International Standard 3189/1

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

Sockets for wire ropes for general purposes — Part 1: General characteristics and conditions of acceptance

Douilles pour câbles en acier d'usages courants — Partie 1: Caractéristiques générales et conditions de réception

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Descriptors : lifting equipment, wire rope, sockets (ropes), specifications, dimensions, quality control, tests, certification.

Foreword

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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 3189/1 was prepared by Technical Committee ISO/TC 111, *Round steel link chains, lifting hooks and accessories.*

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Sockets for wire ropes for general purposes — Part 1: General characteristics and conditions of acceptance

0 Introduction

Sockets complying with this International Standard are intended for use as terminal fittings for wire ropes in general engineering applications within a temperature range of −20 to +60 °C. They may be used for other purposes, such as mine haulage, and at other temperatures, but in all cases the user should ensure that the socket is suitable for the actual usage and temperature conditions and that it complies with any national regulations.

Sockets of the type specified in this International Standard may be re-used, provided that the temperature necessary to remove the rope does not affect the properties of the material used in its manufacture. Sockets may be heat-treated, if necessary.

Each design of socket should be used only with the method or methods of socketing which have proved satisfactory by prototype testing.

Generally, the prototype tests for sockets will relate to a particular design, material and method of manufacture. Any change in that design, material or method of manufacture may require further prototype testing. It is the responsibility of the manufacturer to ensure that the modified socket meets the requirements of this International Standard.

1 Scope and field of application

This part of ISO 3189 lays down the dimensions necessary for interchangeability and specifies prototype test requirements and quality control of steel sockets for use with steel wire ropes within the nominal diameter range of 8 to 60 mm.

These sockets are not suitable for use in conjunction with locked coil and spiral strands.

This part of ISO 3189 applies to sockets which are made by one of the following methods of manufacture:

- forged or machined from solid (see also ISO 3189/2),
- cast (see also ISO 3189/3),

and used as terminal attachments for steel wire ropes complying with ISO 2408 or other nationally or internationally recognized specifications for steel wire ropes containing wires in tensile grades up to 1 770 N/mm^2 [1)] but excluding ropes with fibre strand cores.[2)]

2 References

ISO 643, *Steels — Micrographic determination of the ferritic or austenitic grain size.*

ISO 2408, *Steel wire ropes for general purposes — Characteristics.*[3)]

ISO 2859, *Sampling procedures and tables for inspection by attributes.*

ISO 3189/2, *Sockets for wire ropes for general purposes — Part 2: Special requirements for sockets produced by forging or machined from the solid.*

ISO 3189/3, *Sockets for wire ropes for general purposes — Part 3: Special requirements for sockets produced by casting.*

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 socket type I: A fitting of the open type consisting of a body and pin (see figure 1).

3.2 socket type II: A fitting of the closed type consisting of a body only (see figure 2).

4 Socket manufacture

4.1 Form

Sockets complying with this International Standard shall be either of the (open) type I or of the (closed) type II, as shown in figures 1 and 2. Sockets shall be designed to allow for the removal of the cast cone, i.e. the maximum diameter of the conical bore of the basket of the type I socket shall not exceed the internal distance between the lugs.

1) 1 N/mm^2 = 1 MPa

2) If sockets complying with this part of ISO 3189 are to be attached to ropes using wire of higher tensile grade, prototype tests based on the specified minimum breaking force for the rope concerned should be carried out.

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

4.2 Method of manufacture

Sockets complying with this part of ISO 3189 shall be manufactured in accordance with the appropriate methods specified in ISO 3189/2 and ISO 3189/3. At the time of placing the order, the user may nominate the method of manufacture. Sockets supplied shall be identical, within normal manufacturing tolerances, to those subjected to the prototype tests.

If requested by the purchaser, the supplier shall supply evidence that the design of socket has been prototype tested in accordance with this part of ISO 3189.

4.3 Materials

Sockets shall be made only from the steels specified for the particular method of manufacture (see ISO 3189/2 and ISO 3189/3).

4.4 Heat treatment

Sockets shall, if necessary after forging, gas cutting or casting, be subjected to a suitable heat treatment having regard to the material, the method of manufacture and the required mechanical properties.

