INTERNATIONAL STANDARD

ISO 3076

Third edition
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Round steel short link chains for general lifting purposes — Medium tolerance sling chains for chain slings — Grade 8

Chaînes de levage général en acier, de section ronde, à maillons courts — Chaînes de tolérance moyenne pour élingues — Classe 8

Reference number
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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 3076 was prepared by Technical Committee ISO/TC 111, *Round steel link chains, chain slings, components and accessories*, Subcommittee SC 1, *Chains and chain slings*.

This third edition cancels and replaces the second edition (ISO 3076:1984), which has been technically revised.

Round steel short link chains for general lifting purposes — Medium tolerance sling chains for chain slings — Grade 8

1 Scope

This International Standard specifies the requirements for medium tolerance sling chains of grade 8 for use in chain slings and for general lifting purposes.

They are round steel short link chains (3 d_n), electrically welded, heat treated and tested; they comply with the general conditions of acceptance of ISO 1834.

NOTE 1 Butt welding and flash butt welding are listed in ISO 4063.

The range of nominal sizes covered by this International Standard is from 4 mm to 45 mm. They are for use in the temperature range –40 °C to +400 °C.

NOTE 2 Concerning the use and maintenance of chain slings of grade 8, see ISO 3056.

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.

ISO 148-1, *Metallic materials — Charpy pendulum impact test — Part 1: Test method*

ISO 643, *Steels — Micrographic determination of the apparent grain size*

ISO 1035-1, *Hot-rolled steel bars — Part 1: Dimensions of round bars*

ISO 1834, *Short link chain for lifting purposes — General conditions of acceptance*

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

ISO 14556, *Steel — Charpy V-notch pendulum impact test — Instrumented test method*

ISO 16124, *Steel wire rod — Dimensions and tolerances*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1834 apply.

4 General conditions of acceptance

The sling chains shall comply with the requirements of ISO 1834 as well as those of this International Standard.

5 Dimensions

5.1 Nominal size, d_n

The nominal size, d_n, of the sling chain shall be one of the nominal sizes listed in Table 1, column 1, corresponding to the nominal diameter of the steel wire in accordance with ISO 16124 or bar in accordance with ISO 1035-1 from which the sling chain is made.

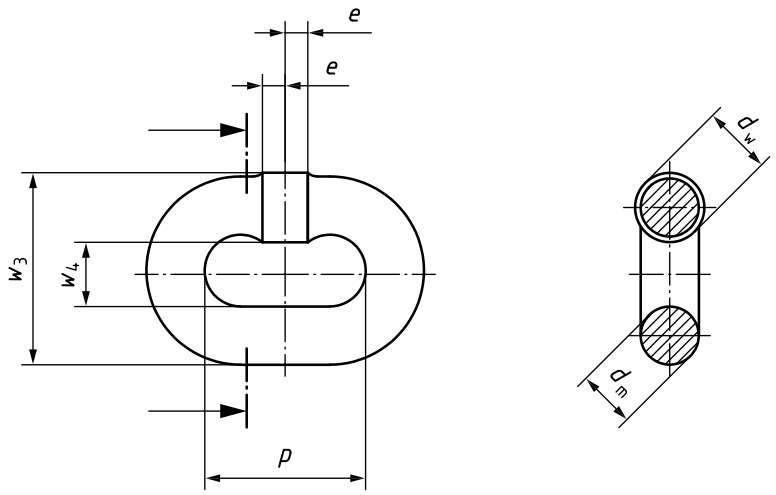
Other nominal sizes may be used, provided the dimensions and tolerances are calculated in accordance with Annex A.

NOTE Intermediate nominal chain sizes increase the potential of mismatch with mating components. Manufacturers of sling chain and component assemblies are expected to ensure that the sling chain and components are compatible.

