INTERNATIONAL STANDARD

ISO 4778

Second edition
2019-06

Round steel short link chains for lifting purposes — Chain slings of welded construction — Grade 8

Chaînes de levage en acier de section ronde à maillons courts — Elingues en chaînes assemblées par soudure — Classe de qualité 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.

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 of 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 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 1, *Chains and chain slings*.

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.

This second edition cancels and replaces the first edition (ISO 4778:1981), which has been technically revised.

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

— omission of grades 4 and 6;

— increased range of nominal diameters from 4 mm to 45 mm;

— modernization of the document structure and layout, following the structure already implemented in the latest publications of ISO/TC 111/SC 1.

Round steel short link chains for lifting purposes — Chain slings of welded construction — Grade 8

1 Scope

This document specifies the requirements, methods of rating and testing of single, double, three and four leg welded chain slings of grade 8 using components such as sling chains according to ISO 3076 together with links according to ISO 16798, hooks according to ISO 7597 and forged components according to ISO 8539.

NOTE 1 For special lifting purposes not covered by this document, additionally intermediate links can be used, for example to connect components to each other having different working load limit.

The range of nominal diameter, d_n, covered by this document is from 4 mm to 45 mm.

Chain slings according to this document are for use in the temperature range –40 °C to +400 °C according to ISO 3056.

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

Chain slings according to this document comply with the general conditions of acceptance of ISO 1834 and are used for symmetrically distributed loads only.

NOTE 3 For rating of chain slings with asymmetrically distributed loads, see ISO 3056.

This document does not apply to mechanically joined chain slings.

NOTE 4 For mechanically joined chain slings, see ISO 7593.

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 3076, *Round steel short link chains for general lifting purposes — Medium tolerance sling chains for chain slings — Grade 8*

ISO 7597, *Forged steel lifting hooks with latch, grade 8*

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

ISO 16798, *Links of Grade 8 for use with slings*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
nominal diameter
d_n
diameter of the sling chain used as a chain leg in a chain sling

Note 1 to entry: The nominal diameter of the chain slings is the nominal diameter of the sling chain used.

3.2
chain sling
assembly consisting of chain leg or chain legs joined to upper and lower terminal components for attaching loads to be lifted to the hook of a crane or other lifting machine

Note 1 to entry: See Figures 5 to 8.

3.3
chain leg
component of a chain sling, consisting of a fixed number of identical chain links

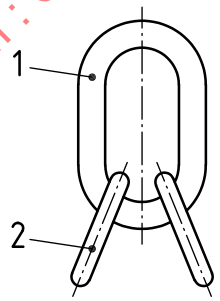
3.4
upper terminal component
link or other device fitted through a joining link or links to the end of a chain leg or chain legs by means of which it is attached to the hook of a crane or other lifting machine

Note 1 to entry: See Figures 5 to 8.

3.5
master link
parallel-sided link forming the upper terminal component

3.6
master link assembly
assembly consisting of a master link together with two intermediate master links

Note 1 to entry: See Figure 1.



Key
1 master link
2 intermediate master link

Figure 1 — Master link assembly

3.7
intermediate master link
parallel-sided link used to connect one or two chain legs to a master link

Note 1 to entry: See Figures 5 to 8.

3.8
joining link
parallel-sided link fitted to connect the chain leg to an upper or lower terminal component

Note 1 to entry: See Figures 5 to 8.

3.9
lower terminal component
end link, hook or other device fitted through a joining link to the end of a chain leg opposite to the upper terminal component

Note 1 to entry: See Figures 5 to 8.

3.10
end link
parallel-sided link forming the lower terminal component

3.11
nominal reach
effective length of a chain leg, measured from the inside of the lower terminal component to the inside of the upper terminal component

Note 1 to entry: See Figures 5 to 8.

3.12
working load limit
WLL
maximum mass which a chain sling is authorized to sustain in service

3.13
manufacturing proof force
MPF
force applied during manufacture to test sections of the chain sling

3.14
breaking force
BF
maximum force which the test sections of the chain withstands during the course of a static tensile test to destruction

3.15
inclination angle
β
angle between the chain leg and the vertical, separated to the range from 0° up to and including 45° and the range from 45° up to including 60°

3.16
test section
TS
individual section of the chain sling to be tested

4 Requirements

4.1 Chain sling

No one but the chain manufacturer, its licensee or an organization authorized by an appropriate authority is allowed to weld, heat treat and test chain slings covered by this document.

Where components of chain slings need to be altered or repaired, this shall be undertaken only by the chain manufacturer, his licensee, or a manufacturer authorized by an appropriate authority.

Every component shall have a working load limit not less than that of a single chain leg to which it is connected.

When constructing the chain sling, a tolerance of $^{+2}_{0}$ chain links is permissible on the nominal reach.

After proof loading, the difference between the longest and shortest chain legs of a multi-leg chain sling, when measured under a tension of 20 % of the working load limit, shall not exceed 10 mm for chain legs up to 2 m in length. For chain slings in excess of 2 m, the difference between the longest and shortest chain legs may be increased by 5 mm/m.

4.2 Components

4.2.1 Chain legs

Chain legs shall comply with ISO 3076.

4.2.2 Master links

Master links shall comply with ISO 16798.