4.5 Critical dimensions

The critical dimensions of sockets complying with this part of ISO 3189 shall be as specified in table 1 and illustrated in figures 1 and 2, unless otherwise specified in ISO 3189/2 and ISO 3189/3.

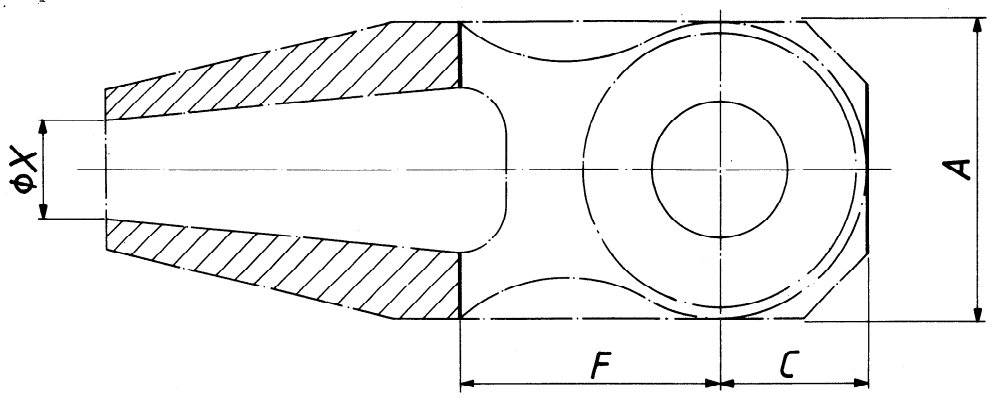
Table 1 — Dimensions of sockets

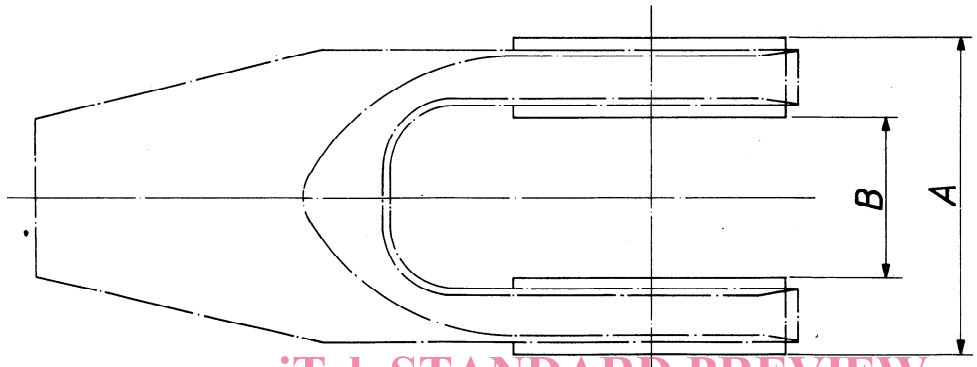
Dimensions in millimetres

Basic design size	Nominal rope diameter	*A*	*B*	*C*	*D*	*F*	*X*	*L* [Type II (closed) sockets)]
n	*d*	max.	min.	max.	min.	min.	min.	min.
10	8, 9 and 10	45	19	27	16	20	14	43
12	11 and 12	54	23	32	19	24	16	52
14	13 and 14	63	27	37	22	28	18	60
16	16	72	30	42	26	32	20	69
18	18	81	34	48	29	36	23	77
20	20	90	38	53	32	40	25	86
22	22	99	42	58	35	44	27	95
24	24	108	46	64	38	48	30	103
28	26 and 28	126	53	74	45	56	34	120
32	32	144	61	85	51	64	39	138
36	36	162	68	95	58	72	43	155
40	40	180	76	106	64	80	48	172
44	44	198	84	117	70	88	53	189
48	48	216	91	127	77	96	57	206
52	52	234	99	138	83	104	62	224
56	56	252	106	148	90	112	66	241
60	60	270	114	159	96	120	71	258

The dimensions in the above table are based on the following proportions:

