

INTERNATIONAL STANDARD

**ISO
610**

Second edition
1990-08-15

ANSI Internat Doc Sec1

High-tensile steel chains (round link) for chain conveyors and coal ploughs

*Chaînes en acier à haute résistance à la traction (à maillons ronds) pour
convoyeurs à chaînes et rabots à charbon*



Reference number
ISO 610:1990(E)

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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.

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.

International Standard ISO 610 was prepared by Technical Committee ISO/TC 82, *Mining*.

This second edition cancels and replaces the first edition (ISO 610:1979), of which it constitutes a technical revision. All references to ISO/R 147 have been replaced by a reference to ISO 7500-1.

Annexes A, B, C, D, E and F of this International Standard are for information only.

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International Organization for Standardization
Case Postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

High-tensile steel chains (round link) for chain conveyors and coal ploughs

1 Scope

This International Standard specifies the requirements for a range of high-grade special purpose calibrated, high-tensile, electrically welded, steel chains (round link) for use with machines and equipment in mining, such as the following:

- a) conveyors, flexible and rigid, of the chain type, chain belt conveyors, gate end and stage loaders;
- b) coal ploughs, coal cutters and power loaders;
- c) bucket elevators;
- d) other similar machines used in mines.

This International Standard covers a size range from 14 mm to 30 mm. Three grades of quality (B, C and D) are specified with regard to the mechanical properties of chain. The values given for grade D in tables 3, 4, 7 and 8 are, however, provisional.

Chains covered by this International Standard are not designed for lifting appliances, such as cranes and slings.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 643:1983, *Steels — Micrographic determination of the ferritic or austenitic grain size*.

ISO 7500-1:1986, *Metallic materials — Verification of*

static uniaxial testing machines — Part 1: Tensile testing machines.

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 size of chain: The nominal diameter d of the steel wire or bar from which the chain is made.

3.2 breaking force: The maximum force which a sample of finished chain withstands during the course of a tensile test to destruction.

3.3 test force: The specified force to which a sample of the finished chain has to be subjected without exceeding the stated elongation.

3.4 proof force: The specified force to which, after processing (see 3.6), the whole of the chain has to be subjected without significant permanent deformation or damage.

This force may be re-applied to the whole of the new chain or to any part thereof by the purchaser or by his inspector at their discretion.

3.5 percentage elongation: The extension expressed as a percentage of the gauge length.

3.6 processing: Any treatment of the chain subsequent to welding, for example heat treatment, calibration or surface treatment.

3.7 calibration: The application of force to the whole of the chain during the production process to control the link dimensions.

3.8 elastic limit: The maximum force which can be applied to the chain without producing permanent deformation.

3.9 setting force: The force applied to hold the sample under tension while the gauge length is marked and/or the extensometer is fitted.

NOTE 1 Other technical terms are illustrated in the force-extension diagram given in annex A.

3.10 inspector: The representative of the purchaser.

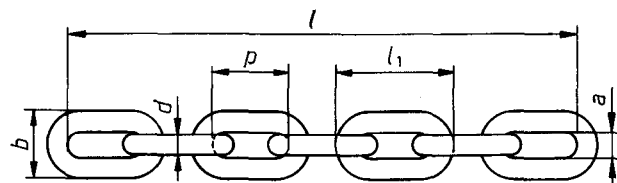


Figure 1 — Dimensions of chains

4 Dimensions of chains

The dimensions of chains shall be as shown in figure 1 and figure 2 and table 1.