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

a) the master link fits to a shank hook (e.g. according to ISO 17440; see Annex C);

b) the inside width of the master link is not less than 1,2 times the maximum width (see dimension b_2 in ISO 17440:2014, Figure A.1 and Table A.1) of the shank hook;

c) for chain slings with hooks as lower terminal components the inside dimensions and the cross-section are such as to allow the lower terminal component when not loaded to be hooked back into the master link while it is on the shank hook.

Master links may be of round or other suitable cross-section. But the cross-section of the material shall be chosen so that:

a) after proof loading (see 4.4.1) the master link does not show any significant permanent deformation;

b) the minimum total ultimate elongation at fracture is at least that of the sling chain.

NOTE A method of calculating the cross-section of master links is given in Annex D.

IMPORTANT — Egg- or pear-shaped links shall be designed to exclude unintended inverting.

4.2.3 Intermediate master links, joining links and end links

Intermediate master links, joining links and end links shall comply with ISO 16798 except for the clauses relating to link dimensions.

The internal dimensions of intermediate master links, joining links and end links shall be such that they ensure free articulation of the links.

The cross-section of the material shall be such that:

a) after proof loading (see 4.4.1) the intermediate master links, joining links and end links do not show any significant permanent deformation;

b) the minimum total ultimate elongation at fracture is at least that of the sling chain.

IMPORTANT — Egg- or pear-shaped links shall be designed to exclude unintended inverting.

4.2.4 Hooks

Forged steel lifting hooks with latch shall comply with ISO 7597 and shall be compatible with the sling chains according to ISO 3076.

Hooks not otherwise covered by this document shall comply with ISO 8539.

4.2.5 Other forged components

Other forged steel components, e.g. shackles, shall comply with ISO 8539 and shall be compatible with the sling chains according to ISO 3076.

4.3 Working load limit (WLL)

Table 1 gives values for the working load limit (WLL) calculated on the bases given in Annex A.

Table 1 — Working load limit (WLL)

Values in tonnes

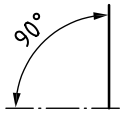
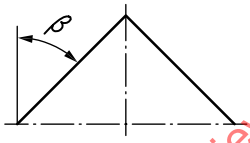
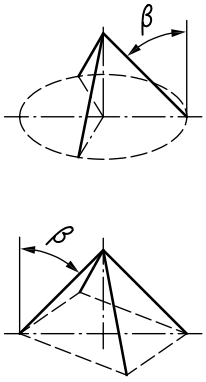
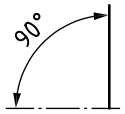
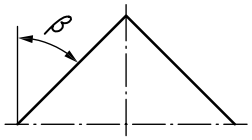
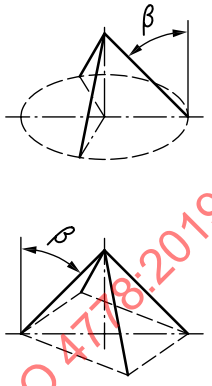
1	2	3	4	5	6	7
Nominal diameter	**Single leg**	**Double leg**		**Three- and four-leg**		
d_n mm				Intermediate master link		
	$\beta = 0°$	$0° < \beta \leq 45°$	$45° < \beta \leq 60°$	$\beta = 37{,}5°$	$0° < \beta \leq 45°$	$45° < \beta \leq 60°$
	WLL1/0°	WLL2/45°	WLL2/60°	WLL3/37,5°	WLL4/45°	WLL4/60°
	Load factor 1,0 [= 1 × cos 0°]	Load factor 1,41 [= 2 × cos 45°]	Load factor 1,0 [= 2 × cos 60°]	Load factor 1,6 [= 2 × cos 37,5°]	Load factor 2,12 [= 3 × cos 45°]	Load factor 1,5 [= 3 × cos 60°]
4	0,50	0,71	0,50	0,80	1,06	0,75
6	1,12	1,60	1,12	1,80	2,36	1,70
7	1,50	2,12	1,50	2,36	3,15	2,24
8	2,00	2,80	2,00	3,15	4,25	3,00
10	3,15	4,50	3,15	5,00	6,70	4,75
13	5,30	7,50	5,30	8,50	11,2	8,00
16	8,00	11,2	8,00	12,5	17,0	11,8
18	10,0	14,0	10,0	16,0	21,2	15,0
19	11,2	16,0	11,2	18,0	23,6	17,0
20	12,5	18,0	12,5	20,0	26,5	19,0
22	15,0	21,2	15,0	23,6	31,5	22,4
26	21,2	30,0	21,2	33,5	45,0	31,5
28	25,0	35,5	25,0	37,5	53,0	37,5
32	31,5	45,0	31,5	50,0	67,0	47,5

Table 1 *(continued)*

1	2	3	4	5	6	7
Nominal diameter	**Single leg**	**Double leg**		**Three- and four-leg**		
d_n mm				Intermediate master link		
	β = 0°	*0° < β ≤ 45°*	*45° < β ≤ 60°*	*β = 37,5°*	*0° < β ≤ 45°*	*45° < β ≤ 60°*
	WLL1/0°	WLL2/45°	WLL2/60°	WLL3/37,5°	WLL4/45°	WLL4/60°
	Load factor 1,0 [= 1 × cos 0°]	Load factor 1,41 [= 2 × cos 45°]	Load factor 1,0 [= 2 × cos 60°]	Load factor 1,6 [= 2 × cos 37,5°]	Load factor 2,12 [= 3 × cos 45°]	Load factor 1,5 [= 3 × cos 60°]
36	40,0	56,0	40,0	63,0	85,0	60,0
40	50,0	71,0	50,0	80,0	106	75,0
45	63,0	90,0	63,0	100	132	95,0

For the calculation of a working load limit (WLL) for angles other than specified, the indicated formulae shall be used in a corresponding manner. For this purpose, the value of the maximum angle of a range or the fixed inclination angle is inserted into the corresponding formula.