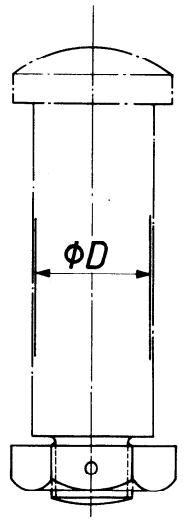
$A \leqslant 4{,}5\,n$
$B \geqslant 1{,}9\,n$
$C \leqslant 2{,}65\,n$
$\phi D \geqslant 1{,}6\,n$
$F \geqslant 2\,n$
$\phi X \geqslant 1{,}15\,n + 2$ mm
$L \geqslant 4{,}3\,n$





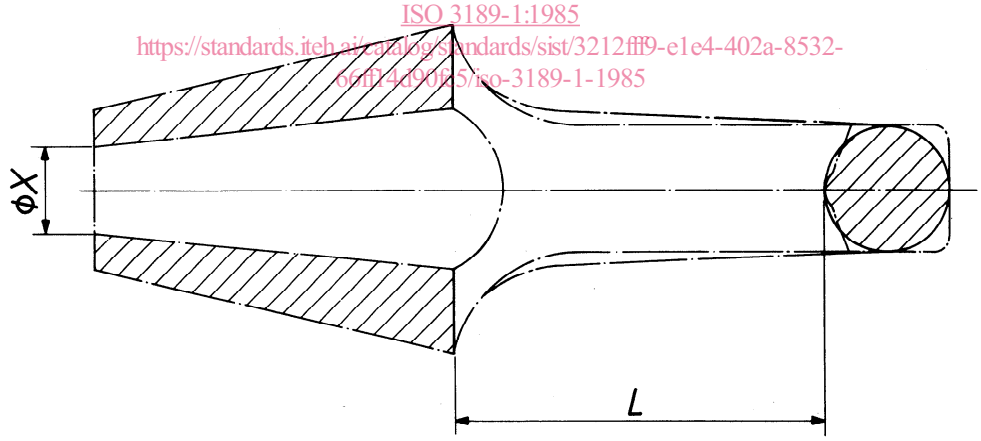
Typical socket body

NOTE — Within the limits of dimensions A, B, C, D and F, specified in table 1, the manufacturer may choose the form of lugs, basket and pin to suit the material and method of manufacture, subject to satisfactory prototype test results.



Typical socket pin

Figure 1 — Type I (open) socket



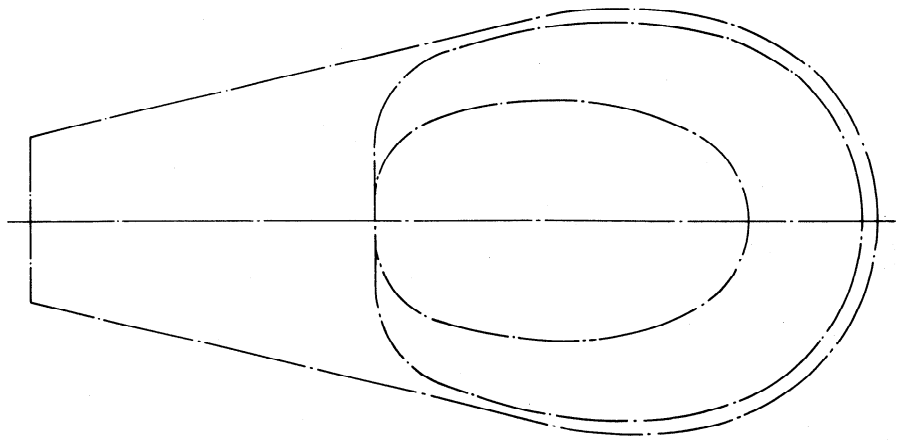


Figure 2 — Type II (closed) socket

4.6 Quality control

4.6.1 The manufacturer shall ensure that the quality of material used for the production of sockets conforms with the appropriate material specified in ISO 3189/2 and ISO 3189/3 and that the material is of the same specification as that used in the prototype test.

4.6.2 Each socket, after manufacture, shall be inspected to ensure that it is free from flaws or defects which would reduce the performance of the socket to below the requirements of this International Standard.

4.6.3 Random samples of each batch shall be taken from each production run and checked for compliance with the dimensional requirements. The number of samples taken shall be in accordance with table 2. If any sample is found to be outside any dimensional requirement, the dimension shall be checked on every socket in the batch.

