
**Chain components for lifting
purposes — Forged eye hook with
point and latch — Grade 4, stainless
steel, solution annealed**

*Éléments de chaînes de levage — Crochets de levage forgés en acier à
bec et à œil — Grade 4, acier inoxydable, recuit d'homogénéisation*

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Published in Switzerland

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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. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 111, *Round steel link chains, chain slings, components and accessories*, Subcommittee SC 3, *Components and accessories*.

This second edition cancels and replaces the first edition (ISO 4779:1986), which has been technically revised.

The main changes compared to the previous edition are as follows:

- limitation of the materials used to stainless steels;
- corresponding adaptation of the alloy elements and heat treatment;
- reduction of the sizes, corresponding to the related nominal chain sizes;
- including detailed formulae base for calculation of dimensions, working load limits and mechanical requirements in [Annex A](#).

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Chain components for lifting purposes — Forged eye hook with point and latch — Grade 4, stainless steel, solution annealed

1 Scope

This document specifies the requirements for forged eye hooks with point and latch of grade 4 from stainless steel and solution annealed for use preferably as a component in chain slings of welded construction of grade 4 from stainless steel and solution annealed.

IMPORTANT — For other applications, e.g. steel wire rope slings or textile slings, it is important that the hook design is checked to ensure its fitness for a safe use.

NOTE 1 The grade for the hook according to this document is taken from the grade of the sling chain according to ISO 1835. Both (sling chains and hooks) have identical scopes and values for the working load limit, *WLL*, according to Table 2 and values for the mechanical requirements according to Table 3. Thus, the direct correlation of hooks to the sling chain is given by the *WLL* and especially the code system on the product body itself. The grade of the hook does not define any values of the tensile strength of the hook material. For further information, see Annex B.

The range of the nominal diameter, d_n , of the associated sling chain according to ISO 1835 is from 4 mm to 22 mm.

Hooks according to this document are for use in the temperature range $-100\text{ }^{\circ}\text{C}$ to $+400\text{ }^{\circ}\text{C}$.

These hooks are solution annealed in the finished condition and can therefore be used without restrictions with regard to the corrosion resistance of the steels according to 5.1.

NOTE 2 The term “eye hook with point and latch” is taken from ISO 1837:2003, Figure 5.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO 1835, *Round steel short link chains for lifting purposes — Medium tolerance sling chains — Grade 4, stainless steel*

ISO 1837, *Lifting hooks — Nomenclature*

ISO 3452-1, *Non-destructive testing — Penetrant testing — Part 1: General principles*

ISO 7500-1, *Metallic materials — Calibration and verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Calibration and verification of the force-measuring system*

ISO 8539, *Forged steel lifting components for use with Grade 8 chain*

ISO 13385-1, *Geometrical product specifications (GPS) — Dimensional measuring equipment — Part 1: Design and metrological characteristics of callipers*

ISO 16143-2, *Stainless steels for general purposes — Part 2: Corrosion-resistant semi-finished products, bars, rods and sections*

EN 10228-2, *Non-destructive testing of steel forgings - Part 2: Penetrant testing*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1837, ISO 8539 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1

nominal size

combination of numerical values without units for designation and ordering purposes, which indicates the nominal diameter of the associated round steel link chain and the grade of the forged component

EXAMPLE 10-4

3.2

test force

F_T

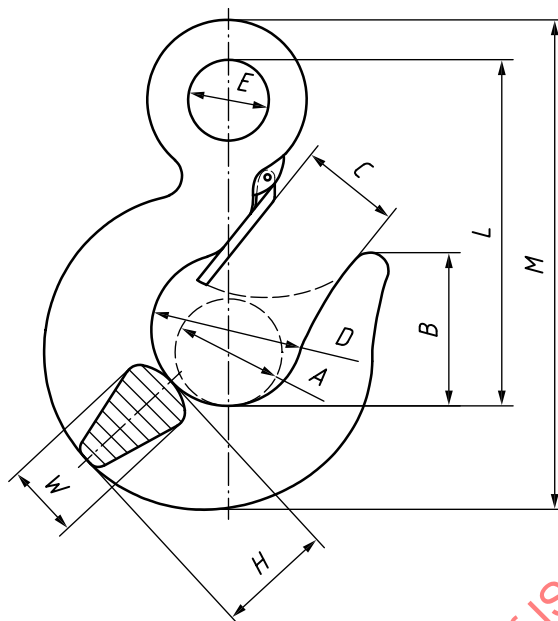
force applied to the hook during the tensile test

4 Dimensions and designation

4.1 Dimensions

The bases for calculation of the values for the dimension limits listed in [Table 1](#) are given in [Annex A](#). The corresponding dimension letters are shown in [Figure 1](#). The specified values are absolute limits.