4.4 Mechanical requirements

4.4.1 General

Chain slings according to this document shall comply with the mechanical requirements given in Table 2, 3 and 4 for the appropriate test sections.

If the whole chain sling is heat treated, it shall be tested as an assembly by subjecting each test section to a value for the manufacturing proof force (MPF) at least equal to the value specified in Tables 2, 3 and 4, calculated on the bases given in Annex A. Subsequently, the chain sling shall be examined by a competent person. The manufacturer shall also verify that all components remain in accordance with the appropriate requirements of the component standards.

If only the inserted links are heat treated, they shall be considered as a test section, as well as any parts of the chain sling affected by this heat treatment. These sections shall then be subjected to a value for the manufacturing proof force (MPF) at least equal to the value specified in Tables 2, 3 and 4, calculated on the bases given in Annex A. Subsequently, the inserted links and any parts of the chain slings affected by heat treatment shall be examined by a competent person. The manufacturer shall also verify that all components remain in accordance with the appropriate requirements of the component standards.

The manufacturer shall have records concerning the breaking test and bend test for every type and size of sling chain and link built into the complete chain sling.

The manufacturer shall have records concerning the breaking test for every type and size of each other component built into the complete chain sling.

The manufacturer shall have records concerning the fatigue test for every type and size of each component built into the complete chain sling.

The records may be done during the manufacturing of separate lots of these parts as long as their manufacturing processes are similar to them for the complete chain sling.

If records concerning the above-mentioned individual tests are not available, the tests shall be conducted using the latest chain slings to be manufactured.

4.4.2 Single leg chain sling

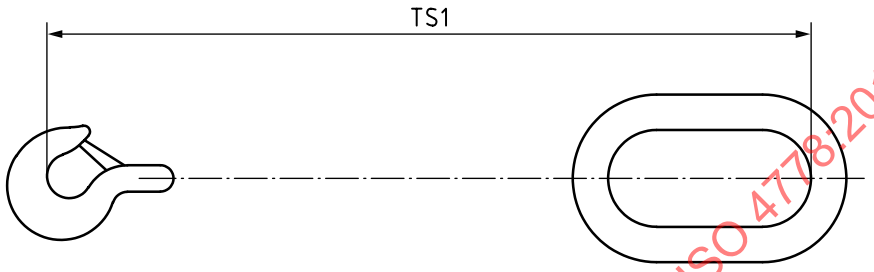


Figure 2 — Test section (TS1)

Table 2 — Mechanical requirements (TS1)

1	2	3
	Test section 1 (TS1)	
Nominal diameter d_n mm	Manufacturing proof force (MPF1) F_{MP1} kN min.	Breaking force (BF1) F_{B1} kN min.
4	12,5	20,0
6	28,0	45,0
7	37,5	60,0
8	50,0	80,0
10	80,0	125
13	132	212
16	200	315
18	250	400
19	280	450
20	315	500
22	375	600
26	530	850
28	630	1 000
32	800	1 250
36	1 000	1 600
40	1 250	2 000
45	1 600	2 500

4.4.3 Double leg chain sling

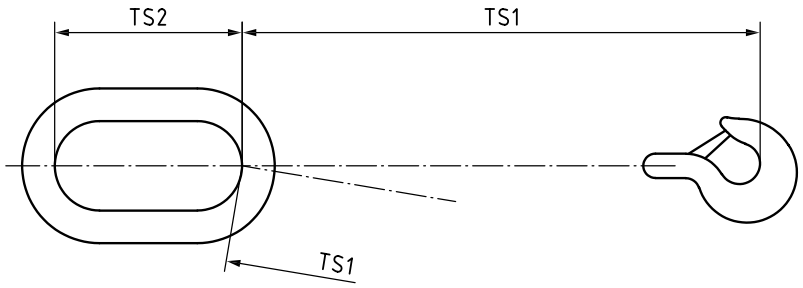


Figure 3 — Test sections (TS1, TS2)

Table 3 — Mechanical requirements (TS1, TS2)

1	2	3	4	5
	Test section 1 (TS1)		Test section 2 (TS2)	
Nominal diameter d_n mm	Manufacturing proof force (MPF1) F_{MP1} kN min.	Breaking force (BF1) F_{B1} kN min.	Manufacturing proof force (MPF2) F_{MP2} kN min.	Breaking force (BF2) F_{B2} kN min.
4	12,5	20,0	18,0	28,0
6	28,0	45,0	40,0	63,0
7	37,5	60,0	53,0	85,0
8	50,0	80,0	71,0	112
10	80,0	125	112	180
13	132	212	190	300
16	200	315	280	450
18	250	400	355	560
19	280	450	400	630
20	315	500	450	710
22	375	600	530	850
26	530	850	750	1 180
28	630	1 000	900	1 400
32	800	1 250	1 120	1 800
36	1 000	1 600	1 400	2 240
40	1 250	2 000	1 800	2 800
45	1 600	2 500	2 240	3 550

