International Standard 7595

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

Socketing procedures for wire ropes — Molten metal socketing

Procédés de terminaison des câbles métalliques — Manchonnage à l'aide de métal fondu

First edition — 1984-10-15

UDC 621.86.065.3 **Ref. No. ISO 7595-1984 (E)**

Descriptors : lifting equipment, wire rope, sockets (ropes), brushes, specifications, quality control.

Price based on 6 pages

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 7595 was prepared by Technical Committee ISO/TC 111, *Round steel link chains, lifting hooks and accessories*.

Printed in Switzerland

Socketing procedures for wire ropes — Molten metal socketing

1 Scope and field of application

This International Standard provides guidance on recommended practices for the metal socketing of wire ropes produced in accordance with ISO 2408. The recommendations are also generally applicable to the socketing of other wire ropes.

When socketing ropes which have wire tensile grades greater than 1 960 MPa (N/mm^2), special precautions may be necessary and the rope supplier should be consulted.

Rope terminations made by socketing in accordance with this International Standard may be used for determining the breaking load of wire ropes in accordance with ISO 3108.

2 References

ISO 2408, *Steel wire ropes for general purposes — Characteristics.*[1)]

ISO 3108, *Steel wire ropes for general purposes — Determination of actual breaking load.*

ISO 3189/1, *Sockets for wire ropes — Part 1 : General conditions of acceptance.*[2)]

ISO 4381, *Plain bearings — Lead and tin casting alloys for multilayer plain bearings.*

3 General

ISO 3189/1 specifies the dimensions of the sockets for general purpose ropes. The sockets and socketed assemblies shall pass the prototype tests in that International Standard.

Sockets for spiral strands, locked coil ropes, and for breaking load tests may have special requirements.

4 Preparation of the rope end

A sufficient length of the rope should be externally cleaned on both sides of the designated point of cut by wiping with a clean dry cloth or a cloth dipped in solvent. This cleaning should be confined to the length of rope to be threaded through the socket.

4.1 Seizing of the rope

Two types of seizing are recognized.

a) Temporary seizing is used when cutting non-preformed ropes, multistrand ropes, spiral strands, etc. A temporary seizing may be applied to the rope on each side of the cut. These seizings should be such as to hold the strands and wires reasonably well in position during the cutting operation.

b) Permanent seizing is used to hold the wires and strands during the socketing operation. A permanent seizing is applied to that part of the rope which is partly within or adjacent to the mouth of the socket when the operation is completed. Permanent seizing should be in position before cutting the rope.

The permanent seizing should

1) ensure that the wires and strands are undisturbed during socketing operations;

2) permit the passage of the seized rope through the mouth of the socket.

4.2 Seizing material

The seizing material should be tinned or galvanized soft wire or strand for galvanized rope, and bright or galvanized soft wire or strand for bright rope.

Alternative materials may be used but care should be taken that they do not cause electrolytic action in service, and that they are capable of withstanding the temperatures involved.

Copper and brass wires should not be used for seizings. Plastic seizings of proven suitability may be allowed.

4.3 Cutting the rope

The rope should be cut by any suitable method which does not disturb the position of the wires below the permanent seizing. Cutting with an abrasive wheel is to be preferred. When cutting by percussive or shearing methods special care is required. Oxy-acetylene cutting should not be employed owing to the risk of heat damage to the wires and lubrication, and to the difficulties of separating the wires during subsequent socketing operations.

1) At present at the stage of draft. (Revision of ISO 2408-1973.)
2) At present at the stage of draft.

5 Preparation of the brush

5.1 Preparation of the rope

Before threading the socket on to the rope, all dirt, grease or scale should be removed from the inside of the basket.

The cut end of the rope should be threaded through the socket taking care that the basket walls do not come into contact with the uncleaned part of the rope. If this does occur, the rope should be unthreaded and the socket walls recleaned. After threading, the temporary seizing at the point of cut should be removed and the strands unlaid as far back as the permanent seizing, and swept outwards to allow opening of the wires.

The opening angle of the final brush should not exceed 45° from the vertical for stranded ropes [see figure 1a)].

For locked coil ropes and spiral strands the wires should be unlaid and swept outwards at an angle not exceeding 60° from the vertical [see figure 1b)].

When a rope contains a steel core, the wires of the core should be completely unlaid to form an open brush.

When a rope contains a fibre core, the core should be cut and removed down to the permanent seizing. To avoid damage to the core by molten metal at the cut end, the core may be protected by a plug of a suitable heat-resistant material. Such protection is particularly important if the core is of synthetic material.