The geometry of the hook is not specified in detail. Therefore, [Figure 1](#) specifies only where the dimension values according to [Table 1](#) are measured.

**Key**

<i>A</i>	bar diameter	<i>D</i>	seat diameter	<i>L</i>	inner length
<i>B</i>	point height	<i>E</i>	eye dimension	<i>M</i>	outer length, see 5.6.3
<i>C</i>	throat opening	<i>H</i>	seat height	<i>W</i>	seat width

Figure 1 — Dimensions of hooks

Preferred nominal sizes are given in Table 1, column 1. Other nominal sizes may be used, provided the corresponding dimensions are calculated in accordance with Annex A.

Table 1 — Dimension limits

Dimensions in millimetres

1	2	3	4	5	6	7	8	9	10
Nominal size	<i>A</i> max	<i>B</i> min	<i>C</i> min	<i>C</i> max	<i>D</i> min	<i>E</i> min	<i>H</i> max	<i>L</i> max	<i>W</i> max
4 - 4	10	12	11	14	15	10	17	62	12
6 - 4	15	17	16	21	22	15	26	93	17
8 - 4	21	23	22	27	30	20	34	124	23
10 - 4	26	29	27	35	38	25	44	157	29
13 - 4	33	38	35	45	49	33	56	202	38
16 - 4	41	47	43	55	60	40	69	248	46
18 - 4	46	52	48	61	67	45	77	277	52
20 - 4	51	58	54	69	75	50	86	311	58
22 - 4	56	64	59	75	82	55	94	340	64

4.2 Designation

The designation of the hook shall be in accordance with the general format given in Figure 2.

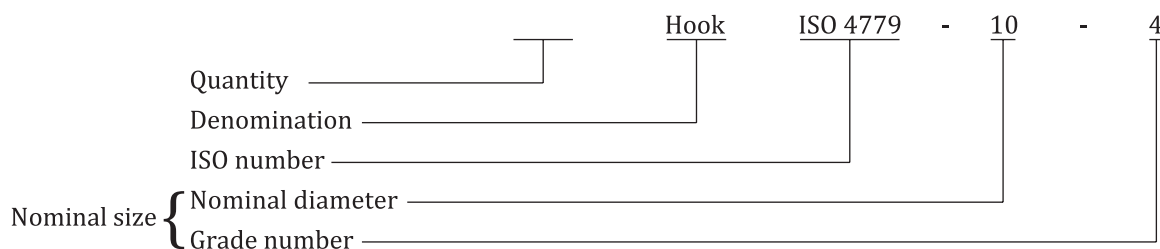


Figure 2 — General format

5 Requirements

5.1 Material

The steel used shall be austenitic stainless steels with molybdenum and shall be resistant against intergranular corrosion.

NOTE 1 For example the steel with the ISO name X6CrNiMoTi17-12-2 respectively with the ISO number 4571 316-35-I according to ISO 15510.

NOTE 2 The resistance against pitting corrosion will be increased by alloying with molybdenum.

After solution annealing, intergranular corrosion is unlikely at a service temperature of +400 °C and with an extra low carbon content of the steel. To avoid this corrosive attack under severe service conditions and with higher carbon contents of the steel, a stabilization with titanium is recommended.

NOTE 3 According to ISO 15510, the above-mentioned stainless steel is also well known under the number S31635, where 35 means titanium added. Internationally equivalent numbers of the steel according to 5.1 are 1.4571, AISI/SAE 316Ti and UNS S31635.

5.2 Manufacture

The hook shall be drop forged hot in one piece. It shall be free from any harmful surface defects, including cracks.

5.3 Heat treatment

The hooks shall be solution annealed within a temperature range of 1 020 °C to 1 120 °C required by ISO 16143-2 and cooled rapidly by water. The enhanced corrosion resistance of each hook requires the passivation of the surface by pickling after heat treatment to obtain a smooth surface condition.

5.4 Dimensions

It is the responsibility of the manufacturer to select the nominal dimensions and tolerances from the dimension limits according to Table 1, so that the finished hook complies with the mechanical properties specified in this document.

The dimensions shall be as given in Table 1, columns 2 to 10.

The geometry of the eye shall be designed to cover a diameter equal to eye dimension, E , but the eye needs not to be circular.