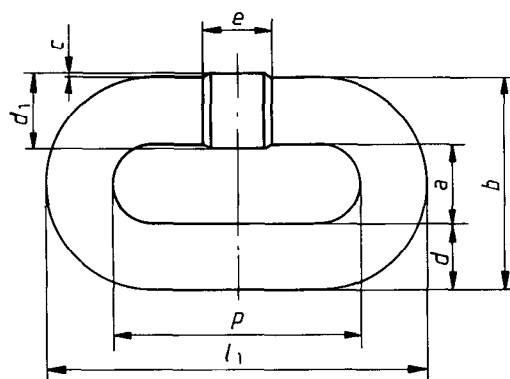


Figure 2 — Chain link dimensions

Table 1 — Chain link dimensions and mass

Dimensions in millimetres

1	2	3	4	5	6	7	8	9	10	11	12
Diameter of material in the finished link		Pitch		Width		Length		Weld			Mass per unit length ≈ kg/m
Nominal diameter <i>d</i>	Tolerance	Nominal <i>p</i>	Tolerance	Inside <i>a</i> min.	Outside <i>b</i> max.	Nominal <i>l₁</i>	Tolerance	Allowable offset <i>c</i> max.	Diameter <i>d₁</i> max.	Length <i>e</i>	
14	± 0,4	50	± 0,5	17	48	78	+ 0,5 - 1,3	0,4	15	10	4
18	± 0,5	64	± 0,6	21	60	100	+ 0,6 - 1,6	0,5	19,5	13	6,6
22	± 0,7	86	± 0,9	26	74	130	+ 0,9 - 2,3	0,7	23,5	15,5	9,5
24	± 0,8	86	± 0,9	28	79	134	+ 0,9 - 2,5	0,7	26	17	11,6
24	± 0,8	87,5	± 0,9	28	79	135,5	+ 0,9 - 2,5	0,7	26	17	11,5
26	± 0,8	92	± 0,9	30	86	144	+ 0,9 - 2,5	0,8	28	18	13,7
30	± 0,9	108	± 1	34	98	168	+ 1 - 2,8	0,9	32,5	21	18

4.1 Material diameter

4.1.1 Diameter of material in the link

The diameter d of the material in the link (except at the weld) shall be as stated in column 1 of table 1, subject to the tolerance shown in column 2.

The tolerance on the diameter of material in the link shall be applied to the average of two diameters measured at right angles in the same section.

4.1.2 Weld diameter

The diameter of the weld d_1 shall be not less than the actual diameter of the steel adjacent to the weld, nor shall it exceed the diameter stated in column 10 of table 1.

The weld offset c shall not exceed the actual diameter of the wire by more than the value stated in column 9 of table 1, and shall not be below the surface of the wire.

4.1.3 Position and extent of weld

The weld or welds shall be positioned equidistant about the centre of one or both legs of the link. The area affected dimensionally by welding shall not exceed the value given in column 11 of table 1.

4.2 Pitch

The nominal pitch p of the link shall be as stated in column 3 of table 1, and shall be subject to the tolerances shown in column 4 of that table.

4.3 Width of link

4.3.1 Inside width

The minimum inside width a of the link shall be as shown in column 5 of table 1, except at the weld.

4.3.2 Outside width

The maximum outside width b of the link shall be as shown in column 6 of table 1, except at the weld.

4.4 Length of link

The nominal length l_1 of the link shall be as stated in column 7 of table 1 and shall be subject to the tolerances stated in column 8 of that table. This is the theoretical length of the link and may be greater than the actual overall length due to flattening during manufacture.

4.5 Multiple pitch length

4.5.1 Nominal multiple pitch length

The nominal multiple pitch length l (see figure 1 and annex B, annex C and annex D) is the nominal pitch of the chain multiplied by the number of links specified. The number of links per length (being an odd number) shall be stated at the time of ordering.

4.5.2 Tolerance on actual multiple pitch length

The actual multiple pitch length of the chain shall be measured on the chain in the finished condition under the setting force stated in table 5. (See 6.5.3.)

The length so measured shall not vary from the sum of nominal inside lengths (i.e. pitches) of the individual links by more than

$$\pm \frac{p}{100} (1 + 0,15n)$$

where

- p is the nominal pitch;
- n is the specified number of links.

4.6 Matching of lengths

Where chain is required in short lengths having a specified number of links for use in double or triple chain conveyors, it shall be ordered and supplied in "matched lengths".

When measured under the setting force stated in table 5, the difference between any two matched lengths shall not be greater than:

- a) 0,1 % of the multiple pitch length, for lengths up to 2 m;
- b) 0,15 % of the multiple pitch length, for lengths greater than 2 m.

If the purchaser requires chain with tighter matching tolerances, they shall be the subject of special agreement between the purchaser and the manufacturer. An example of tighter matching tolerances is given in annex C.

4.7 Mass

The approximate mass per metre of single chain calculated on nominal dimensions is stated in column 12 of table 1.

5 Material and manufacture

5.1 Quality of material

The chain shall be made from steel which, in its finished state as supplied to the chain manufacturer, shall meet the following requirements:

- a) The steel shall be fully killed and shall possess reliable welding properties.
- b) The content of sulfur and phosphorus shall be as shown in table 2.

Table 2 — Content of sulfur and phosphorus

Element	Cast analysis		Check analysis	
	Quality B	Qualities C and D	Quality B	Qualities C and D
Sulfur, max.	0,040 %	0,030 %	0,045 %	0,035 %
Phosphorus, max.	0,035 %	0,030 %	0,040 %	0,035 %

- c) The steel shall be of such composition as to guarantee the mechanical properties of the chain after appropriate heat treatment. For grades C and D, an alloy steel containing alloying elements (such as nickel, chromium and molybdenum) shall be used. Care shall be exercised in the choice of steel so that the achievement of high ultimate tensile stress in the material does not result in the disproportionate loss of other properties, particularly notch toughness.
- d) The steel shall be made in conformity with fine grain practice to give an austenitic grain size of 5 or finer when tested in accordance with ISO 643. This could be accomplished, for example, by ensuring that it contains sufficient aluminium or an equivalent element to allow the manufacture of chain stabilized against strain age embrittlement during service; a minimum value of 0,020 % metallic aluminium is quoted for guidance, and to safeguard weldability, a maximum of 0,055 %. For grade B chain, however, this may be slightly relaxed, a grain size of 4 being acceptable.