When preformed round strand ropes are being socketed, a longer piece of the fibre core may be removed and replaced by a suitable strand. In this case the permanent seizing should be removed, the rope unlaid over a longer distance, the fibre core cut and the strand inserted, the rope strands closed again and the permanent seizing re-applied at its original position. The replacement core should be then completely unlaid to form an open brush.

The following diameters, d_R, for the replacement core are recommended :

ropes with 6 strands, $d_R = 0{,}35$ to $0{,}40\ d_M$

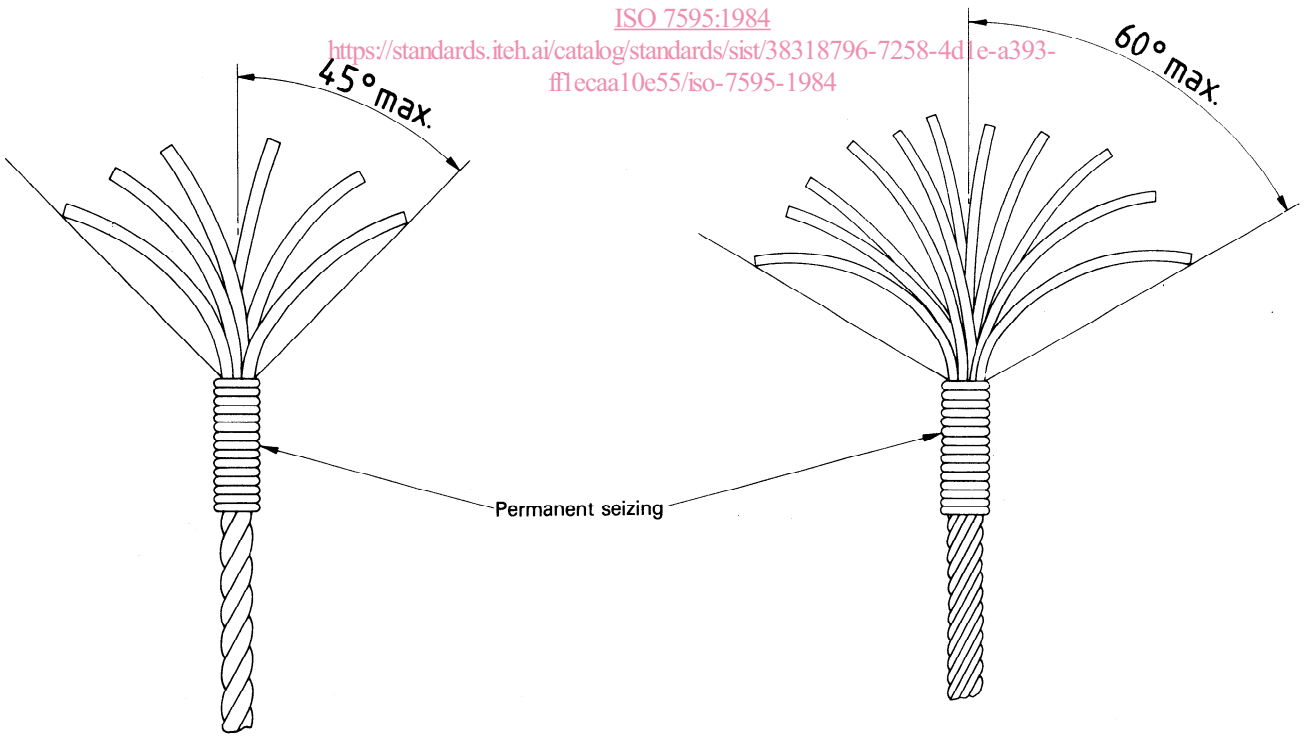
ropes with 8 strands, $d_R = 0{,}47$ to $0{,}52\ d_M$

where

d_M is the measured diameter of the rope.

After dealing with the core, the individual wires from the strands should be unlaid (but not straightened) and a brush formed.

Care should be taken not to bend the wires or strands to an excessive angle at the permanent seizing, since this may cause premature fatigue failure in the completed assembly.



a) Stranded ropes

b) Locked coil ropes and spiral strands

Figure — Opening angle of the brush

5.2 Cleaning and degreasing

The open brush should be thoroughly cleaned and degreased, with either an approved organic solvent, or an emulsion type cleaner. Hot degreasing solutions are preferred.

Petrol, paraffin and similar materials are not recommended.

When using liquid degreasing agents, the brush should be held downward to prevent the degreasing fluid, or water, being trapped in the throat of the brush. The degreasing process may be accelerated by use of an ultrasonic device.

The degreasing agent should be liberally used and worked well into the throat of the brush.