In addition, the following requirements shall be met:

- the actual point height, B , shall be equal to or greater than the actual throat opening, C ;
- the actual throat opening, C , shall not exceed 90 % of the actual seat diameter, D ;

- c) the latch shall be capable to close over the actual bar diameter, A ;
- d) the actual bar diameter, A , shall not exceed 90 % of the actual throat opening, C ;
- e) for direct use in wire rope slings and textile slings, the actual eye dimension, E , should be larger than the value given in [Table 1](#).

5.5 Working load limit, WLL

[Table 2](#) gives values for the working load limit, WLL , specified by ISO 1835. For other nominal sizes, the values for the working load limit, WLL , shall be calculated in accordance with [A.2](#).

Table 2 — Working load limit

1	2
Nominal size	Working load limit WLL t
4 - 4	0,25
6 - 4	0,56
8 - 4	1,00
10 - 4	1,60
13 - 4	2,65
16 - 4	4,00
18 - 4	5,00
20 - 4	6,30
22 - 4	7,50

5.6 Mechanical properties

5.6.1 General

Hooks according to this document shall comply with the mechanical requirements as given in [Table 3](#), columns 2 and 3.

Table 3 — Mechanical requirements

1	2	3
Nominal size	Test force F_T kN	Breaking force F_B kN min
4 - 4	5,0	10,0
6 - 4	11,2	22,4
8 - 4	20,0	40,0
10 - 4	31,5	63,0
13 - 4	53,0	106
16 - 4	80,0	160
18 - 4	100	200
20 - 4	125	250
22 - 4	150	300

5.6.2 Test force, F_T

Each hook shall be capable of sustaining the test force, F_T , specified in [Table 3](#), column 2, calculated on the bases given in [Annex A](#).

5.6.3 Elongation at test force

Following the removal of the force, the dimensions shall be within the tolerances specified on the component manufacturer's drawings. In no case shall any dimension alter by more than 1,0 % of the initial dimension after the test force has been applied and removed.

5.6.4 Breaking force, F_B

Each hook shall have a breaking force, F_B , at least equal to that specified in [Table 3](#), column 3. The values for the breaking force, F_B , are calculated on the bases given in [Annex A](#).

5.6.5 Deformation

On completion of the static tensile test there shall be a clearly visible widening of the throat opening. The dimension of the throat opening, C , shall have an increase of at least 100 % until it fails to sustain the load.

5.7 Surface condition

Hooks shall be free from scale, surface cracks or notches which impair their usability.

The verification of all hooks according to this document concerning actual indications of cracks and notches takes place through the manufacturing examination according to [6.3](#).

6 Tests

6.1 Qualification of personnel

All tests shall be carried out by a competent person as defined in ISO 8539.

6.2 Type tests

6.2.1 General

Type tests demonstrate that hooks certified by the manufacturer as complying with the requirements laid down in this document possess the mechanical properties specified in this document.

The purpose of these tests is to prove the design, material, heat treatment and method of manufacture of each nominal size of finished hook. Any change in design, material specification, heat treatment, method of manufacture or in any dimension outside normal manufacturing tolerances which may lead to a modification of the mechanical properties (specified in [5.6](#)) shall require that the type tests are carried out on the modified hook.

For the type test, three hooks shall be selected for each nominal size.

Only if all three samples pass the type tests, the hooks of this nominal size comply to this document.

6.2.2 Dimension test

The dimensions of the hooks as specified in [Table 1](#) shall be checked using a calliper in accordance with ISO 13385-1.

6.2.3 Surface test

After heat treatment and de-scaling, the surface of each hook shall be checked for cracks and notches using dye penetrant examination in accordance with ISO 3452-1 or EN 10228-2.

Indications greater than 2 mm in length shall not be permitted. Indications may be removed by grinding provided after removal the hook shall confirm to the dimensions and tolerances selected by the manufacturer.

A final examination shall show no indications greater than 2 mm in length.

CAUTION — Care should be taken when removing indications to ensure that the direction and roughness of grinding does not create starting points for fatigue failure and cause excessive heating, which may have a local effect on the heat-treated conditions or may cause cracks.

6.2.4 Tensile test

6.2.4.1 Testing machine

The testing machine shall be calibrated in accordance with ISO 7500-1 and shall comply with class 1 of machine range.

The machine shall be verified and adjusted as necessary by a competent and independent person at intervals not exceeding 12 months.

A signed certificate of the last examination shall be displayed prominently near the machine.

The machine shall be equipped with an autographic recorder to record a force-extension-diagram.