4.6.4 Records of all quality control measurements and checks shall be kept for at least seven years, and shall be made available to the purchaser if so required. The manufacturer shall show evidence of an adequate system of quality control.

Table 2 — Sample size for quality control purposes

Lot or batch size (Number of sockets)	**Sample size** (Number of sockets)
2 to 13	Each socket
14 to 90	13
91 to 150	20
151 to 280	32
281 to 500	50
501 to 1 200	80
1 201 to 3 200	125
3 201 to 10 000	200

5 Method of socketing

The method of socketing shall be one of those which has passed the prototype test given in 6.2 for the particular design, material and method of manufacture of socket.

Attention is drawn to the following ISO publications:

ISO 7595, *Socketing procedures for wire ropes — Molten metal socketing.*

ISO/TR 7596, *Socketing procedures for wire ropes — Resin socketing.*

6 Prototype tests

Prototype tests are intended to demonstrate that the socket specified by the manufacturer and certified in accordance with clause 10, and each of the methods of socketing declared as being suitable for use with it, can withstand the maximum loading to be imposed on it under normal conditions of usage.

Prototype tests are divided into two groups, that is one group consisting of tests on the sockets (see 6.1) and the other on the socketed assembly (see 6.2). While the tests in each group are considered separately in this part of ISO 3189, tensile tests for the same size in each group (see 6.1.1 and 6.2.1) may be carried out concurrently in a single test, provided all the necessary data can be obtained.

6.1 Prototype tests on sockets

The purpose of these tests is to prove the design, material and method of manufacture of the sockets. Tests to prove socketed assemblies are given in 6.2.

6.1.1 Tensile test

Two tensile tests shall be carried out on each size of socket of each design, material and method of manufacture. An apparatus suitable for testing type I (open) sockets with machined internal surfaces is shown in figure 3. For the type II (closed) socket, a suitable device designed to apply the force in a comparable manner shall be used. The force shall be applied in two stages as follows:

Stage 1

A force equal to 40 % of the minimum specified breaking force[1)] of the strongest rope for which the socket is designed (see table 4) shall be applied and held for 2 min. On removing this force, the socket shall be deemed to have satisfied this stage of the test if, compared with their initial values,

a) the increase in the diameter of the pin hole does not exceed 0,2 % or 0,1 mm, whichever is the greater; in the case of type II (closed) sockets, the internal dimensions of the lug shall not have varied by more than 0,2 % or 0,1 mm, whichever is the greater;

b) the increase in diameter at the socket mouth (ϕX in table 1) does not exceed 0,2 % or 0,1 mm, whichever is the greater.

Stage 2

The force shall then be re-applied to the socket and increased quickly to not more than 80 % of the reference test force given in table 3. Thereafter the force shall be increased slowly until the reference test force has been reached. The socket shall be deemed to have satisfied this stage of the test if it shows no evidence of cracking or splitting when subjected to non-destructive testing (NDT) examination, such as magnetic particle inspection. In the case of sockets with pins, the force shall be applied uniformly over the length of the pins, until the value shown in table 3 has been reached.

6.1.2 Pulsatory fatigue test

The range of sizes of sockets is divided into four groups (see table 1). From each group of sizes, one size shall be selected for test, representing each design, material and method of manufacture of socket in the manufacturer's range. The test shall be carried out on four samples of each size selected.

The fatigue forces may be applied to the socket by a split steel cone on a steel stem as shown in figure 3. The steel stem should have a tensile strength of approximately

1) ISO 2408 currently refers to the term "minimum breaking load".

1 100 N/mm² (MPa). In order to prevent premature fatigue failure of the stem by fretting, an interleaf of a thermosetting phenolic resin with a fibre reinforcement may be placed between the split cones and the stem.

After being subjected to a proof test force of not less than that given in table 4, the socket shall be capable of withstanding, without failure, 2×10^6 cycles of a pulsating force[1], in newtons, from $10\ d_1{}^2$ to $185\ d_1{}^2$, where d_1 is the maximum rope diameter, in millimetres. In the case of the type I (open) sockets, the pin shall be subjected to a uniformly distributed force.

