International Standard 8539

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

Forged steel lifting components for use with grade T(8) chain

Accessoires de levage en acier forgé pour utilisation avec des chaînes de classe T(8)

First edition — 1986-12-01

UDC 621.86.065.4 **Ref. No. ISO 8539-1986 (E)**

Descriptors : lifting equipment, hoisting slings, chains, components, specifications, dimensions, tests, certification, marking.

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 8539 was prepared by Technical Committee ISO/TC 111, *Round steel link chains, lifting hooks and accessories.*

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

Printed in Switzerland

Forged steel lifting components for use with grade T(8) chain

1 Scope and field of application

This International Standard specifies requirements for forged lifting components for use in chain sling assemblies in a range of sizes having performance compatibility with the corresponding nominal sizes of grade T(8) chain complying with ISO 3076. Performance compatibility encompasses component strength and the necessary physical dimensions.

The components covered by this International Standard are normally supplied as part of a sling system, but they may also be supplied separately for other applications. Where such components are supplied as part of a sling complying with ISO 7593, the additional requirements laid down in ISO 7593 also apply.

This International Standard does not apply to welded master links, welded intermediate links and welded joining links, which form part of a welded sling complying with ISO 4778, nor to other welded components.

NOTE — Forged steel lifting hooks with point and eye and forged shackles for use with grade T(8) chain are dealt with in ISO 7597 and ISO 2415, respectively.

2 References

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

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

ISO 2415, *Forged shackles for general lifting purposes — Dee shackles and bow shackles.*

ISO 3076, *Short link chains for lifting purposes — Grade T(8), non calibrated, for chain slings, etc.*

ISO 4778, *Chain slings of welded construction — Grades M(4), S(6) and T(8).*

ISO 7593, *Chain slings assembled by methods other than welding — Grade T(8).*

ISO 7597, *Forged steel lifting hooks with point and eye for use with steel chains of grade T(8).*

3 Definitions

3.1 working load limit (WLL): The maximum mass which a component is designed to sustain in general service.

3.2 working load (WL): The maximum mass which a component should be used to sustain in a particular stated service.

3.3 proof force, F_e**:** A force applied as a test to the component as specified in clause 9.

3.4 ultimate strength: The maximum force reached during the tensile testing of the component at the end of which the component fails to retain the load.

3.5 chain sling: An assembly consisting of chain or chains joined to upper and lower terminal fittings suitable according to the requirements of this International Standard for attaching loads to be lifted to the hook of a crane or other lifting machine.

3.6 master link: A link forming the upper terminal fitting of a chain sling by means of which the sling is attached to the hook of a crane or other lifting machine.

3.7 intermediate master link: A link used to connect two or more branches of a sling to a master link.

3.8 joining link: A link fitted to the end of a chain to connect it either directly or through an intermediate link to an upper or lower terminal fitting.

3.9 intermediate link: A link used to form a connection between the terminal fitting and the joining link fitted to the chain.

3.10 lower terminal: A link, hook or other device fitted at the end of a branch of a sling, remote from the master link or upper terminal.

4 Dimensions

4.1 Master links and intermediate master links

The inside dimension and the section of the material shall be such that

a) the master link fits on a crane hook with a working load limit 1,25 times that of the component;

b) the inside width of the master link is not less than 1,2 times the maximum width of the crane hook defined in a);

c) for slings with hooks as lower terminals, unless another means of securing the hooks when not loaded is provided, the inside dimensions and section are such as to allow the lower terminals to be hooked into the master link while it is on a hook as defined in a).

4.2 Lower terminal links

The internal dimensions of the lower terminal links shall be such as to ensure free articulation of the links.

4.3 Other components

The dimensions of these components shall be such as to ensure sufficient articulation so that the load may be transmitted axially.

5 Mechanical properties

5.1 General

The mechanical properties of load-bearing components shall be as specified in table 1 in which the properties are related to the nominal size of the chain.

5.2 Proof force

Each component, including load-bearing pins, if any, tested in accordance with 8.2, shall be capable of sustaining the proof force specified in table 1 without significant permanent deformation.

5.3 Ultimate strength

Each component, including load-bearing pins, if any, tested in accordance with 8.3, shall have an ultimate strength at least equal to that specified in table 1.

On completion of the test, the component shall show evidence of ductility.

5.4 Fatigue resistance

Components, including load-bearing pins, if any, with a working load limit of up to and including 10 t, when tested in accordance with 8.4, shall, after at least 10 000 cycles, be capable of retaining the load.

