INTERNATIONAL STANDARD

ISO 3077

Third edition
2001-12-01

Short-link chain for lifting purposes — Grade T, (types T, DAT and DT), fine-tolerance hoist chain

Chaînes de levage à maillons courts — Chaînes de tolérance serrée pour palans, classe T (types T, DAT et DT)

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 3.

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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 3077 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 3077:1984), which has been technically revised.

Annexes A and B form a normative part of this International Standard. Annex C is for information only.

Short-link chain for lifting purposes — Grade T, (types T, DAT and DT), fine-tolerance hoist chain

1 Scope

This International Standard specifies requirements for fine-tolerance hoist chain of Grade T (types T, DAT and DT) for use with manually operated or power-driven chain hoists[1)].

It is applicable to electrically welded, round, steel short-link chain, heat-treated and tested in accordance with the general conditions of acceptance of ISO 1834, in the nominal chain size range from 3 mm to 22 mm.

NOTE Type T chain, but not type DAT or DT, may be used in lifting equipment other than chain hoists. Chain of grades TH and VH, intended specifically for use in hand-operated hoists, will be the subject of future International Standards.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 643:—[2)], *Steels — Micrographic determination of the apparent grain size*

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

ISO 4301-1, *Cranes and lifting appliances — Classification — Part 1: General*

ISO 4965, *Axial load fatigue testing machines — Dynamic force calibration — Strain gauge technique*

ISO 6507-1, *Metallic materials — Vickers hardness test — Part 1: Test method*

EN 10002-2:1991, *Metallic Materials — Tensile Testing — Part 2: Verification of the Force Measuring System of the Tensile Testing Machines*

3 Terms and definitions

For the purposes of this International Standard, the terms and definitions given in ISO 1834 and the following apply.

3.1
gauge length
specified multiple pitch length of chain

1) Types DT and DAT possess a surface hardness greater than their core hardness, offering greater resistance to wear, and are for use in power-driven hoists only.

2) To be published. (Revision of ISO 643:1983)