4.4.4 Three and four leg chain sling

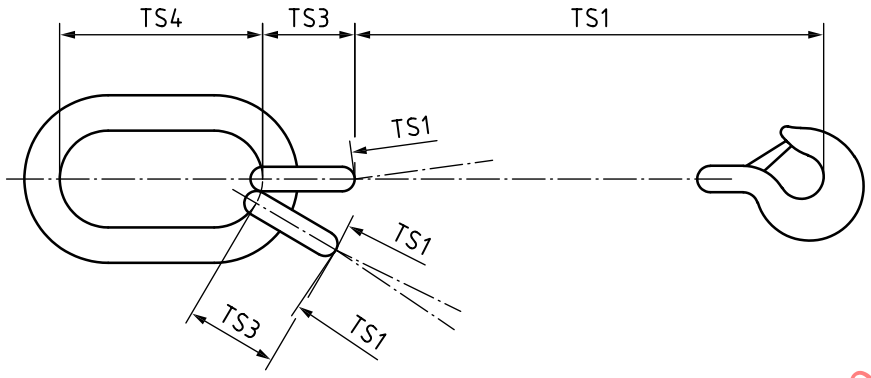


Figure 4 — Test sections (TS1, TS3, TS4)

Table 4 — Mechanical requirements (TS1, TS3, TS4)

1	2	3	4	5	6	7
	Test section 1 (TS1)		Test section 3 (TS3)		Test section 4 (TS4)	
Nominal diameter	Manufacturing proof force (MPF1)	Breaking force (BF1)	Manufacturing proof force (MPF3)	Breaking force (BF3)	Manufacturing proof force (MPF4)	Breaking force (BF4)
d_n mm	F_{MP1} kN min.	F_{B1} kN min.	F_{MP3} kN min.	F_{B3} kN min.	F_{MP4} kN min.	F_{B4} kN min.
4	12,5	20,0	20,0	31,5	26,5	42,5
6	28,0	45,0	45,0	71,0	60,0	95,0
7	37,5	60,0	60,0	95,0	80,0	125
8	50,0	80,0	80,0	125	106	170
10	80,0	125	125	200	170	265
13	132	212	212	335	280	450
16	200	315	315	500	425	670
18	250	400	400	630	530	850
19	280	450	450	710	600	950
20	315	500	500	800	670	1 060
22	375	600	600	950	800	1 250
26	530	850	850	1 320	1 120	1 800
28	630	1 000	1 000	1 500	1 320	2 120
32	800	1 250	1 250	2 000	1 700	2 650
36	1 000	1 600	1 600	2 500	2 120	3 350
40	1 250	2 000	2 000	3150	2 650	4 250
45	1 600	2 500	2500	4 000	3 350	5 300

5 Marking

5.1 General

The following information shall be shown on a metal tag or on a label permanently attached to the master link or to a link immediately adjacent to it. Alternatively, all or a part of the information may be marked on the master link provided the mechanical properties of the master link are not impaired.

5.2 Single leg chain sling

a) number of chain legs, "1";

b) nominal diameter;

c) grade, "8";

d) working load limit (kg or t);

e) manufacturer's name or symbol;

f) if appropriate, an individual identification mark (related to the manufacturer's certificate).

5.3 Double leg chain sling

a) number of chain legs, "2";

b) nominal diameter;

c) grade, "8";

d) working load limit at inclination angle $0° < \beta \leq 45°$ (kg or t);

e) working load limit at inclination angle $45° < \beta \leq 60°$ (kg or t);

f) manufacturer's name or symbol;

g) if appropriate, an individual identification mark (related to the manufacturer's certificate).

5.4 Three and four leg chain sling

a) number of chain legs, "3" or "4";

b) nominal diameter;

c) grade, "8";

d) working load limit at inclination angle $0° < \beta \leq 45°$ (kg or t);

e) working load limit at inclination angle $45° < \beta \leq 60°$ (kg or t);

f) manufacturer's name or symbol;

g) if appropriate, an individual identification mark (related to the manufacturer's certificate).

6 Manufacturer's certificate

Every chain sling shall be provided with a certificate giving the following information:

a) name and address of manufacturer;

b) date of issue of the certificate;

c) number of chain leg(s);

d) nominal diameter;

e) grade, "8";

f) working load limit for single leg chain sling only (kg or t);

g) working load limit at inclination angle $0° < \beta \leq 45°$ (kg or t);

h) working load limit at inclination angle $45° < \beta \leq 60°$ (kg or t);

i) value(s) for the manufacturing proof force (MPF) applied, depending on the test sections (TS);