6.2.4.2 Procedure

6.2.4.2.1 General

During the tensile test the force shall be applied to the hook axially without shock, using test fixtures with a diameter $\leq 50\%$ of the actual seat diameter, D , and of the actual eye dimension, E .

The hook shall be gripped in such a manner that it can be freely loaded. The force shall be applied smoothly until the end of the test.

6.2.4.2.2 Test force, F_T

When the test force is applied it shall be simultaneously recorded in the force-extension diagram.

6.2.4.2.3 Elongation at test force

The elongation at test force as specified in [5.6.3](#) shall be checked using a calliper in accordance with ISO 13385-1.

6.2.4.2.4 Breaking force, F_B

The value for the breaking force, F_B , is the maximum of the curve in the force-extension diagram.

6.2.4.2.5 Deformation

Based on the requirement of [5.6.5](#), at the end of the static tensile test the deformation is determined by the actual dimension, C , in relation to the dimension at the start of the test using a calliper according to ISO 13385-1.

6.3 Manufacturing examination

After heat treatment, the surface of each hook shall be examined for cracks and notches using suitable methods.

6.4 End tests

6.4.1 General

Conformance with this document is verified by the end tests, conducted as lot by lot tests, after finishing the manufacturing processes. A lot is defined as a number of finished hooks manufactured from a single material batch in a continuous drop forging process, followed by a joint heat treatment.

Apart from the dimension test, the end tests are conducted as destructive tests on samples taken from each lot.

6.4.2 Size of lot

A single lot comprises a manufacturing unit of 200 hooks. Any started manufacturing unit is deemed to be one lot.

6.4.3 Sampling

For the dimension test, three hooks shall be selected from a single lot.

For the static tensile test, one single hook shall be selected from each lot.

6.4.4 Dimension test

The dimensions of the hooks as specified in [Table 1](#) shall be checked using a calliper in accordance with ISO 13385-1.

6.4.5 Tensile test

6.4.5.1 Testing machine

The testing machine shall be calibrated in accordance with ISO 7500-1 and shall comply with class 1 of machine range.

The machine shall be verified and adjusted as necessary by a competent and independent person at intervals not exceeding 12 months.

A signed certificate of the last examination shall be displayed prominently near the machine.

The machine shall be equipped with an autographic recorder to record a force-extension-diagram.

6.4.5.2 Procedure

6.4.5.2.1 General

During the tensile test the force shall be applied to the hook axially without shock, using test fixtures with a diameter $\leq 50\%$ either of the actual seat diameter, D , or of the actual eye dimension, E .

The hook shall be gripped in such a manner that it can be freely loaded. The force shall be applied smoothly until the end of the test.

6.4.5.2.2 Test force, F_T

The hook is loaded with the test force, F_T , which is simultaneously recorded in the force-extension diagram.

6.4.5.2.3 Elongation at test force

The elongation at test force as specified in 5.6.3 shall be checked using a calliper in accordance with ISO 13385-1.

6.4.5.2.4 Breaking force, F_B

The value for the breaking force, F_B , is the maximum of the curve in the force-extension diagram.

6.4.5.2.5 Deformation

Based on the requirement of 5.6.5, at the end of the static tensile test the deformation is determined by the actual dimension, C , in relation to the dimension at the start of the test using a calliper according to ISO 13385-1.

7 Marking

Each hook shall be legibly and indelibly marked by the manufacturer in a manner which will not impair the mechanical properties of the hook. The marking placed on the hook shall include at least the following information:

- a) the number for the nominal diameter, d_n , of the associated sling chain, with which the hook is compatible;
- b) the grade number “4”, designating the grade of the associated sling chain;
- c) a mark that indicates that the hook is manufactured from stainless steel, e.g. “st”;
- d) the manufacturer’s name, identification mark or symbol;
- e) the traceability code.

8 Certificates

8.1 Type test certificate

When the type test has been carried out with satisfactory result, the manufacturer may issue the type test certificate for conformity of hooks with the same nominal dimensions, nominal sizes, material, heat treatment and method of manufacture.

The manufacturer shall keep a record for at least 10 years after the last certificate has been issued, of the material specification, heat treatment, dimensions, test results and all relevant data concerning these hooks which have passed the type tests.

This record shall also include the manufacturing specifications, which shall apply to subsequent production.

Any change in material specification, in method of manufacture, in heat treatment or in any dimension outside normal manufacturing tolerances of a hook, which may lead to a modification of the mechanical properties shall be considered as a design change. Type tests are required before the manufacturer is permitted to issue type test certificates of conformity for any modified design.