Within the above limitations it shall be the responsibility of the chain maker to select the steel so that the finished chain, suitably heat treated, possesses the specified mechanical properties.

The steel wire or bar used for the links shall be cleanly finished and shall be free from harmful flaws and surface defects. If requested by the purchaser, the following information shall be supplied:

- a) the method of steel manufacture and the steelmaker's cast analysis;
- b) an analysis of steel millings taken from, and representative of, a link which formed part of a length tested to destruction.

5.2 Heat treatment

Chain complying with this International Standard shall be heat treated in the course of manufacture. Heating to an appropriate temperature above the critical point (A_{c3}) of the steel used shall form part of such heat treatment.

5.3 Workmanship

Fins caused by welding shall be removed and welds shall be smoothly finished. Any links which on visual examination show detrimental fissures, notches or similar faults shall be rejected unless the faults can be rectified by means agreed between the purchaser and manufacturer.

5.4 Links inserted in the course of manufacture

Any links which have been inserted shall be processed and inspected so as to ensure that every link in the chain is in a uniform condition.

5.5 Condition at delivery

Unless otherwise agreed between purchaser and manufacturer, chains shall be supplied unpolished and free from any coating. Different quality grades may, however, be identified by markings or by colours (see 7.2.1).

Surface finishes such as the following shall be specified at the time of ordering:

- rust preventive coating;
- polished finish;
- coloured coating;
- rumbling without abrasives.

5.6 Method of marking

Where inspection marking (see 7.2.2) or identification marking (see 7.2.1) is applied by means of stamping the chain,

- a) impressed marks shall be placed on the straight sides of the links and shall in no case coincide with the weld;

- b) the stamps shall have a concave surface and the indentation shall be neither too sharp nor of excessive depth.

5.7 Inspection

The whole of the finished chain shall be given a thorough visual examination by the manufacturer's competent personnel. Any fractured or defective links shall be replaced (see 5.4).

6 Test requirements

6.1 General

The dimensions and basic mechanical properties required for each size and grade of chain are summarized in table 1 and table 3. The forces stated in

table 4 (for each size and grade of chain) apply to tests carried out by the manufacturer and/or the inspector, in the course of final acceptance tests.

6.2 Proof loading

The manufacturer shall proof load all chain to at least 90 % of the test force specified in table 4. If this requirement is met during the calibration process, then no separate proof load is necessary.

After proof loading, all chain shall be subjected to a thorough visual examination by the manufacturer's competent personnel. Any fractured or defective links shall be replaced (see 5.4).

Table 3 — Mechanical properties — Basic table

Mechanical properties	Quality grade of chain		
	B	C	D
Minimum breaking stress, N/mm ² (MPa)	630	800	1 000
Stress at test force, N/mm ² (MPa)	500	640	800
Ratio $\frac{\text{test force}}{\text{min. breaking force}}$, %	80	80 ¹⁾	80 ¹⁾
Maximum elongation at test force, %	1,4	1,6	1,9
Minimum total elongation at fracture, %	12	12	12
1) By agreement between purchaser and manufacturer, the ratio of test force to minimum breaking force for grade C and D quality chains of 26 mm and 30 mm may be reduced from 80 % to 75 %.			

Table 4 — Mechanical properties — Specified test forces

Nominal size and pitch of chain mm x mm	Grade B		Grade C		Grade D	
	Breaking force, min.	Test force	Breaking force, min.	Test force	Breaking force, min.	Test force
	kN	kN	kN	kN	kN	kN
14 x 50	190	150	250	200	310	250
18 x 64	320	260	410	330	510	410
22 x 86	480	380	610	490	760	610
24 x 86	570	460	720	580	900	720
24 x 87,5	570	460	720	580	900	720
26 x 92	670	540	850	680 ¹⁾	1 060	850 ¹⁾
30 x 108	890	710	1 130	900 ¹⁾	1 410	1 130 ¹⁾
1) By agreement between purchaser and manufacturer, the ratio of test force to minimum breaking force for grade C and D quality chains of 26 mm and 30 mm may be reduced from 80 % to 75 %.						