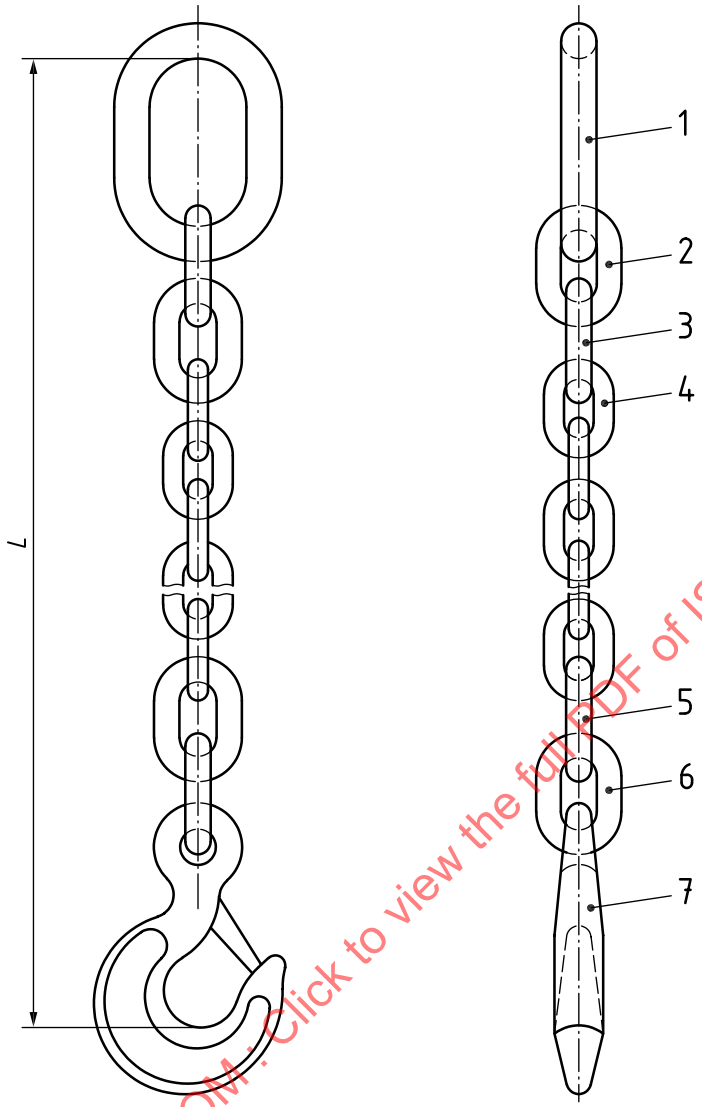
j) nominal reach;

k) reference to this document, i.e. ISO 4778;

l) if appropriate, an individual identification mark (related to the manufacturer's certificate).

7 Examples of chain slings

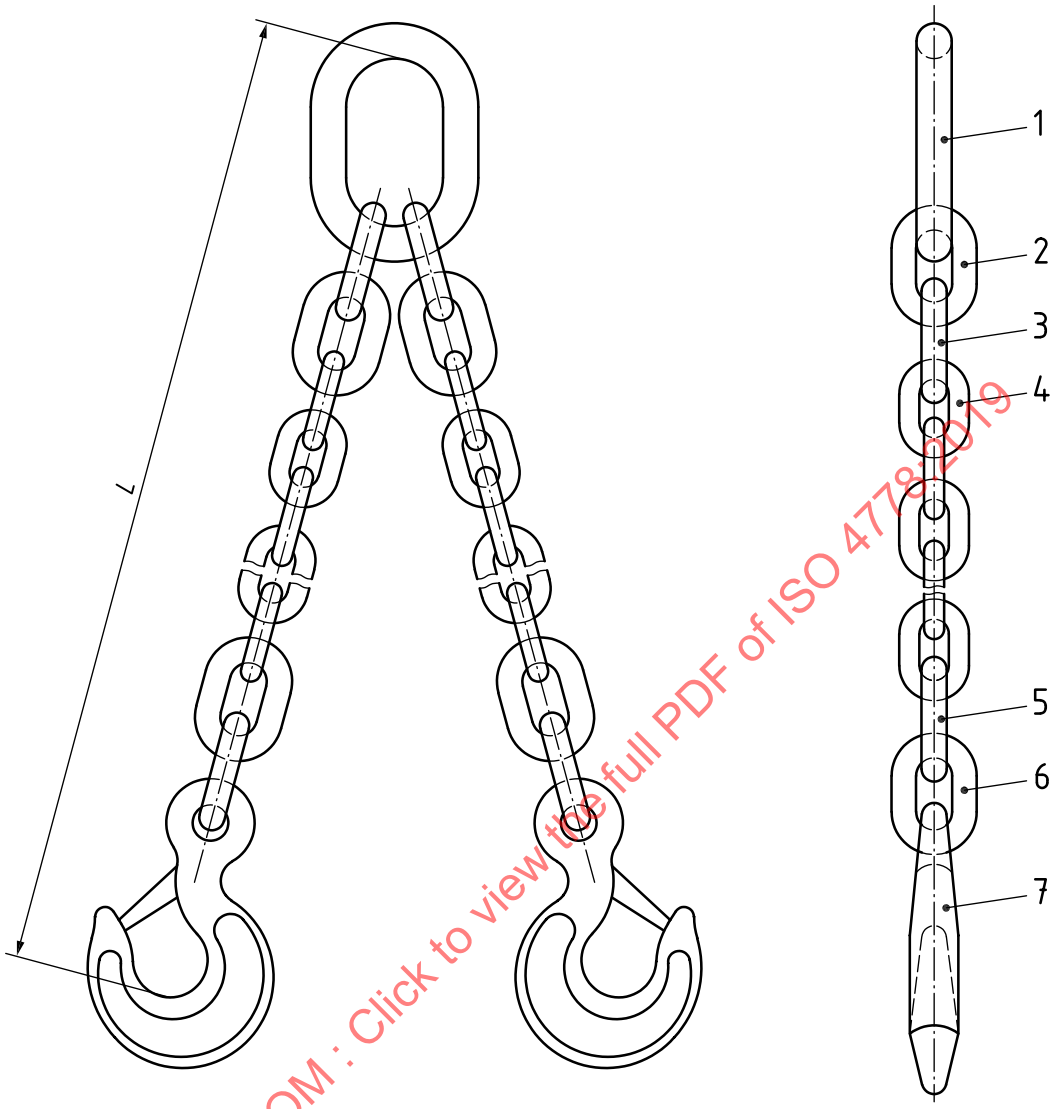
Figures 5 to 8 are intended to show examples of typical forms of sling and to illustrate the terms used; they are not intended to limit the design of slings.