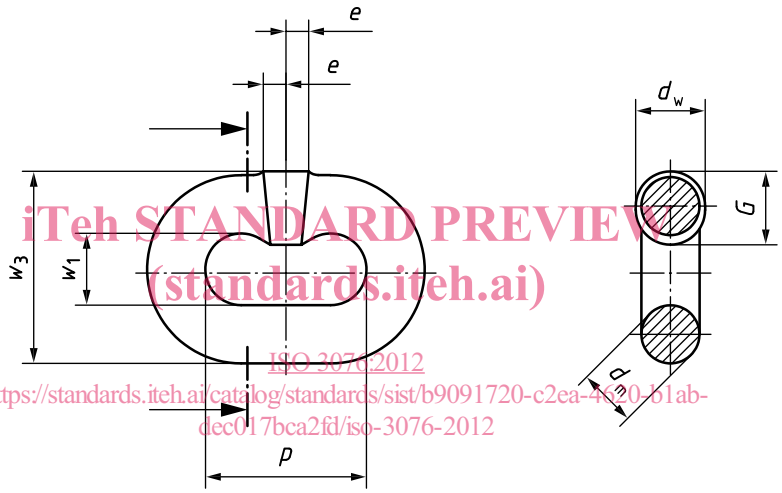
Table 1 — Dimensions

Dimensions in millimetres

1	2	3	4	5	6	7	8	9
Nominal size	**Diameter tolerance**	**Pitch**		**Width**			**Weld diameter**	
				Internal	**External**	**Internal**		
			Tolerance	**Type 2**	**Types 1 and 2**	**Type 1**	**Types 1 and 2**	**Type 2**
d_n		p_n		w_1 min.	w_3 max.	w_4 min.	d_w max.	G max.
4	+0,08/–0,24	12	±0,4	5,0	14,8	5,2	4,4	5,0
6	+0,12/–0,36	18	±0,5	7,5	22,2	7,8	6,6	7,5
7	+0,14/–0,42	21	±0,6	8,8	25,9	9,1	7,7	8,8
8	+0,16/–0,48	24	±0,7	10,0	29,6	10,4	8,8	10,0
10	+0,20/–0,60	30	±0,9	12,5	37,0	13,0	11,0	12,5
13	+0,26/–0,78	39	±1,2	16,3	48,1	16,9	14,3	16,3
16	+0,32/–0,96	48	±1,4	20,0	59,2	20,8	17,6	20,0
18	±0,9	54	±1,6	22,5	66,6	23,4	19,8	22,5
19	±0,95	57	±1,7	23,8	70,3	24,7	20,9	23,8
20	±1,0	60	±1,8	25,0	74,0	26,0	22,0	25,0
22	±1,1	66	±2,0	27,5	81,4	28,6	24,2	27,5
26	±1,3	78	±2,3	32,5	96,2	33,8	28,6	32,5
28	±1,4	84	±2,5	35,0	104,0	36,4	30,8	35,0
32	±1,6	96	±2,9	40,0	118,0	41,6	35,2	40,0
36	±1,8	108	±3,2	45,0	133,0	46,8	39,6	45,0
40	±2,0	120	±3,6	50,0	148,0	52,0	44,0	50,0
45	±2,25	135	±4,1	56,3	167,0	58,5	49,5	56,3



a) Type 1



b) Type 2

Key

p pitch (internal link length)

d_m measured diameter of the material, except at the weld

d_w measured diameter of the material at the weld (type 1) or weld dimension perpendicular to the plane of the link (type 2)

G dimension in other planes (type 2)

e length affected by welding, on either side of the centre of the link

w_1 internal link width away from the weld (type 2)

w_3 external link width over the weld (types 1 and 2)

w_4 internal link width at the weld (type 1)

Figure 1 — Chain link

5.2 Material diameter and tolerance

The definition of material diameter and method of measurement shall be in accordance with ISO 1834. The diameter tolerance for the nominal sizes shall be as listed in Table 1, column 2, calculated in accordance with Annex A.

5.3 Weld diameter

The maximum diameter at the weld (see Figure 1 and Table 1, columns 8 and 9) shall not exceed the following:

— type 1: the maximum diameter at the weld shall not be in excess of 10 % above the nominal size in any direction;

— type 2: the maximum diameter at the weld shall not be in excess of 10 % above the nominal size in any direction perpendicular to the plane of the link and 25 % in the other planes.

NOTE Type 1 eliminates functional problems, such as kinking or locking, by severely limiting the weld oversize to 10 % of the nominal diameter. Type 2 ensures freedom from these hazards by limiting the oversize beyond the 10 % allowed under type 1 to certain areas of the link only (see Figure 1), thus providing clearance where required.

5.4 Length dimensionally affected by welding

The length dimensionally affected by welding, e, shall not extend by more than 0,6 d_n to either side of the centre of the link (see Figure 1).