If water-based cleaning agents are used, the residues should be completely removed by washing off in boiling water. Then allow the brush to dry.

When using a vapour degreasing method, the brush should be held inserted in the vapour until all the grease and dirt has been removed. Care must be taken to ensure that the rope above the serving is not immersed in the vapour.

If corrosion preventives, not soluble in the above materials, have been used, the wire brush may be additionally dipped up to 80 % of its length in a hot solution of sodium hydroxide (400 g/l) then subsequently washed with hot water and dried quickly. The time of immersion in the sodium hydroxide solution should be carefully controlled so that any zinc coating is not significantly attacked.

CAUTION : During the cleaning and degreasing operations, the following precautions shall be taken :

a) Great care must be taken that degreasing is confined to the brush, and does not affect the rope beyond the brush.

b) When using water-based cleaning agents, it is essential to ensure that the agent is completely removed, that the brush is dried quickly, and that it is completely dry before pouring the molten metal. This is particularly important when using sodium hydroxide solution.

c) In all cases the time between cleaning and pouring should be as short as possible to minimize oxidation and corrosion of the rope.

d) Chlorinated hydrocarbons and other toxic or flammable organic solvents should only be used in areas designed for the purpose, or in an extremely well ventilated environment.

5.3 Hooking

Hooking of wires (i.e. turning over the wire ends without a sharp radius) is recommended for 6 × 7 and similar coarse construction ropes, especially where there is the possibility of shock loading.

Hooking of wires for other constructions is not normally necessary.

6 Pre-treatment of ropes of bright wires

National regulations, or specific methods of socketing, may require bright wires to be tinned, when socketed with molten metal. In certain conditions this may also be required to improve adhesion between the wires and the socketing metal. In these cases the procedures given in annex A are recommended.

7 Positioning and alignment of brush, rope and socket

A seizing wire should be placed around the brush near its top end to draw the brush slightly together to form a shape approximating to, but slightly smaller than, the shape of the socket basket, to prevent an appreciable length of the outermost wires from bearing against the wall of the socket when the socket is positioned over the brush.

The socket basket should be drawn over the brush until the ends of the wires, or the bends in the hooked wires, are 1 mm to 2 mm above the basket of the socket. Alternatively, the wire ends may be slightly below the top of the socket, but in these cases the rope just below the mouth of the socket should be marked to indicate any movement during subsequent operations.

The wires should be evenly distributed as far as possible at the top of the socket basket.

Following the positioning of the brush, the rope should be clamped to a suitable support and the axes of the rope and socket aligned. The rope below the socket should be straight for at least 30 diameters, after which the rope may be allowed to bend but with a radius of at least 50 rope diameters.

The neck of the socket should then be sealed with a suitable heat-resistant material, to prevent passage of molten metal. Care should be taken to ensure that the sealing material is not pushed into the gap between the socket and rope. If this occurs it will prevent penetration of socketing metal through to the socket mouth, which could lead to corrosion and premature fatigue failure in service. When using sealing materials containing water, care should be taken to ensure that all moisture is driven off before starting to pour socketing metal.

8 Preheating and fluxing the socket

After preparation and aligning the brush, rope and socket, the socket should be preheated to 120 to 350 °C depending on the conditions and place of the socketing operation.

The preheat temperature should be monitored by a thermometer, pyrometer, temperature-sensitive sticks or marks, or other means suitable for ensuring that the temperature of the socket is even and within the limits set. The preheat temperature should be achieved gradually by applying heat evenly around the outer surface. Care should be taken not to overheat any part of the socket.

The preheating flame must not be allowed to come into contact with the rope or wires.

Particular care must be taken with ropes with synthetic cores to avoid overheating the socket or rope.

Immediately the preheating temperature has been achieved, the socket may be fluxed with powdered resin or a suitable proprietary compound. During this fluxing all the wires in the basket must be covered with fluxing compound.[1)]

Pouring must commence immediately on reaching the preheating temperature.

9 Preparation of socketing metal and pouring

The socketing crucible should be fed with ingots of new metal and the pouring ladle should hold at least 20 % more metal than required to fill the socket basket.

Heating of the crucible should be even, and the pouring temperature should be within the limits set by the specification or supplier of the metal.

Immediately prior to pouring, the molten metal should be stirred to prevent separation of the constituents, and to ensure that an accurate temperature measurement can be obtained.

The dross should be removed from the surface of the molten metal, and the dry pouring ladle preheated by immersing it in the pot. The molten metal should be poured into one side of the socket basket to permit the escape of gases. Pouring should be slow and continuous until the basket is full.