Key

1 master link
2 intermediate link (if required)
3 joining link
4 chain
5 joining link
6 intermediate link (if required)
7 hook or other lower terminal
L nominal reach

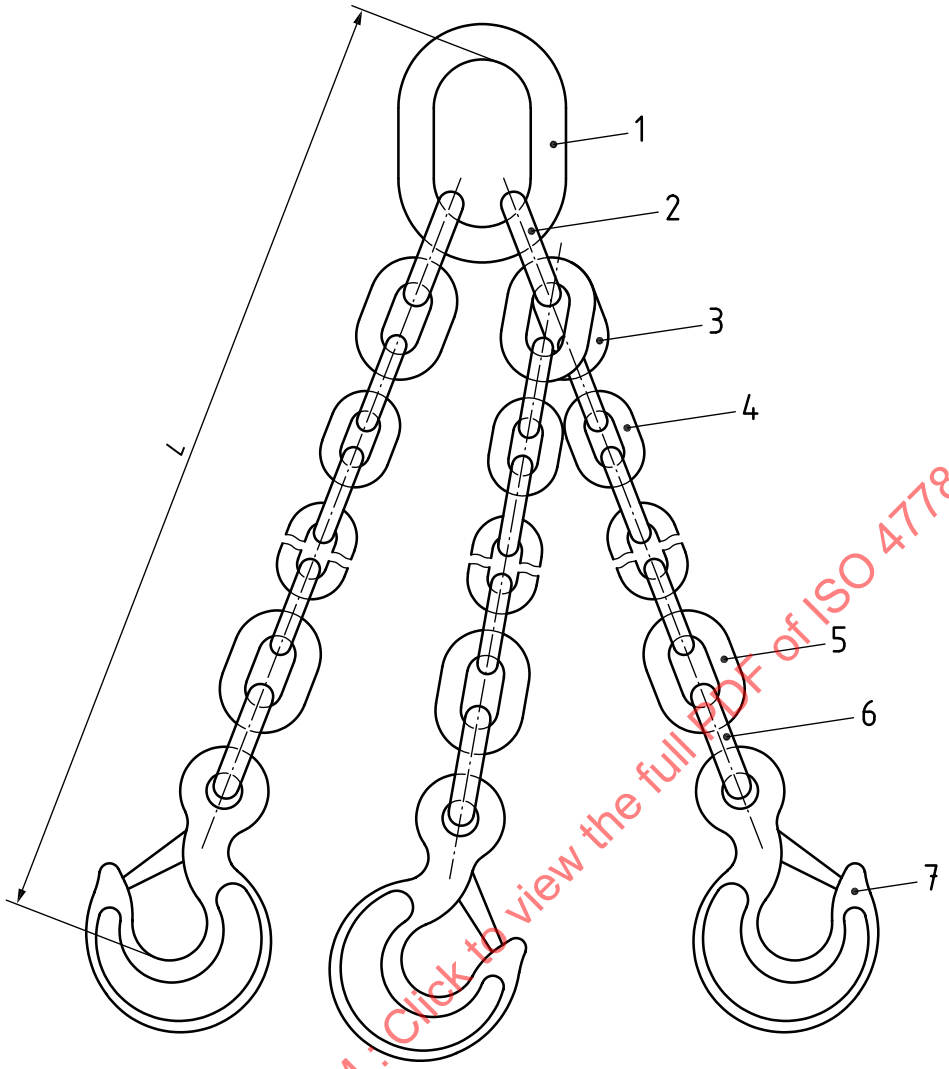
Figure 5 — Single leg chain sling



Key

1 master link
2 intermediate link (if required)
3 joining link
4 chain
5 joining link
6 intermediate link (if required)
7 hook or other lower terminal
L nominal reach