6.2 Prototype tests on socketed assemblies

These tests are designed to assess the suitability of each design, material and method of manufacture of socket and the declared methods of socketing. Consequently it is also a test of the declared socketing methods.

6.2.1 Tensile test

Two tests shall be carried out on each size of socket of each design, material and method of manufacture and for each nominal diameter of rope, d, given in table 3, using the socketing method in question. When the sockets are tested in pairs, the distance between the inner faces of the sockets shall be at least 30 d. The force may be applied quickly up to not more than 80 % of the reference test force given in table 3. Thereafter, the force shall be increased slowly until the reference test force has been reached.

This test may be carried out concurrently with that specified in 6.1.1. In the case of sockets with pins, the force shall be applied uniformly over the length of the pins, until the value shown in table 3 has been reached.

After completion of the test, the rope shall not have moved out of the socket mouth by more than 2 % of the basket length.

6.2.2 Pulsatory fatigue test

The rope constructions used for these tests shall be 6 × 7 IWR and 6 × 36 IWR, using wire of tensile grade 1 770 N/mm²[2].

For those countries where 6 × 7 IWR constructions are not in general use, sockets need not be tested using these constructions. In this case, a 6 × 19 IWR rope may be substituted for the 6 × 7 IWR for the purpose of the pulsatory fatigue test, but a statement to this effect shall be included in the test certificate (see clause 10). Such sockets shall not be used for 6 × 7 IWR ropes unless they are subjected to the tests specified for such constructions.

The range of sizes of sockets is divided into four groups (see table 1). From each group of sizes, one size shall be selected for test, representing each design, material and method of manufacture of socket in the manufacturer's range.

The tests shall be carried out on four test pieces from each size selected, for each of the socketing methods to be approved. When the sockets are tested in pairs, the length of the rope between the sockets shall be as for the prototype tensile test. Each assembly shall be subjected to a cyclic tension along the rope axis from 15 % to 30 % of the relevant values in table 3.

The machine frequency shall not exceed 4 Hz.

To comply with this part of ISO 3189, each of the assemblies selected for the prototype test shall withstand 75 000 cycles after which the breaking force of the assembly shall not be less than the reference test force given in table 3.

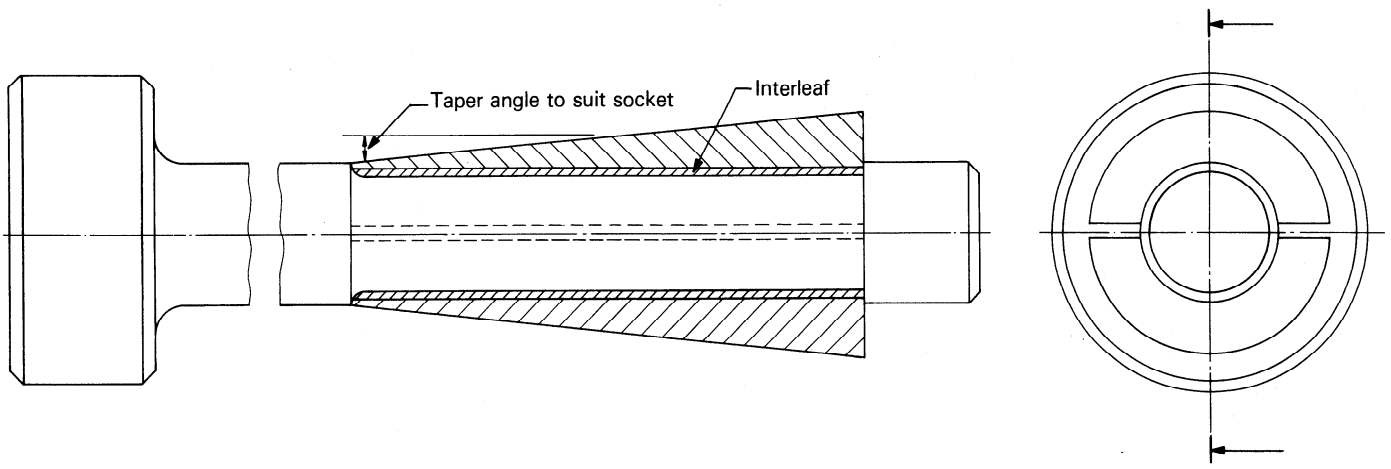


Figure 3 — Split cone and stem for testing sockets

1) If sockets complying with this part of ISO 3189 are to be attached to ropes using wire of higher tensile grade, the pulsatory force should be appropriately increased.