5.5 Pitch

The dimensions and tolerances for the pitch, p, shall be as given in Table 1, columns 3 and 4 and as shown in Figure 1 calculated in accordance with Annex A.

5.6 Width

The dimensions for the widths, w, shall be as given in Table 1, columns 5, 6 and 7 and as shown in Figure 1 calculated in accordance with Annex A.

6 Material and manufacture

6.1 Quality of material

Within the limitations given in 6.1.1 to 6.1.4, it is the responsibility of the manufacturer of the sling chain to select the type of steel to be used so that the finished sling chain, where suitably heat treated, complies with the mechanical properties specified in this International Standard and also possesses adequate low-temperature ductility and toughness to provide resistance against impact loading.

The low-temperature ductility and toughness shall be achieved either by complying with the alloying elements specified in 6.1.5 or by complying with the toughness-testing requirements specified in 6.4.5.

6.1.1 Type of steel

The steel used shall be produced by the electric process or by an oxygen-blown process.

6.1.2 Deoxidation

The steel shall be fully killed and shall be made in conformity with a suitable deoxidation process in order to obtain an austenitic grain size of 6 or finer where tested in accordance with ISO 643.

To ensure the sling chain is stabilized against strain-age embrittlement during service, the steel shall contain at least 0,025 % aluminium, but not more than 0,050 % aluminium.

6.1.3 Weldability

The steel shall be of reliable weldable quality.

6.1.4 Sulfur and phosphorus content

The content of sulfur and phosphorus shall be restricted as specified in Table 2.

Table 2 — Sulfur and phosphorus content

Element	Maximum mass content as determined by	
	cast analysis	check analysis
	%	%
Sulfur	0,020	0,025
Phosphorus	0,020	0,025
Sum of sulfur and phosphorus	0,035	0,045

6.1.5 Alloying elements

The steel shall contain alloying elements in sufficient quantities so that the finished sling chain, where heat treated in accordance with 6.2, complies with the mechanical properties specified in this International Standard but also possesses adequate low-temperature ductility and toughness to provided resistance to impact loading.

The steel shall contain nickel and at least one of the other elements in the minimum percentage shown in Table 3.

Table 3 — Content of alloying elements

Element	Minimum mass content as determined by cast analysis
	%
Nickel	0,40
Chromium	0,40
Molybdenum	0,15

6.1.6 Finished condition

In its finished condition, as supplied to the manufacturer of the sling chain, the steel shall comply with the requirements of 6.1.1 to 6.1.4 and 6.1.5, where appropriate, as determined by check analysis on the rod, wire or finished link.

6.2 Heat treatment

Sling chains shall be hardened from a temperature above the Ac_3 point and tempered before being subjected to the manufacturing proof force (MPF), F_{MP}. The tempering temperature shall be at least + 400 °C.

The tempering conditions shall be at least as effective as the temperature of + 400 °C maintained for a period of 1 h. This requirement is the responsibility of the chain manufacturer. Where proposed for verification, samples of sling chains shall be tested after they have been re-heated to, and maintained for 1 h, at + 400 °C and then cooled to room temperature. These samples shall comply with the requirements of Table 5.

For sling chains with a surface finish other than natural black, samples required for verification shall be taken and re-heat treated prior to the surface finishing process.

6.3 Working load limits (WLLs)

Table 4 gives values for the working load limits (WLLs), calculated on the bases given in Annex A for the appropriate nominal size.

6.4 Mechanical properties

6.4.1 Manufacturing proof force (MPF)

All sling chains shall be subjected to the manufacturing proof force, F_{MP}, specified in Table 4, column 3, calculated on the bases given in Annex A for the appropriate nominal size.

For other nominal sizes, the mechanical properties shall be calculated in accordance with Annex A.

