the socket basket shall be no greater than 5 % of the length of the socket basket.

If the ends of the wires at the top of the brush do not protrude beyond the large end of the socket basket, the actual position of the wire ends in relation to the large end of the basket shall be measured and documented.

The rope axis shall be coincident with the socket axis for a sufficient length, typically three lay lengths, but may be reduced by the use of suitable clamps.

NOTE The concentricity of the rope in relation to the socket bore is part of the negotiation.

5.2.11 Sealing

The area where the rope enters the bore of the socket shall be sealed with a material that prevents leakage of molten metal or resin.

NOTE Care should be taken to ensure that the sealing material is not pushed into the gap between the socket and rope at the bore. If this occurs, it might prevent penetration of the socketing medium into the socket bore region, which could lead to corrosion and reduced life of the assembly.

5.3 Socketing

5.3.1 General

The medium used for socketing shall be either:

- molten metal conforming to Annex A (normative); or
- resin conforming to Annex B (normative).

Previously used socketing medium shall not be re-used.

5.3.2 Molten metal socketing

5.3.2.1 Pre-heating the socket

The socket manufacturer shall provide the maximum temperature to which the socket can be heated without adversely affecting the socket material properties.

The socket shall be heated to ensure that the molten metal is able to fill the socket basket without solidifying prematurely. Unless specified otherwise in these instructions, the socket pre-heat temperature shall be at least 50 % of the pouring temperature of the socketing medium.

The pre-heat temperature shall be achieved gradually by applying heat evenly around the outer surface of the socket.

NOTE Care should be taken not to overheat any part of the socket.

The pre-heat temperature shall be checked immediately prior to pouring of the socketing medium.

5.3.2.2 Melting the metal

Sufficient metal shall be melted to ensure complete filling of the basket. Melting temperatures shall be in accordance with those given in Annex A (normative).

The containers used for melting and pouring the socketing metal shall be of a material that does not influence the molten metal.

Galvanized containers shall not be used with lead-based metals.

Containers used for the melting of one family of metals shall not be used for the melting of any other family of metal.

Lead-based alloys shall be kept molten for as short a time as possible to minimize oxidation and loss of antimony and tin.

5.3.2.3 Pouring

Immediately prior to pouring, the temperature of the molten metal socketing medium shall be checked and be within the limits given in Annex A (normative).

Before pouring, the molten metal shall be stirred to ensure even temperature distribution within the container. Any dross shall be removed from the surface of the molten metal.

The ladle shall be dry and pre-heated and the socket and brush shall be completely dry to avoid the explosive generation of steam.

NOTE 1 The wires of the brush can be fluxed by introducing a suitable fluxing compound to the socket basket before pouring in the molten metal.

The molten metal socketing medium shall be poured slowly to allow the escape of gases until the socket basket is completely filled.

The socketer shall ensure there is sufficient volume of melted socketing medium so that the basket can be filled in a continuous pour.

NOTE 2 Shrinkage sometimes occurs in the metal at the large end of the basket. In such cases sufficient additional metal can be poured (topping up) to fill the depression. This should be carried out as the existing metal solidifies, and where necessary, the surface should be re-liquefied before pouring commences, e.g. by gentle heating at the large end of the basket.

5.3.2.4 Cooling

The socketing metal shall be undisturbed during cooling to ambient temperature in air so that it solidifies naturally.

5.3.3 Resin socketing

5.3.3.1 General

The socketer shall follow the resin system manufacturer's instructions.

Resin system packages or kits shall not be used after the expiry date indicated on the container.

Resin system material packages or kits shall never be sub-divided.

5.3.3.2 Pouring

The socket shall be filled from a single mix until the basket is full.

During the pouring and topping-up operation and early stages of gelling, it is essential that any leaks are identified and stopped. Such leaks will result in cavities being formed near the root of the brush if allowed to continue.

5.3.3.3 Curing

The resin mixture shall be allowed to harden after gelling.

The socket shall not be moved until the resin has hardened to the point that it passes the 'scratch test' – see 6.13.

NOTE It is quite normal, particularly in the case of small sockets, to have a thin, tacky layer on the surface of the resin after hardening. The scratch test can be carried out through this layer.

5.4 Removal of sealing material

After socketing the sealing material shall be removed.

5.5 Protection

A suitable corrosion protection compound shall be applied to the rope in the vicinity of the rope and the socket when the socketing system used is molten metal.

NOTE This is to replenish any lubricant that may have leached from the rope at the socket interface as a consequence of pre-heating the socket and filling with molten metal.

5.6 Type testing

Type testing is not necessary when socketing with sockets conforming to design parameters listed in Annex F.

Where the socket design parameters differ to those listed in Annex F, the results of type tests (see Annex C) to assess the tensile efficiency of a given rope type(s) in a given socket shall be available, proving compliance with this European Standard. Existing reports are permissible as proof of compliance.

6 Verification of the safety requirements and/or measures

6.1 Length marking of rope

The marking of the rope shall be confirmed by visual inspection.