Figure 6 — Double leg chain sling

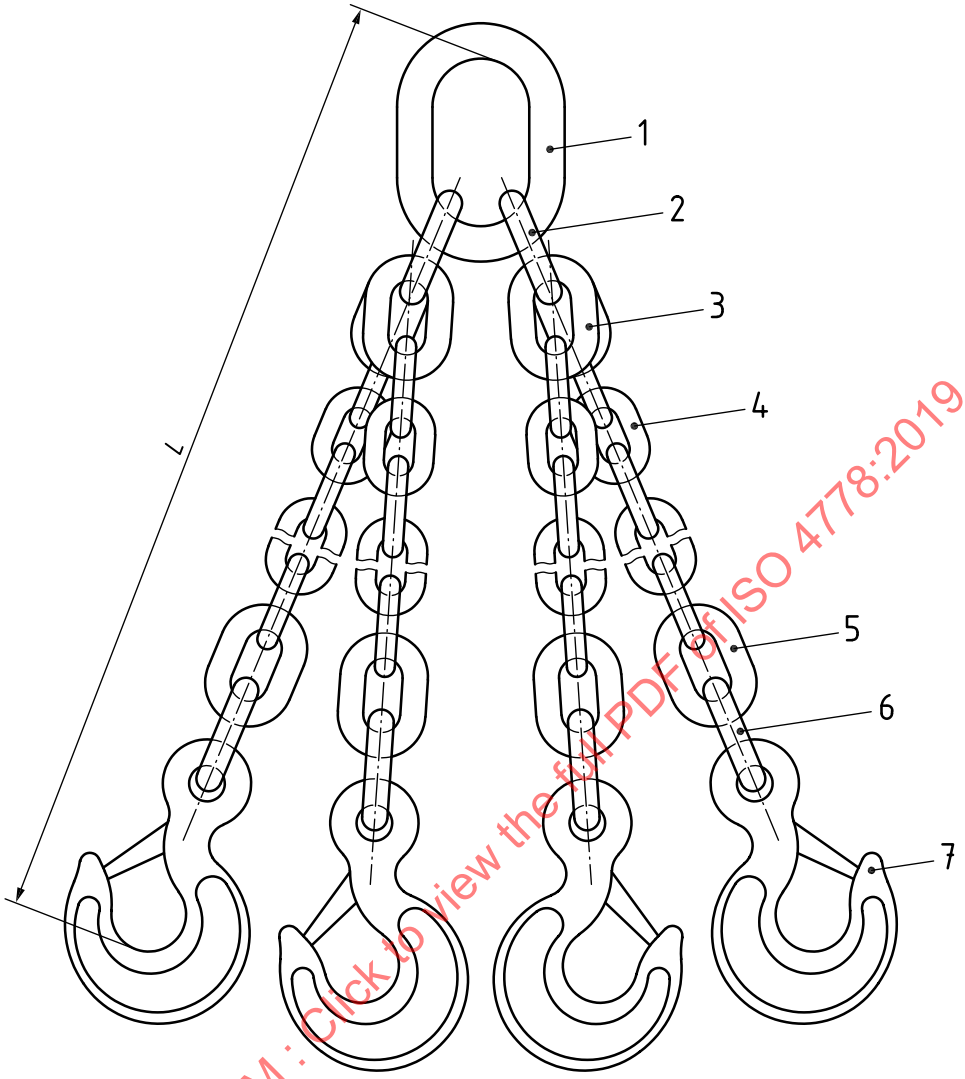


Key

1 master link
2 intermediate master link
3 joining link
4 chain
5 joining link
6 intermediate link (if required)
7 sling hook or other terminal
L nominal reach

NOTE The master link (1) and the two intermediate master links (2) form the master link assembly (see 3.6)

Figure 7 — Three leg chain sling



Key

1 master link
2 intermediate master link
3 joining link
4 chain
5 joining link
6 intermediate link (if required)
7 sling hook or other terminal
L nominal reach

NOTE The master link (1) and the two intermediate master links (2) form the master link assembly (see 3.6)

Figure 8 — Four leg chain sling

Annex A
(informative)

Bases for calculation

A.1 Working load limit (WLL)

A.1.1 General

The specified nominal stress at working load limit (WLL) used in the calculation of values for the working load limit in Formulae (A.1) to (A.6) is 200 N/mm^2.

For Formulae (A.1) to (A.6),

WLL is the working load limit, expressed in tonnes;

g is the acceleration due to gravity, expressed in metres per second squared (m/s^2, i.e. 9,806 65).

The calculation for the working load limit for four leg chain slings is based on three supporting chain legs.

A.1.2 Single leg chain sling with inclination angle $\beta = 0°$

$$WLL1/0° = 1 \times \frac{2 \times \frac{1}{4} \times \pi \times 200 \times d_n{}^2}{g \times 1\,000} \times \cos 0° \qquad \text{(A.1)}$$

$$WLL1/0° = 0{,}032\,035 \times d_n{}^2$$

Based on 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 1, column 2.

A.1.3 Double leg chain sling with inclination angle $0° < \beta \leq 45°$

$$WLL2/45° = 2 \times \frac{2 \times \frac{1}{4} \times \pi \times 200 \times d_n{}^2}{g \times 1\,000} \times \cos 45° \qquad \text{(A.2)}$$

$$WLL2/45° = 0{,}045\,305 \times d_n{}^2$$

Based on 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 1, column 3.

A.1.4 Double leg chain sling with inclination angle $45° < \beta \leq 60°$

$$WLL2/60° = 2 \times \frac{2 \times \frac{1}{4} \times \pi \times 200 \times d_n{}^2}{g \times 1\,000} \times \cos 60° \qquad \text{(A.3)}$$

$$WLL2/60° = 0{,}032\,035 \times d_n{}^2$$

Based on 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 1, column 4.