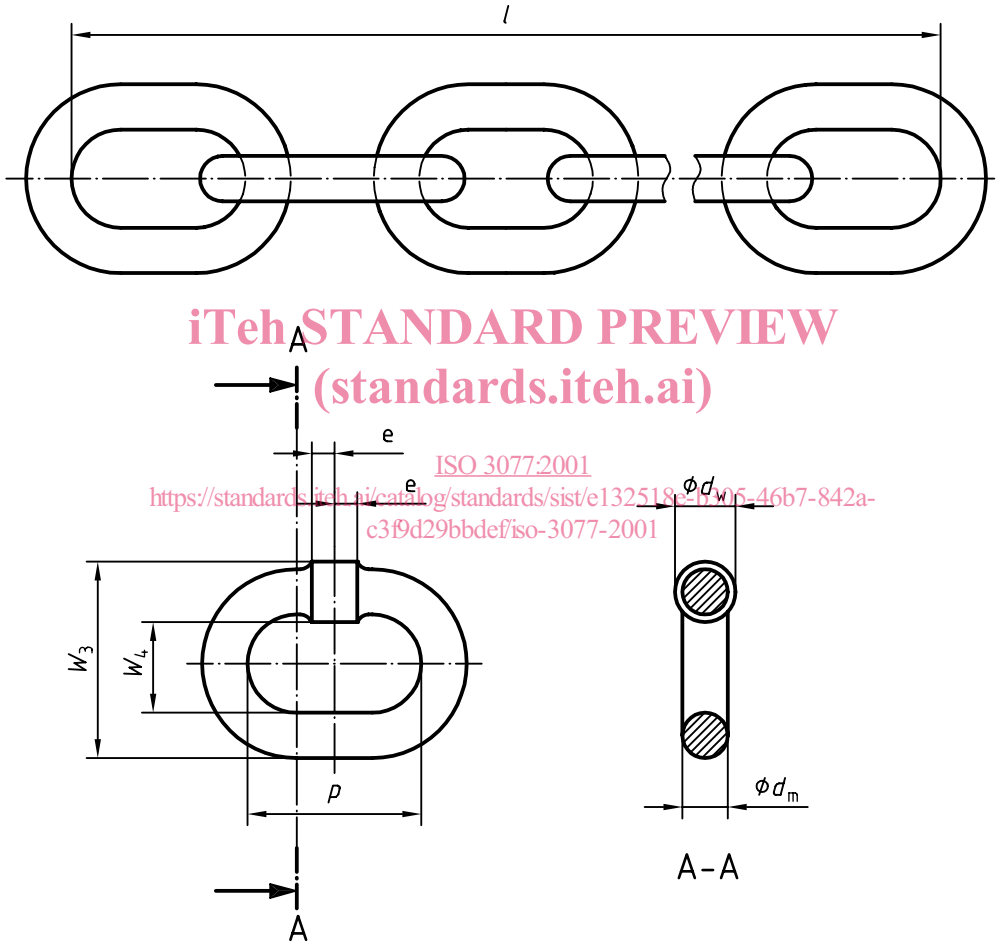
4 General conditions of acceptance

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

5 Dimensions (see Figure 1)

5.1 Nominal size, d_n

A selection of nominal sizes is given in Table 1. Other nominal sizes may be used, provided the dimensions and tolerances are calculated in accordance with annex A.



l multiple pitch length

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

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

W_3 external link width over the weld

W_4 internal link width at the weld

Figure 1 — Link and chain dimensions

Table 1 — Typical dimensions

Dimensions in millimetres

Dimension		Pitch		Width		Gauge length $11 \times p_n$		Weld diameter
nominal d_n	tolerance	nominal p_n	tolerance [a]	internal W_4 min.	external W_3 max.	nominal	tolerance [a]	d_w max.
3	± 0,2	9	$^{+0,18}_{0}$	3,6	10,2	99	$^{+0,5}_{0}$	3,3
4	± 0,2	12	$^{+0,25}_{0}$	4,8	13,6	132	$^{+0,6}_{0}$	4,3
5	± 0,2	15	$^{+0,3}_{0}$	6	17	165	$^{+0,8}_{0}$	5,4
6,3	± 0,2	19	$^{+0,4}_{0}$	7,2	20,4	209	$^{+1}_{0}$	6,5
7,1	± 0,3	21	$^{+0,4}_{0}$	8,4	23,8	231	$^{+1,1}_{0}$	7,6
8	± 0,3	24	$^{+0,5}_{0}$	9,6	27,2	264	$^{+1,3}_{0}$	8,6
9	± 0,4	27	$^{+0,5}_{0}$	10,8	30,6	297	$^{+1,4}_{0}$	9,7
10	± 0,4	30	$^{+0,6}_{0}$	12	34	330	$^{+1,6}_{0}$	10,8
11,2	± 0,4	34	$^{+0,7}_{0}$	13,2	37,4	374	$^{+1,8}_{0}$	11,9
12,5	± 0,5	38	$^{+0,8}_{0}$	14,4	40,8	418	$^{+2,0}_{0}$	13
13	± 0,5	39	$^{+0,8}_{0}$	15,6	44,2	429	$^{+2,1}_{0}$	14
14	± 0,6	42	$^{+0,8}_{0}$	16,8	47,6	462	$^{+2,2}_{0}$	15,1
16	± 0,6	48	$^{+0,9}_{0}$	19,2	54,4	528	$^{+2,5}_{0}$	17,3
18	± 0,9	54	$^{+1,0}_{0}$	21,6	61,2	594	$^{+2,9}_{0}$	19,4
20	± 1	60	$^{+1,2}_{0}$	24	68	660	$^{+3,2}_{0}$	21,6
22	± 1,1	66	$^{+1,3}_{0}$	26,4	74,8	726	$^{+3,5}_{0}$	23,8

NOTE In this table, typical dimensions for a range of nominal sizes are given calculated and rounded in accordance with the formulae in annex A, and based upon a nominal pitch of 3 d_n. Other nominal sizes may be used, provided the dimensions and tolerances are calculated in accordance with annex A. While the nominal link pitch is based upon 3 d_n, this may be varied up to a maximum of 3,2 d_n, also subject to the tolerances specified in annex A.

[a] These tolerances are usually divided into + 2/3 and − 1/3 for both the individual link and the standard gauge length.