6.2 Serving

The serving shall be confirmed by visual inspection.

6.3 Cleanliness of socket

Cleanliness shall be confirmed by visual inspection.

6.4 Opening the brush

The formation of the wires into a brush, and, where applicable, the removal of any fibre core and protection of its exposed end at the root of the brush shall be confirmed by visual inspection.

6.5 Degreasing the brush

The cleanliness of the brush following degreasing shall be confirmed by visual inspection.

6.6 Hooking

If hooking is considered necessary, the length of any hooked portion shall be confirmed by visual inspection.

6.7 Positioning and alignment of brush, rope and socket

The evenness of the distribution of the wires forming the brush shall be confirmed by visual inspection.

The distance between the end of the brush and the end of the basket when the brush is to be completely embedded shall be confirmed by measurement and the value documented.

6.8 Pre-heating the socket

The temperature of the socket shall be confirmed by the use of thermo-melt sticks or appropriate instrumentation.

6.9 Melting the metal

The temperature of the metal shall be confirmed by the use of a suitable thermometer.

6.10 Pouring the metal

The pouring temperature of the metal shall be confirmed by the use of a suitable thermometer.

6.11 Cooling

Undisturbed cooling of the metal shall be confirmed by visual inspection.

6.12 Pouring the resin

The absence of any leaks shall be confirmed by visual inspection.

6.13 Curing of the resin

Acceptable Scratch Test is when a sharp instrument such as a screwdriver blade is drawn over the surface of the resin at the large end of the cone, only a shallow, light-coloured scratch mark is left on the surface.

6.14 Removal of sealing

Confirmation that the sealing has been removed shall be by visual inspection.

6.15 After completion of the socketing

The socketed assembly shall be visually inspected to confirm that:

- a) the socket and the rope axes are coincident;
- b) the gap between the rope and the socket at the entry of the rope into the socket is even and filled with socketing medium, unless stated otherwise by the socket manufacturer in his instructions; and
- c) the socket basket is filled with the socketing medium.

7 Information for use

7.1 General

Information for use of the machine shall be provided in accordance with EN ISO 12100:2010, 6.1.

7.2 Marking

The socketing manufacturer's trade mark or symbol and traceability code indentifying the assembly with the socketing manufacturer's certificate (see 7.3) shall be legibly and durably marked at the large end of the socketed medium.

Marking shall be by stamping or by label embedded in, or affixed to, the socketed medium.

The indentation from any stamping shall be such as not to impair the mechanical properties of the socketed portion of the termination.

7.3 Socketing manufacturer's certificate

The certificate for the assembly which includes socketing in accordance with the procedures stated in this European Standard shall show at least the following information:

- a) name and address of the socketing manufacturer and, if appropriate, his authorized representative;
- b) description of the assembly including:
 - 1) nominal size;
 - 2) construction;
- c) maximum working load;
- d) socketing procedure conforms to this European Standard.

Annex A (normative)

Molten metal socketing media

A.1 Lead-based alloys

Lead-based alloys shall have an approximate melting point of 240 °C and shall have a pouring temperature of (350 ± 10) °C. Their constituents shall conform to Table A.1.

Table A.1 — Composition of lead-based alloys

| Composition % mass | | | | | | Total impurities ^a % mass max. |
|--|-----------------|-------------|------------|------------|-----------|--|
| Sn | Sb | Cd | Cu | As | Pb | |
| 4,75 to 5,25 | 14,5 to 15,5 | — | — | — | remainder | 0,2 |
| 7,0 to 8,0 | 9,0 to 10,0 | — | — | — | remainder | 0,2 |
| 9,0 to 11,0 | 9,0 to 11,0 | 1,72 to 2,5 | 0,3 to 0,7 | 0,3 to 0,7 | remainder | 0,2 |
| ^a Maximum permitted impurity levels: 0,005 % Al; 0,005 % Zn; 0,05 % Cu (copper impurity level for first two alloys only). | | | | | | |

WARNING — Breathing lead fumes can seriously damage health.

Local regulations should be checked to determine whether such alloys are allowed to be used for socketing.

A.2 Zinc

Zinc shall have a purity by mass % of 99,9 and have a melting point of 419 °C.

NOTE The pouring temperature should not exceed 500 °C.

A.3 Zinc-based alloy

Zinc-based alloys shall conform to EN 1774:1997 grade ZnAl6Cu1, having an approximate melting point of 380 °C and shall have a pouring temperature of 450 °C ± 10 °C.

Annex B (normative)

Resin socketing media

B.1 General

Resin socketing systems shall be polyester based and include an inorganic filler and a curing agent.

B.2 Physical properties

Cured resins shall have the following physical properties:

- a) when tested in accordance with EN ISO 604, the resin system shall have a minimum ultimate compressive strength of 100 N/mm²;
- b) when tested in accordance with EN ISO 75-2:2004, Method A, the resin system shall have a minimum heat distortion point of 110 °C;
- c) when tested in accordance with EN ISO 604, the resin system shall have a minimum modulus of elasticity of 6 000 N/mm²;
- d) when tested in accordance with EN 59, the resin system shall have a minimum Barcol hardness of 36;
- e) when tested in accordance with EN ISO 3838, the resin system shall have a density between 1,54 and 1,96.