A.1.5 Intermediate master link with inclination angle $0° < \beta \leq 37,5°$ [1)]

$$WLL3/37,5° = 2 \times \frac{2 \times \frac{1}{4} \times \pi \times 200 \times d_n{}^2}{g \times 1\,000} \times \cos 37,5° \tag{A.4}$$

$$WLL3/37,5° = 0,050\,831 \times d_n{}^2$$

A.1.6 Three and four leg chain sling with inclination angle $0° < \beta \leq 45°$

$$WLL4/45° = 3 \times \frac{2 \times \frac{1}{4} \times \pi \times 200 \times d_n{}^2}{g \times 1\,000} \times \cos 45° \tag{A.5}$$

$$WLL4/45° = 0,067\,957 \times d_n{}^2$$

Based on 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 1, column 5.

A.1.7 Three and four leg chain sling with inclination angle $45° < \beta \leq 60°$

$$WLL4/60° = 3 \times \frac{2 \times \frac{1}{4} \times \pi \times 200 \times d_n{}^2}{g \times 1\,000} \times \cos 60° \tag{A.6}$$

$$WLL4/60° = 0,048\,053 \times d_n{}^2$$

Based on 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 1, column 6.

A.2 Manufacturing proof force (MPF)

A.2.1 General

For Formulae (A.7) to (A.10),

WLL is the working load limit, expressed in tonnes;

F_{MP} is the manufacturing proof force (MPF), expressed in kilo Newton;

g is the acceleration due to gravity, expressed in metres per second squared (m/s^2, i.e. 9,806 65).

A.2.2 Test section 1 (TS1)

$$F_{MP1} = 2,5 \times WLL1/0° \times g$$

$$F_{MP1} = 24,571 \times WLL1/0° \tag{A.7}$$

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 2, column 2.

1) Developed at the National Physical Laboratory, United Kingdom.

A.2.3 Test section 2 (TS2)

$$F_{MP2} = 2{,}5 \times WLL2 / 45° \times g$$
$$F_{MP2} = 24{,}571 \times WLL2 / 45° \quad \text{(A.8)}$$

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 4.

A.2.4 Test section 3 (TS3)

$$F_{MP3} = 2{,}5 \times WLL3 / 37{,}5° \times g$$
$$F_{MP3} = 24{,}571 \times WLL3 / 37{,}5° \quad \text{(A.9)}$$

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 4, column 4.

A.2.5 Test section 4 (TS4)

$$F_{MP4} = 2{,}5 \times WLL4 / 45° \times g$$
$$F_{MP4} = 24{,}571 \times WLL4 / 45° \quad \text{(A.10)}$$

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 4, column 6.

A.3 Breaking force (BF)

A.3.1 General

For Formulae (A.11) to (A.14),

WLL is the working load limit, expressed in tonnes;

F_B is the breaking force (BF), expressed in kilonewtons;

g is the acceleration due to gravity, expressed in metres per second squared (m/s^2, i.e. 9,806 65).

A.3.2 Test section 1 (TS1)

$$F_{B1} = 4 \times WLL1 / 0° \times g$$
$$F_{B1} = 39{,}227 \times WLL1 / 0° \quad \text{(A.11)}$$

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 2, column 3.

A.3.3 Test section 2 (TS2)

$$F_{B2} = 4 \times WLL2 / 45° \times g$$
$$F_{B2} = 39{,}227 \times WLL2 / 45° \quad \text{(A.12)}$$

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 5.

A.3.4 Test section 3 (TS3)

$$F_{B3} = 4 \times WLL3 / 37{,}5° \times g$$
$$F_{B3} = 39{,}227 \times WLL3 / 37{,}5° \quad \text{(A.13)}$$

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 4, column 5.

A.3.5 Test section 4 (TS4)

$$F_{B4} = 4 \times WLL4 / 45° \times g$$
$$F_{B4} = 39{,}227 \times WLL4 / 45° \quad \text{(A.14)}$$

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 4, column 7.

Annex B
(informative)

Correlations, grade 8

Table B.1 — Correlation of loads and forces, grade 8

1	2	3
Working load limit (WLL) t	**Manufacturing proof force (MPF)** F_{MP} kN min.	**Breaking force (BF)** F_B kN min.
10,0	250	400
10,6	265	425
11,2	280	450
11,8	300	475
12,5	315	500
13,2	335	530
14,0	355	560
15,0	375	600
16,0	400	630
17,0	425	670
18,0	450	710
19,0	475	750
20,0	500	800
21,2	530	850
22,4	560	900
23,6	600	950
25,0	630	1 000
26,5	670	1 060
28,0	710	1 120
30,0	750	1 180
31,5	800	1 250
33,5	850	1 320
35,5	900	1 400
37,5	950	1 500
40,0	1 000	1 600
42,5	1 060	1 700
45,0	1 120	1 800
47,5	1 180	1 900
50,0	1 250	2 000
53,0	1 320	2 120
56,0	1 400	2 240
60,0	1 500	2 360

Table B.1 *(continued)*

1	2	3
Working load limit (WLL) t	**Manufacturing proof force (MPF)** F_{MP} kN min.	**Breaking force (BF)** F_B kN min.
63,0	1 600	2 500
67,0	1 700	2 650
71,0	1 800	2 800
75,0	1 900	3 000
80,0	2 000	3 150
85,0	2 120	3 350
90,0	2 240	3 550
95,0	2 360	3 750