
Links of Grade 8 for use with slings

Mailles de classe 8 pour utilisation avec élingues

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ISO 16798:2004

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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.

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 16798 was prepared by Technical Committee ISO/TC 111, *Round steel link chains, chain slings, components and accessories*, Subcommittee SC 3, *Components and accessories*.

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Introduction

The links covered by this International Standard are normally supplied to be part of a sling, but could also be used for other applications. In such instances it is important that the link design be checked to ensure its fitness for the intended use.

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Links of Grade 8 for use with slings

1 Scope

This International Standard specifies requirements for forged or welded steel master links, intermediate master links, master link assemblies and lower terminal links of Grade 8 up to 132 t WLL (working load limit), mainly for use in

- chain slings in conformance with ISO 4778 and ISO 7593,
- steel wire rope slings in conformance with ISO 7531, and
- textile slings in conformance with EN 1492-1 and EN 1492-2,

intended for lifting objects, materials or goods.

This International Standard is not applicable to hand-forged links.

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 643, *Steels — Micrographic determination of the apparent grain size*
- ISO 4778:1981, *Chain slings of welded construction — Grades M (4), S (6) and T (8)*
- ISO 7500-1:—¹⁾, *Metallic materials — Verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Verification and calibration of the force-measuring system*
- ISO 7531, *Wire rope slings for general purposes — Characteristics and specifications*
- ISO 7593:1986, *Chain slings assembled by methods other than welding — Grade T(8)*
- ISO/IEC Guide 62, *General requirements for bodies operating assessment and certification/registration of quality systems*
- EN 818-6, *Short link chain for lifting purposes — Safety — Part 6: Chain slings — Specification for information for use and maintenance to be provided by the manufacturer*
- EN 1492-1, *Textile slings — Safety — Part 1: Flat woven webbing slings made of man-made fibres, for general purpose use*
- EN 1492-2, *Textile slings — Safety — Part 2: Roundslings made of man-made fibres, for general purpose use*
- EN 10025, *Hot rolled products of non-alloy structural steels — Technical delivery conditions*
- EN 10228-1, *Non-destructive testing of steel forgings — Part 1: Magnetic particle inspection*
- EN 10228-2, *Non-destructive testing of steel forgings — Part 2: Penetrant testing*

1) To be published. (Revision of ISO 7500-1:1999)

3 Terms and definitions

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

- 3.1**
working load limit
WLL
maximum mass a link is authorized to sustain in general lifting service
- 3.2**
manufacturing proof force
MPF
force applied to the link during the manufacturing proof test
- 3.3**
breaking force
BF
maximum force reached during the static tensile test of the link at the end of which the link fails to retain the load
- 3.4**
sling
assembly consisting of chain, wire rope or textile joined to upper and lower terminals, suitable for attaching loads to the hook of a crane or other lifting machine
- 3.5**
master link
link forming the upper terminal of a sling by means of which the sling is attached to the hook of a crane or other lifting machine
- 3.6**
intermediate master link
link used to connect one or two legs of a sling to a master link
- 3.7**
master link assembly
assembly consisting of a master link together with two intermediate master links
- 3.8**
lower terminal
link, hook or other device fitted at the end of a leg of a sling, remote from the master link or upper terminal
- 3.9**
traceability code
series of letters and/or numbers marked on a link that enable its manufacturing history, including the identity of the cast of steel used, to be traced.
- 3.10**
lot
specified number of links from which samples are selected for testing purposes and which have been manufactured from the same cast of steel and subjected to the same heat treatment
- 3.11**
integral joining device
means of connection that does not depend on welding and which is integrated with the link
- 3.12**
total ultimate elongation
total extension at the point of fracture of the link, expressed as a percentage of the internal length of the test sample

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3.13**competent person**

designated person, suitably trained, qualified by knowledge and practical experience, and with the necessary instruction to enable the required test and examination to be carried out.

NOTE ISO 10015 gives guidance on training.

4 Safety requirements**4.1 Design**

Links shall be either

- a) parallel-sided links produced by forging — with or without integral joining devices — or by welding, or
- b) pear-shaped links with integral joining devices (i.e. links with unequal radii at either end) produced by forging.

Parts of integral joining devices, such as pins and their securing elements, shall be so designed and manufactured that, after assembly, no unintended displacement can occur.

The effects of wear, corrosion of securing elements or rough usage should be considered.

4.2 Dimensions

The internal dimensions of links covered by this International Standard shall be such as to ensure articulation so that the force imposed is transmitted in the intended direction.

The cross-section of links shall be in accordance with 4.5.