Test samples for physical property verification shall be 40mm cubes cast in a multi-cavity mould. The resin cubes shall be post cured to 80 °C for two hours prior to testing.

Annex C (normative)

Type testing for assessment of molten metal or resin socketed termination

C.1 General

For each socketing medium with which the socket is intended to be used, tensile tests shall be carried out on socketed end terminations representing the most extreme and unfavourable combinations of rope construction and rope strength and socket basket dimensions.

C.2 Method of test

The method of test shall be in accordance with EN 12385-1:2002+A1:2008, 6.4.1.

C.3 Acceptance criteria

If any of the tensile tests fail to meet the minimum breaking force a further two socketed end terminations comprising the same rope size, rope construction and minimum breaking force; same size, design and material of socket; same socketing medium; and same method of socketing shall be tested. If these pass, the method of socketing and socketing medium is deemed to be suitable for the socket and ropes under test.

If one or both fail the re-test, the method of socketing and socketing media is deemed to be unsuitable for the socket and ropes under test.

C.4 Test report

The test report shall include the following particulars:

- a) name and address of the test body or its authorized representative;
- b) test number;
- c) reference to the test method used;
- d) identification of rope constructions, rope breaking forces and socketing media for which the socket is suitable; and
- e) results;and
- f) date and signature of the authorized test person.

Annex D (informative)

Procedure for pre-treatment of bright rope for improved adhesion when socketing with lead-based alloys

D.1 General

Before pouring, the wire brush of a wire rope may be tinned using this procedure.

The coating process in D.3 should be carried out slowly and in such a way as to avoid splashing molten metal.

D.2 Fluxing

The cleaned brush should be dipped for approximately 1 min into a zinc chloride solution for approximately two-thirds of the brush length.

WARNING — The fluxing solution and components are strong skin irritants. Care should be taken to ensure that they do not come into contact with the bare skin.

A suitable zinc ammonium chloride solution has a composition as follows:

| | |
|---|--|
| zinc chloride (ZnCl): | 26,00 % by mass |
| ammonium chloride (NH ₄ Cl): | 1,75 % by mass |
| hydrochloric acid (HCl): | 5,25 % by mass; 30,00 % solution with water |
| water (H ₂ O) | 67,00 % by mass |

Its density at 20 °C should be 1,30 g/cm³.

D.3 Coating

Immediately following fluxing, and whilst still wet, approximately three-quarters of the brush length of the wire brush should be slowly immersed in tin solder (60 % Sn, 40 % Pb) at a bath temperature of (290 ± 10) °C.

After tinning the wires should have a tight adherent metal coating for about two-thirds of the brush length. If this condition is not achieved the fluxing and metallic-coating process should be repeated. Alternatively a new brush may be formed if the rope length allows.

Annex E (normative)

Operating temperature limits

Unless stated otherwise by the socketing system designer or socket manufacturer, the following operating temperature limits apply to ropes socketed with media covered by this European Standard:

Lead-based alloys:

— - 45 °C to + 80 °C

Zinc and zinc-based alloys:

— stranded rope with fibre core: - 40 °C to + 80 °C

— stranded rope with steel core: - 40 °C to + 120 °C

— spiral rope: - 40 °C to +120 °C

Resin:

— stranded rope with fibre core: - 50 °C to + 80 °C

— stranded rope with steel core: - 50°C to + 110°C

— spiral rope: - 50 °C to + 110 °C

For higher temperature discussions should take place with the socketing manufacturer or socketing system designer in particular to consider loading conditions

Annex F (informative)

Approved socket design parameters

Experience has demonstrated that ropes terminated in accordance with this European Standard using sockets falling within the design parameters listed below will meet the tensile efficiency requirements of this European Standard. Accordingly the use of this combination may be supplied without the need for type testing.

The included angle of the socket basket is not less than $9,5^\circ$ nor greater than 18° , and the socket basket length meets the following minimum requirements:

Stranded rope:

4 x rope diameter ($4d$) or 50 x outer wire diameter ($50 \delta_a$) for constructions containing less than 50 wires.

Bore of socket $\leq d \cdot 1.2$

Spiral rope:

5 x rope diameter ($5d$) or 50 x outer wire diameter ($50 \delta_a$) for constructions containing less than 50 wires.

Bore of socket $\leq d \cdot 1.4$

Annex ZA (informative)

Relationship between this European Standard And the Essential Requirements of EU Directive 2006/42/EC

This European Standard has been prepared under a mandate given to CEN by the European Commission [and the European Free Trade Association] to provide one means of conforming to Essential Requirements of the New Approach Directive 2006/42/EC on machinery.

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the normative clauses of this standard confers, within the limits of the scope of this standard, a presumption of conformity with Essential Requirement(s) of that Directive and associated EFTA regulations.

WARNING: Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

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