If the molten metal solidifies too quickly, air bubbles may become entrapped or shrinkage holes may form which can be detrimental.

Therefore, when pouring larger sockets, in particular, it is advisable to extend the cooling period. This may be accomplished by using a preheating device for some time after pouring.

Tapping the socket, whilst the metal is still molten, may help to prevent entrapment of gases within the basket.

Shrinkage sometimes occurs in the metal at the top of the basket. In these cases sufficient additional metal should be poured to fill the depression. This should be carried out as the metal solidifies, and where necessary the surface metal should be re-liquified before pouring commences.

When the socket basket has cooled the seizing shall be removed up to the mouth of the socket to facilitate inspection.

The socket must not be quenched in water at any stage during the cooling cycle.

After the socket has cooled sufficiently a suitable corrosion preventive compound should be applied to the "cleaned" length of the rope taking care to cover all the exposed wires, and to seal the mouth of the socket.

10 Socketing metals

For guidance some examples of commonly used socketing metals, together with their analyses and pouring instructions are given in annex B. Attention is drawn to the fact that certain socketing metals have been developed for particular designs of socket. In case of doubt the metal manufacturer or sponsor should be consulted.

11 Quality control

The quality of the socketing may be assessed in one of the following ways:

a) by removing the cone after solidification, and visually inspecting it to ensure that it is satisfactory. If this method is used care should be taken to ensure that the orientation of the cone in the socket is the same before and after inspection. This may be achieved by setting a mark;

b) by visual inspection to ensure that the socket metal has completely filled the annulus between the rope and the socket mouth, and that the socket is properly filled with socketing material;

c) by proof loading to 40 % of the minimum specified breaking load of the rope, after which the rope shall not have moved out of the mouth of the socket by more than 2 % of the basket length.

1) Alternatively bright wires may be fluxed using the procedures and precautions laid down in annex A.

Annex A

Pretreatment of bright rope

Before pouring, the wire brush of a bright rope may be tinned, in order to improve the adhesion between the wires and socketing metal, by the following procedure.

A.1 Fluxing

The cleaned wire brush should be dipped into a zinc chloride solution for three quarters of the brush length.

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

zinc chloride ($ZnCl_2$) :	32,6 % (m/m)
ammonium chloride (NH_4Cl_2) :	2,1 % (m/m)
hydrochloric acid (HCl) :	6,7 % (m/m)
water (H_2O) :	58,6 % (m/m)
density (at 20 °C) :	1,3 g/cm^3
dipping time :	approximately 1 min

A.2 Coating

Immediately following fluxing the still damp whole length of the wire brush is slowly immersed in molten 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 66 % 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.

A.3 Precautions

A.3.1 The fluxing solution and components are strong skin irritants. Care must be taken to ensure that they do not come into contact with the bare skin.

A.3.2 The coating process must be carried out slowly and in such a way as to avoid splashing the hot metal.

Annex B

Examples of commonly used socketing metals

B.1 Lead-based socketing alloys

Melting point : 240 °C

Pouring temperature : 350 ± 10 °C

Alloy No.	Percentage by mass of						Total impurities[1] % max.
	Sn	Sb	Cd	Cu	As	Pb	
1	4,75 to 5,25	14,5 to 15,5	—	—		remainder	0,2
2	7,0 to 8,0	9,0 to 10,0	—	—		remainder	0,2
3	9,0 to 11,0	9,0 to 11,0	1,7 to 2,5	0,3 to 0,7	0,3 to 0,7	remainder	0,2

1) Al 0,005 % max.
Zn 0,005 % max.
Cu 0,05 % max. (for alloys No. 1 and 2 only)

B.2 Tin-based socketing alloys

Melting point : 400 °C

Pouring temperature : 440 ± 10 °C

Alloy No.	Percentage by mass of				Total impurities % max.
	Sn	Sb	Cu	Pb	
4[1]	79,0 to 81,0	11,0 to 13,0	5,0 to 7,0	1,0 to 3,0	0,4
5	79,0 to 81,0	12,0 to 14,0	6,5 to 7,5	—	0,4

1) ISO 4381.

B.3 Zinc socketing

Melting point : 419 °C

Pouring temperature : 470 ± 20 °C

Alloy No.	Percentage by mass of Zn
6	99,9

B.4 Zinc-based socketing alloys

Melting point : 380 °C

Pouring temperature : 450 ± 10 °C

Alloy No.	Percentage by mass			Impurities % max.
	Al	Cu	Zn	
7	5,6 to 6,0	1,2 to 1,6	remainder	Fe 0,05 Mg 0,005 Pb, Cd 0,006 Sn 0,001