NOTE This requirement permits a varying shape and area of cross-section.

The internal length and internal width of parallel-sided master links shall be in accordance with Table 1.

The internal length of pear shaped master links shall be $53\sqrt{WLL}$ minimum (in millimetres) and the internal width at the widest point $27\sqrt{WLL}$ minimum (in millimetres), where the WLL is expressed in tonnes.

Table 1 — Internal length and width of parallel-sided master links

WLL	Minimum internal length	Minimum internal width
≤ 25 t	$58\sqrt{WLL}$	$31,5\sqrt{WLL}$
> 25 t	$45\sqrt{WLL}$	$25\sqrt{WLL}$

4.3 Materials and heat treatment**4.3.1 Quality of material****4.3.1.1 General**

Within the limitations given in 4.3.1.2 to 4.3.1.4, the manufacturer shall select the type of steel to be used so that the finished links, when suitably heat-treated, conform to the mechanical properties specified in this International Standard.

4.3.1.2 Type of steel

The steel shall be produced by an electric, or by an oxygen blown, process.

4.3.1.3 Deoxidation

The steel shall be fully killed as defined in EN 10025, stabilized against strain-age embrittlement, and have an austenitic grain size of 5 or finer when tested in accordance with ISO 643.

This shall be accomplished by ensuring that the steel contains sufficient aluminium (minimum 0,025 %) to permit the manufacture of links stabilized against strain age embrittlement during service.

4.3.1.4 Chemical composition

4.3.1.4.1 General

The steel shall contain alloying elements in sufficient quantities so that the finished link, when heat-treated in accordance with 4.3.2, not only conforms to the mechanical properties specified in this International Standard, but also possesses low temperature ductility adequate for working satisfactorily in the temperature range $-40\text{ }^{\circ}\text{C}$ to $400\text{ }^{\circ}\text{C}$.

The steel's sulfur and phosphorus content shall be restricted in accordance with Table 2.

Table 2 — Sulfur and phosphorus content

Element	Maximum content (% by mass) determined by	
	cast analysis	check analysis
Sulfur	0,025	0,030
Phosphorus	0,025	0,030

4.3.1.4.2 Forged links

The steel shall contain at least two of the three alloying elements in accordance with Table 3.

Table 3 — Chemical composition — Alloying elements

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

4.3.1.4.3 Welded links

The steel shall contain nickel and at least one of the other two alloying elements in accordance with Table 3.

4.3.2 Heat treatment

Each link shall be hardened from a temperature above the AC3 point and tempered before being subjected to the manufacturing proof force (MPF). The tempering temperature shall be a minimum of $400\text{ }^{\circ}\text{C}$.

The tempering conditions shall be at least as effective as a temperature of $400\text{ }^{\circ}\text{C}$ maintained for a period of 1 h.

A method of verification is that after the links have been reheated to, and maintained for 1 h at, 400 °C and then cooled to room temperature, they should conform in the finished condition to 4.5.2 and 4.5.3.

Surface hardening shall not be used.

4.4 Manufacturing methods and workmanship

4.4.1 Manufacture

4.4.1.1 Forged links

Each forged link shall be hot-forged in one piece. Excess metal from the forging operation shall be removed cleanly, leaving the surface free from sharp edges. After heat treatment, furnace scale shall be removed.

Edges of machined surfaces shall be rounded to ensure attainment of mechanical properties and to eliminate cutting edges.

4.4.1.2 Welded links

Each welded link shall be manufactured from steel of weldable quality.

Welds shall be produced using the resistance butt or flash butt process and shall be positioned in the centre of the leg of the link (see Figure 1).

The steel in the length affected by welding shall not be displaced at any point so as to undercut the contours of the link. The weld shall be smoothly finished all round.

The length affected by welding shall not extend by more than 0,6 of the material diameter to either side of the centre of the weld.

If the link has a flattened section, this shall be on the leg of the link opposite to the weld.

4.4.2 Surface finish

The finished condition of links shall include any surface finish.

NOTE Links are supplied in various surface finishes, e.g. de-scaled, electroplated or painted.

4.5 Mechanical properties

4.5.1 General

The mechanical properties of links shall be as specified in 4.5.2 to 4.5.5.

4.5.2 Manufacturing proof force (MPF)

The MPF shall be calculated by multiplying the appropriate WLL given in Table 4 by a factor of 2,5 and taking account of acceleration due to gravity (g).

Links, including load-bearing pins, if used, shall be able to withstand the MPF. Following removal of the force, the dimensions shall be within the tolerances specified on the link manufacturer's drawings.