Table 1 — Mechanical properties of components

Nominal size of chain [1]	Working load limit (WLL)	Proof force F_e	Minimum ultimate strength
	t	kN	kN
6	1,1	22,7	45,4
7	1,5	30,8	61,6
8	2	40,3	80,6
10	3,2	63	126
13	5,4	107	214
16	8	161	322
18	10	204	408
19	11,5	227	454
20	12,5	252	504
22	15,5	305	610
23	16,9	333	666
25	20	393	786
26	21,6	425	850
28	25	493	986
32	32	644	1 288
36	40	815	1 630
40	50	1 006	2 012
45	63	1 273	2 546

1) Nominal diameter, d_n, in millimetres

NOTES ON BASES OF CALCULATIONS

1 The values for WLL are derived from the full calculated values for the chain (see the annex).

2 The proof force values are half the minimum ultimate strength values.

3 The minimum ultimate strength values are calculated from the following formulae (the first gives values in newtons and the second in kilonewtons) :

$$800 \times \frac{\pi d_n^2}{2}$$

$$0{,}4\,\pi d_n^2$$

The values have been rounded up to the nearest 0,2 below 100 kN and up to the nearest whole even number above 100 kN.

4 With the values given in the table, the ratios 1:2:4 are ensured, the mean stress at WLL is never quite attained and the mean stress at proof force and ultimate strength are all slightly exceeded.

ADDITIONAL FACTORS FOR MASTER LINKS AND INTERMEDIATE MASTER LINKS

1 For master links (two-branch slings), the values given in table 1 shall be multiplied by a factor of 1,4 (uniform load) or a factor of 2 (trigonometric) (see ISO 4778 and ISO 7593).

2 For master links (three- and four-branch slings), the values given in table 1 shall be multiplied by a factor of 2,1 (uniform load) or a factor of 3 (trigonometric) (see ISO 4778 and ISO 7593).

In the case of a four-branch sling, if proper measures are taken to achieve the equal distribution of the load between each branch, all four branches can be considered as supporting the load.

Under such circumstances, the values given in table 1 shall be multiplied by a factor of 4 (trigonometric) (see ISO 7593).

3 For intermediate master links (three- and four-branch slings), the values given in table 1 shall be multiplied by a factor of 1,6 (uniform load) or a factor of 2 (trigonometric) (see ISO 4778 and ISO 7593).

6 Materials and heat treatment

6.1 General

Load-bearing components for use with grade T(8) chain which are not covered by separate ISO International Standards, shall comply with the material requirements specified in 6.2 and 6.3.

6.2 Quality of material

6.2.1 General

The steel used shall be produced by the open-hearth, the electric or an oxygen-blown process and shall possess reliable forging quality.

In its finished state, as supplied to the component manufacturer, the steel shall comply with the requirements specified in 6.2.2, as determined by check analysis on the billet, bar or finished component.

6.2.2 Specific requirements

The steel shall be fully killed, and shall contain alloying elements in sufficient quantities to guarantee the mechanical properties of the component after appropriate heat treatment. The alloy steel used shall contain at least two of the following alloying elements:

- nickel;
- chromium;
- molybdenum.

Its content of sulfur and phosphorus shall be restricted as specified in table 2.

Table 2 — Sulfur and phosphorus content

Element	Maximum content, % (m/m), as determined by	
	cast analysis	check analysis
Sulfur	0,035	0,04
Phosphorus	0,035	0,04

The steel shall be made in conformity with fine grain practice in order to obtain an austenitic grain size of 5 or finer when tested in accordance with ISO 643. This could be achieved, for example, by ensuring that it contains sufficient aluminium or an equivalent element to permit the manufacture of components stabilized against strain-age embrittlement during service; a minimum value of 0,02 % (m/m) of metallic aluminium is given for guidance.

Within the limitations specified above, it is the responsibility of the component manufacturer to select steel so that the finished component, suitably heat-treated, complies with the requirements for the mechanical properties specified in this International Standard.

6.3 Heat treatment

Before proof-loading, components shall be heat treated in such a way as to achieve the required mechanical and metallurgical properties.

Components can be used up to a maximum temperature of 400 °C (see ISO 3056) without impairment or change to their metallurgical and mechanical properties when returned to room temperature. When requested, for verification, sample components shall be tested after they have been re-heated to 400 °C, maintained at that temperature for 1 h, and then cooled to room temperature.

7 Manufacturing methods and workmanship

Each forged element of a component shall be forged in one piece. After heat treatment, furnace scale shall be removed and the components shall be free from harmful surface defects, including cracks. The use of welding procedures at any stage in manufacture is not permitted.

8 Type testing

8.1 General

Type tests demonstrate that components certified by the manufacturer as complying with the requirements laid down in this International Standard possess the mechanical properties specified in this International Standard. The purpose of these tests is to prove the design, material, heat treatment and method of manufacture of each size of finished component. 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 defined in clause 5 shall require that the type tests specified in 8.2 to 8.4 be carried out on the modified components.