Table 4 — Working load limits and test requirements

1	2	3	4	5
Nominal size d_n	**Working load limit (WLL)** t	**Manufacturing proof force (MPF)** F_{MP} kN min.	**Breaking force (BF)** F_B kN min.	**Bend deflection** f mm min.
4	0,5	13	20	3,2
6	1,12	28	45	4,8
7	1,5	38	62	5,6
8	2	50	80	6,4
10	3,15	79	130	8
13	5,3	130	210	10
16	8	200	320	13
18	10	250	410	14
19	11,5	280	450	15
20	12,5	310	500	16
22	15	380	610	18
26	21,2	530	850	21
28	25	620	990	22
32	31,5	800	1 300	26
36	40	1 000	1 600	29
40	50	1 300	2 000	32
45	63	1 600	2 500	36

6.4.2 Breaking force (BF)

Samples of sling chains shall have a breaking force, F_B, at least equal to that specified in Table 4, column 4 calculated on the basis given in Annex A for the appropriate nominal size.

6.4.3 Total ultimate elongation, A

On completion of the tensile test, the minimum total ultimate elongation, A, as defined in ISO 1834 for chain in natural black, shall be 20 %, and for other surface finishes, A shall be 17 %.

6.4.4 Bend deflection, f

Samples of single chain links shall withstand the minimum value of the deflection, f, specified in Table 4, column 5, calculated on the basis given in Annex A, for the appropriate nominal size and shall be free from visible defects.

6.4.5 Toughness

The toughness of the finished chain shall be verified by impact test method on full-size, sub-size or super-sub-size specimens.

Full-size specimens shall be tested in accordance with ISO 148-1. Sub-size specimens shall be tested in accordance with ISO 14556. If the chain leg is too short to extract a full-length sub-size specimen, the sub-size specimens shall be produced according to Figure 3, by joining additional leg parts using laser welding. Super-sub-size specimens shall be tested in accordance with ISO 14556, except that the specimen dimensions shall be in accordance with Figure 4. Super-sub-size specimens shall be produced by joining additional leg parts using pulsed micro-laser welding. The settings for laser welding and pulsed micro-laser welding shall be such that the hardness and micro-structure of the specimen is not affected in the area of the notch. After welding, specimens shall be machined to the specified dimensions.

Either pendulum impact type or drop weight type test equipment may be used, taking account of the accuracy of measurement of the toughness value.

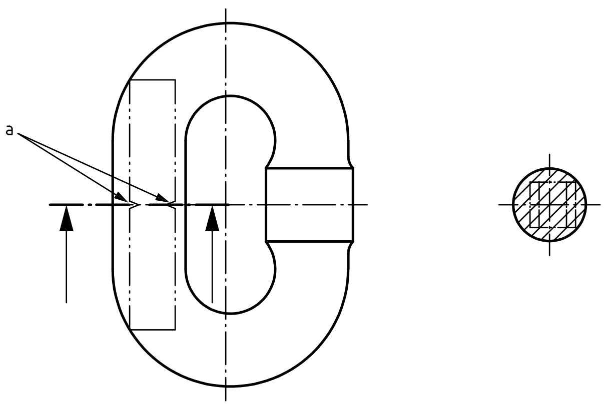
If the chain link is large enough to extract a full-size specimen, the tests shall be carried out on full-size specimens. Three specimens shall be tested, each of which shall achieve a KV toughness of at least 30 J at a test temperature of –40 °C.

If the chain link is too small to extract a full-size specimen, but large enough to extract a sub-size specimen or a welded-on sub-size specimen, the tests shall be carried out on sub-size specimens, which shall achieve a KV toughness of at least 3,5 J at a test temperature of –40 °C. To ensure that the distance of the test temperature to the brittle-tough-transition temperature is sufficient, KV toughness 3,5 J shall be 1/2 E_{US} +1 J [half upper shelf energy (USE) +1 J] or more. The test shall be carried out on 10 specimens, and the mean value used as the KV toughness value. The range of scattering shall be within 1,5 J.

If the chain link is too small to extract a sub-size specimen, the tests shall be carried out on super-sub-size specimens extracted from the chain and full-size specimens made of the same material as the chain, which is heat treated so as to achieve the same ultimate tensile strength of hardness and material as the finished chain. Three full-size specimens shall be tested, each of which shall achieve a KV toughness of at least 30 J at a test temperature of –40 °C. Three super-sub-size specimens shall be tested and shall show 80 % or more non-crystalline area where tested at –90 °C.

NOTE It is assumed that the transition temperature is –90 °C or lower in that case.

The above-mentioned tests shall be repeated if the steel manufacturer or type of steel is changed or the chain manufacturer changes the manufacturing process.



a Alternatives for orientation of the notch.

Figure 2 — Source of specimen and orientation of the notch