2) If sockets complying with this part of ISO 3189 are to be attached to ropes using wire of higher minimum breaking force, then ropes of that grade should be used in these tests and the pulsatory force should be appropriately increased.

Table 3 — Reference test force

Nominal diameter of wire rope d mm	Type of rope construction		
	6 × 7 IWR	6 × 19 IWR	6 × 36 IWR
	Reference test force		
	kN	kN	kN
8	37	36	—
9	46	46	46
10	57	57	57
11	69	69	69
12	82	82	82
13	96	96	96
14	112	112	112
16	147	145	145
18	185	184	184
20	—	—	227
22	—	—	275
24	—	—	327
26	—	—	383
28	—	—	445
32	—	—	581
36	—	—	735
40	—	—	909
44	—	—	1 098
48	—	—	1 305
52	—	—	1 539
56	—	—	1 782
60	—	—	2 043

NOTE — The reference test force is based on 90 % of the minimum breaking force of ropes of tensile grade 1 770 N/mm² with wire rope cores (IWR), as given in ISO 2408, and rounded to the nearest kilonewton. If sockets are to be used with ropes of higher tensile grade, then these reference test forces should be appropriately increased.

6.3 Procedure for re-tests

If any one test piece, subjected to the tests described in 6.1 and 6.2, fails to pass a test, a further two samples of the same size of each design, material and method of manufacture shall be tested for the characteristics in question. If all of these pass the test, the socket or socketed assembly shall be deemed to have passed the prototype tests. If one or more fail, the socket or socketed assembly shall be deemed to have failed the prototype tests.

7 Condition

Each socket shall be supplied either free from any coating, galvanized or coated with an anti-corrosion agent as specified by the purchaser.

8 Proof test

Where required by the purchaser or by national regulations, each finished socket shall be subjected to the proof test force specified in table 4, using the apparatus shown in figure 3 or other suitable apparatus. It shall withstand this proof force with a permanent set of not more than 0,2 % or 0,1 mm, whichever is the greater, when measured at the pin hole in the case of the type I socket and on the main internal dimensions of the bow of the type II socket.

Table 4 — Proof test force

Basic design size mm	Proof test force kN
10	25
12	37
14	50
16	65
18	82
20	100
22	120
24	150
28	200
32	260
36	330
40	400
44	490
48	580
52	680
56	790
60	910

NOTE — The proof test force is based on 40 % of the minimum breaking load of the strongest rope, as given in ISO 2408, for which the socket is deemed to be suitable. If sockets are to be used subsequently with ropes of higher tensile grades, the proof test force should be appropriately increased.

9 Identification and marking

Each socket shall be legibly and permanently marked with the nominal diameter of rope with which it may be used. When required, the body and the pin shall be permanently marked with such marks or symbols as will provide identification with the manufacturer's certificate of test. The identification marking shall not affect the performance of the socket.

10 Certification

When it is required by the purchaser or necessary to comply with statutory regulations, the manufacturer or supplier shall provide a certificate giving the following information:

a) the name and address of the manufacturer;

b) the identification marks or symbols, as required by clause 9;

c) the type, basic design size (see table 1) and the method of manufacture (as specified in this part of ISO 3189, ISO 3189/2 and ISO 3189/3);

d) the specification of the material from which the sockets were made;

e) the type of final heat treatment given to the sockets (see 4.4);

f) the proof test force applied to the socket;

1) in prototype testing;

2) where required on each socket, if requested by the purchaser or required by national regulations (see clause 8);

g) a statement that the sockets are of the same design, material and method of manufacture which has passed the prototype tests given in clause 6;

h) the specific methods of socketing for which the socket is suitable and a statement that these methods of socketing have passed the prototype tests in clause 6;

j) a statement as to whether the sockets and socketing have been tested for use with wire ropes of tensile grade higher than 1 770 N/mm², if applicable.