5.2 Material diameter and tolerance

The definition of material diameter and method of measurement shall be in accordance with ISO 1834, but to the tolerances given in annex A.

The tolerances on material diameter for the selected nominal sizes shall be as given in Table 1. These and all other nominal size material diameter tolerances shall be calculated in accordance with A.1.

5.3 Pitch and widths

The dimensions and tolerances of the pitch and widths of the individual links as shown in Figure 1 shall be calculated in accordance with A.2.

The tolerances of multiple pitch lengths shall be calculated in accordance with A.2 and based on a gauge length of 11 links.

The dimensions and tolerances for the selected nominal sizes shall be as given in Table 1.

The nominal link pitch, p_n, is based upon 3 d_n, where d_n is the nominal size of the chain. This may be varied up to a maximum of 3,2 d_n. Nominal link pitch p_n shall be subject to the tolerances specified in annex A.

5.4 Weld diameter

The maximum diameter at the weld shall not be in excess of 8 % above the nominal diameter in any direction. The maximum diameter at the weld for the selected nominal sizes shall be as given in Table 1. The diameter of the steel at the weld shall nowhere be less than the actual diameter of the steel adjacent to the weld.

5.5 Length dimensionally affected by welding

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

6 Material and manufacture

6.1 Quality of material

6.1.1 Manufacturer's responsibility

Within the limitations given in 6.1.2 to 6.1.5, it shall be the responsibility of the chain maker to select the type of steel to be used so that the finished chain, when suitably heat-treated, complies with the mechanical properties specified in this International Standard.

6.1.2 Type of steel

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

6.1.3 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 5 or finer when tested in accordance with ISO 643.

6.1.4 Chemical composition

The steel shall contain alloying elements in sufficient quantities so that the finished chain, when heat-treated in accordance with 6.2, complies not only with the mechanical properties specified in this International Standard but also possesses a low temperature ductility and toughness adequate for providing resistance to impact loading.

The steel shall contain nickel and at least one of the other elements in the minimum percentages shown in Table 2.

Table 2 — Chemical composition — Alloying elements

Element	Minimum mass content as determined by cast analysis %		
	T	DAT	DT
Nickel	0,40	0,7	0,9 [a]
Chromium	0,40		
Molybdenum	0,15		

[a] Higher surface hardness, greater case depth, or both, requires a higher nickel content to avoid brittleness.

To ensure that the chain is stabilized against strain-age embrittlement during service, the steel shall contain at least 0,025 % aluminium.

The steel shall contain no more sulfur and phosphorus content than that restricted by the limits given in Table 3.

Table 3 — Sulfur and phosphorus content

Element	Minimum mass content as determined by %	
	cast analysis	check analysis
Sulfur	0,020	0,025
Phosphorus	0,020	0,025
Sum of S + P	0,035	0,045

6.1.5 Finished condition

In its finished condition and as supplied to the chain maker, the steel shall comply with the requirements of 6.1.2 to 6.1.4 as determined by check analysis on the rod, wire or finished link.

6.2 Heat treatment

Hoist chains of all types shall be hardened, case-hardened, or both, from a temperature above the AC3 point and tempered before being subjected to the manufacturing proof force.

6.3 Working load limits (WLL)

Table 4 gives working load limits, calculated on the basis given in annex A, for the selected nominal sizes of all types of chains. For nominal sizes not included in Table 4, the working load limits shall be calculated in accordance with annex A.

Additional stresses imposed on the chain by the operation of power-driven hoists shall be taken into account in selecting the nominal size for a particular application. Annex B shall therefore be used for the calculation.

Table 4 — Working load limits (WLL)

Nominal size d_n mm	Chain type T	DAT	D
	Working load limits (WLL) t		
3	0,28	0,22	0,14
4	0,5	0,4	0,25
5	0,8	0,63	0,4
6,3	1,2	1	0,63
7,1	1,6	1,2	0,8
8	2	1,6	1
9	2,5	2	1,25
10	3,2	2,5	1,6
11,2	4	3,2	2
12,5	5	4	2,5
13	5,3	4,2	2,6
14	6	5	3
16	8	6,3	4
18	10	8	5
20	12,5	10	6,3
22	15	12,5	7,5
Mean stress N/mm^2	200	160	100

6.4 Mechanical properties

6.4.1 Manufacturing proof force (MPF)

All chains shall be subjected to the MPF calculated according to annex A. For the selected nominal sizes, values are as given in Table 5.