8.2 Manufacturer's certificate

After the end test has been carried out with satisfactory results, the manufacturer shall issue a certificate with every supply of hooks, which includes at least the following information:

- a) the name and address of the manufacturer including the date of issue and authentication;
- b) the number of this document;
- c) the number for the nominal diameter, d_n , of the associated sling chain, with which the hook is compatible, in millimetres;
- d) the grade number "4", designating the grade of the associated sling chain;
- e) the quantity and denomination;
- f) the working load limit, expressed in tonnes;
- g) the test force, expressed in kilonewtons;
- h) the breaking force, expressed in kilonewtons;
- i) the traceability code.

The manufacturing records shall be kept for at least 10 years.

9 Instructions for use

Concerning the use, inspection and maintenance of hooks from stainless steel according to this document the manufacturer shall provide specific instructions.

10 Environmental issues

In general, hooks from stainless steel according to this document are highly durable without loss of quality in the course of their service life.

Due to the material used, the hooks are 100 % recyclable at the end of their life cycle (removal from service), as they can be melted down completely to produce new materials.

Annex A (informative)

Bases for the calculation

A.1 Dimensions

The dimension limits given in [Table 1](#) are derived from the following formulae:

$$A_{\max} = 19,4\sqrt{WLL} \quad (\text{A.1})$$

where $A_{\max}$ is 90 % of $C_{\min}$.

$$B_{\min} = 23,3\sqrt{WLL} \quad (\text{A.2})$$

where $B_{\min}$ is 85 % of $C_{\max}$.

$$C_{\min} = 21,6\sqrt{WLL} \quad (\text{A.3})$$

$$C_{\max} = 27,4\sqrt{WLL} \quad (\text{A.4})$$

where $C_{\max}$ is 90 % of $D_{\min}$.

$$D_{\min} = 30,4\sqrt{WLL} \quad (\text{A.5})$$

$$E_{\min} = 20,1\sqrt{WLL} \quad (\text{A.6})$$

NOTE This eye dimension, E , corresponds to 2,5 times the nominal diameter, d_n , of the corresponding sling chain according to ISO 1835.

$$H_{\max} = 34,4\sqrt{WLL} \quad (\text{A.7})$$

$$L_{\max} = 124\sqrt{WLL} \quad (\text{A.8})$$

$$W_{\max} = 23,2\sqrt{WLL} \quad (\text{A.9})$$

For [Formulae \(A.1\) to \(A.9\)](#) WLL is the working load limit, expressed in tonnes (t).

The dimension limits are calculated by using the values for the working load limit, WLL , given in [Table 1](#) and rounded to the nearest whole number.

NOTE The factors for the [Formulae \(A.1\) to \(A.9\)](#) derived from ISO 4779:1986, Table 1 (see line 3 with WLL of 1 t).

A.2 Working load limit, WLL

For nominal sizes according to [Table 2](#) the values for the working load limit, WLL , are identical to the values of the working load limit, WLL , of the associated sling chain according to ISO 1835.

For other nominal sizes the values for the working load limit, WLL , are based on [Formula \(A.10\)](#):

$$WLL = \frac{2 \times \frac{1}{4} \times \pi \times 100 \times d_n^2}{g \times 1000} \quad (A.10)$$

$$WLL = 0,016\,018 \times d_n^2$$

where

WLL is the working load limit, WLL , expressed in tonnes;

d_n nominal diameter of the associated sling chain according to ISO 1835;

g is the acceleration due to gravity, expressed in metres per square second (m/s², i.e. 9,806 65).

Based upon ISO 2374, the calculated values are rounded down to the nearest lower value of the R40 series of preferred numbers in accordance with ISO 497. These rounded values are listed in [Table 2](#), column 2.

A.3 Mechanical requirements

A.3.1 Test force

The values for the test force, F_T , given in [Table 3](#) are based on [Formula \(A.11\)](#):

$$F_T = 2,0 \times WLL \times g \quad (A.11)$$

$$F_T = 19,613 \times WLL$$

where

WLL is the working load limit, WLL , according to [Table 2](#), expressed in tonnes;

g is the acceleration due to gravity, expressed in metres per square second (m/s², i.e. 9,806 65).

The calculated values are rounded up to the nearest value of the R40 series of preferred numbers in accordance with ISO 497. These rounded values are listed in [Table 3](#), column 2.

A.3.2 Breaking force

The values for the breaking force, F_B , given in [Table 3](#) are based on [Formula \(A.12\)](#):

$$F_B = 4,0 \times WLL \times g \quad (A.12)$$

$$F_B = 39,227 \times WLL$$

where