All components to be type tested shall comply with all the other requirements laid down in this International Standard. The tests specified in 8.2 to 8.4 shall be carried out on three samples of each size of component of each design, material, heat treatment and method of manufacture.

In the tests specified in 8.2 to 8.4, the force shall be applied to the component axially without shock.

8.2 Deformation test

Three samples shall be tested and each shall be capable of sustaining the proof force specified for the component in table 1 without significant permanent deformation.

NOTE — See also clause 9 for proof testing of all components.

8.3 Static strength test

NOTE — This test may be carried out on the same components that have been subjected to the deformation test.

Three samples shall be tested and each shall have an ultimate strength at least equal to the minimum value specified for the component in table 1.

It is not necessary to test the component up to its actual ultimate strength for the mechanical properties specified to be demonstrated. It is sufficient that the minimum ultimate strength specified is reached and that the component shows evidence of ductility.

8.4 Fatigue test

Components with a working load limit of up to and including 10 t shall be subjected to the fatigue test. Three samples shall be tested.

The force range applied during each cycle shall be equal to 0,75 times the proof force specified in table 1 for the component. The minimum force in each cycle shall be positive and less than or equal to 3 kN. The frequency of force application shall be between 5 and 25 Hz. The samples tested shall be capable of sustaining at least 10 000 cycles of the force range specified above without failing to retain the load.

8.5 Acceptance criteria for type tsting

8.5.1 Deformation test (see 8.2)

All three samples tested shall pass the deformation test in order for the component of the size submitted for type testing to comply with this International Standard.

8.5.2 Static strength test and fatigue test (see 8.3 and 8.4)

If all three samples pass the test, the component of the size submitted for type testing complies with this International Standard.

If one of the samples fails, two further samples shall be tested and both shall pass the test in order for the component of the size submitted for type testing to comply with this International Standard.

If two or three samples fail the test, the component of the size submitted for type testing does not comply with this International Standard.

9 Proof test

All finished components shall be subjected to the appropriate proof force specified in table 1, which they shall sustain without significant permanent deformation. The force shall be applied to the component axially without shock.

NOTE — If these components are used as part of a chain sling assembly, grade T(8) complying with ISO 4778 or ISO 7593, the proof testing requirements laid down in those International Standards apply.

10 Manufacturer's certificate

When the type testing as specified in clause 8 has been carried out with satisfactory results, the manufacturer may issue certificates of conformity for components of the same nominal dimensions, size, material, heat treatment and method of manufacture as the components tested.

The manufacturer shall keep a record, for at least 10 year after the last certificate has been issued, of the material specification, heat treatment, dimensions, test results and all relevant data concerning the components which have satisfied 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 component which may lead to a modification of the mechanical properties as specified in clause 5 shall be considered as a design change. Tests in accordance with clause 8 shall be required before the manufacturer is permitted to issue certificates of conformity for any modified design.

11 Marking

11.1 Forged components

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

a) the nominal size of the chain with which the component is compatible;

b) the grade letter or number, T or 8;

c) the manufacturer's symbol;

d) any marking required by national standards, statutory regulations or by agreement between the manufacturer and the purchaser.

NOTE — Care should be taken to ensure that the marking applied cannot be mistaken for the working load of the component.

11.2 Load-bearing pins

Each load-bearing pin shall be marked with the grade letter or number (T or 8).

Annex

Calculated values of working load limit (WLL)

Working load limits in tonnes

Nominal size of chain [1]	Full calculated working load limit (WLL)	Working load limits (WLL) as specified in table 1
6	1,153 27	1,1
7	1,569 73	1,5
8	2,050 26	2
10	3,203 53	3,2
13	5,413 97	5,4
16	8,201 04	8 *
18	10,379 45	10 *
19	11,564 75	11,5
20	12,814 13	12,5*
22	15,505 1	15,5
23	16,946 69	16,9
25	20,022 08	20
26	21,655 88	21,6
28	25,115 7	25 *
32	32,804 18	32 *
36	41,517 79	40 *
40	51,256 53	50 *
45	64,871 54	63 *

1) Nominal diameter, d_n, in millimetres

NOTES

1 The values for full calculated WLL have been determined using the following formulae (the first gives values in newtons, the second in tonnes):

$$\frac{200\ \pi d_n^2}{2}$$

$$0{,}032\ 035\ 33\ d_n^2$$

2 The values for WLL as specified in table 1 and given in the table above have been derived from the full calculated values, rounded down to one place of decimals, except for those marked with an asterisk (*) which have been rounded down to the nearest preferred number, because the nominal sizes of the chain are also preferred numbers.