NOTE The formula and rounding rules for the calculation are also given in annex A.

6.4.2 Breaking force (BF) and total ultimate elongation A

Samples of hoist chain in the finished condition shall have a breaking force at least equal to that calculated on the basis given in annex A. For the selected nominal sizes, values are given in Table 5.

On completion of the tensile test, the minimum total ultimate elongation shall be in accordance with the values given in Table 6.

Table 5 — Manufacturing proof forces (MPF) and breaking forces (BF)

Nominal size d_n mm	MPF kN min.	BF kN min.
3	7,1	11,3
4	12,6	20,1
5	19,6	31,4
6,3	31,2	49,9
7,1	39,6	63,3
8	50,3	80,4
9	63,6	102
10	78,5	126
11,2	98,5	158
12,5	123	196
13	133	212
14	154	246
16	201	322
18	254	407
20	314	503
22	380	608

Table 6 — Total ultimate elongation, bend deflection and surface hardness

Parameter		Chain type		
		T	DAT	DT
Total ultimate elongation A [a]	% min.	10	10	5
Deflection f	min.	0,8 d_n	— [b]	
Surface hardness [c]	min.			
d_n < 7 mm, HV 5		360	500	550
7 mm ⩽ d_n ⩽ 14 mm, HV 10		360	500	550
d_n > 14 mm, HV 10		360	450	500

a $\frac{\Delta L}{L_o}$

As specified in ISO 1834, except that L_o, the original internal length of the test sample, is used instead of L_n, the nominal internal length.

b See 6.4.3

c Measuring points: see 7.4.

6.4.3 Bend deflection

Single link samples of type T shall withstand the minimum deflection specified in Table 6 and shall be free from visible defects.

Sample links of types DAT and DT shall withstand a force, F_o, equivalent to 2,5 times the working load limit of the chain as given in 6.3 without fracture. A surface crack or visible defect shall not be considered as constituting a fracture.

6.4.4 Surface hardness

The surface hardness at each of the three measuring points as shown in Figure 3 for all types shall be at least equal to the values specified in Table 6.

6.4.5 Case depth

For hoist chain types DAT and DT, the case depth, when measured in accordance with the type test specified in 7.5, shall be within the limits related to nominal size d_n as given in Table 7.

Table 7 — Case depth

Nominal size d_n mm	Chain type	
	DAT	DT
< 8	$\geqslant 0{,}03\ d_n \leqslant 0{,}05\ d_n$	$\geqslant 0{,}03\ d_n \leqslant 0{,}06\ d_n$
$\geqslant 8$	$\geqslant 0{,}02\ d_n \leqslant 0{,}04\ d_n$	$\geqslant 0{,}03\ d_n \leqslant 0{,}05\ d_n$

For hoist chain type DAT below 8 mm d_n and hoist chain type DT of all sizes, case depth in the ranges $\geqslant 0{,}02\ d_n \leqslant 0{,}03\ d_n$ and $\geqslant 0{,}025\ d_n \leqslant 0{,}03\ d_n$, respectively, shall be permitted, providing that the surface hardness, measured in accordance with 7.5, exceeds the relevant values in Table 6 by at least 50 points HV.

6.4.6 Fatigue resistance

Hoist chain types DT and DAT shall withstand at least 2×10^6 cycles of application of the stress range specified in 7.6 without failure.

7 Verification of safety requirements

7.1 Size of lot and selection of samples

The size of the lot from which that samples are selected shall be 200 m. An excess fraction of the length of lot shall be considered as a separate lot. For types DAT and DT, if the batch quantity of the furnace is less than 200 m, it shall be considered as a lot. Samples shall be selected according to ISO 1834.

7.2 Manufacturing proof force, breaking force and total ultimate elongation

7.2.1 Static tensile test

The testing machine and test procedure for the static tensile test shall be as specified in ISO 1834.

The equipment used in the tests specified in 7.2.2.2 and 7.3.1 shall comply with Class 1 of EN 10002-2:1991.