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INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION

R 610

HIGH-TENSILE STEEL CHAINS (ROUND LINK) FOR CHAIN CONVEYORS AND COAL PLOUGHS

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BRIEF HISTORY

The ISO Recommendation R 610, *High-tensile steel chains (round link) for chain conveyors and coal ploughs,* was drawn up by Technical Committee ISO/TC 82, *Mining,* the Secretariat of which is held by Deutscher Normenausschuss (DNA).

Work on this question by the Technical Committee began in 1959 and led, in 1962, to the adoption of a Draft ISO Recommendation.

In June 1964, this Draft ISO Recommendation (No. 727) was circulated to all the ISO Member Bodies for enquiry. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies:

Belgium	Korea, Rep. of	Switzerland
Colombia	Netherlands	Turkey
Czechoslovakia	New Zealand	U.A.R.
France	Poland	United Kingdom
Germany	Spain	
Italy	Sweden	

Two Member Bodies opposed the approval of the Draft:

India
Japan.

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in August 1967, to accept it as an ISO RECOMMENDATION.

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ISO Recommendation R 610 August 1967

HIGH-TENSILE STEEL CHAINS (ROUND LINK) FOR CHAIN CONVEYORS AND COAL PLOUGHS

1. GENERAL

1.1 Scope

This ISO Recommendation covers the requirements for a range of high grade special purpose chains.

These are calibrated high-tensile, electrically welded, steel chains (round link) specially manufactured for use with machines and equipment in mining, such as the following:

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

This ISO Recommendation covers a size range from 14 to 26 mm.

Three grades of quality are specified with regard to the mechanical properties of the chain.

The chains covered by this ISO Recommendation are not designed for lifting appliances, such as cranes and slings.

1.2 Definitions

For the purposes of this ISO Recommendation, the following definitions apply:

1.2.1 *Size.* The nominal diameter of the steel wire or bar from which the chain is made.

1.2.2 *Test load.* The load to which a sample length of finished chain is subjected in order to determine the extent of total and permanent elongations.

1.2.3 *Breaking load.* The maximum load which the chain withstands during the course of a tensile test.

1.2.4 *Processing.* Any treatment of the chain subsequent to welding, e.g. heat treatment, polishing or other surface treatment.

1.2.5 *Inspector.* The representative of the purchaser.

NOTE. — The use of other technical terms such as "energy absorption factor", "total extension" and "permanent extension" is illustrated in the load extension diagram given in Annex A, page 13.

2. DIMENSIONS OF CHAINS

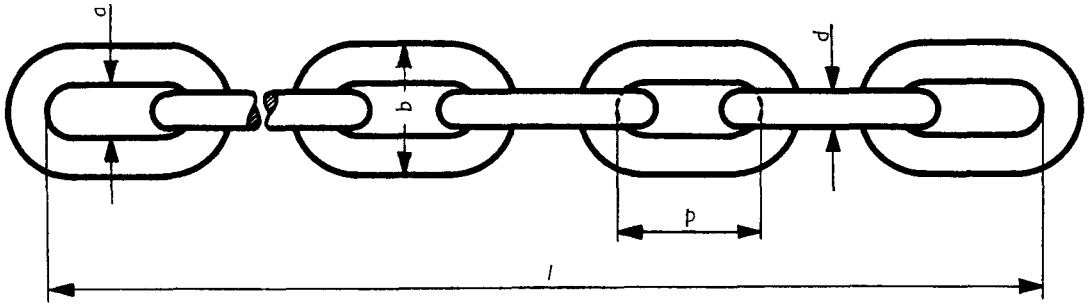

FIG. 1 — **Dimensions of chains**

2.1 Diameter of material

2.1.1 *Diameter of material in the link*

The nominal diameter d of the material in the link, except at the weld, should be as shown in column 1, Table 1, page 11, subject to the tolerance shown in column 2 of that Table.

2.1.2 *Diameter of steel at the weld*

The diameter of the steel at the weld should in no case be less than the actual diameter of the steel from which the chain is made, nor should it exceed it by more than 7.5 %.

2.1.3 *Position and extent of weld*

The weld or welds in chains according to this ISO Recommendation should be positioned in the centre of one or both legs of the link. The area affected dimensionally by welding should not extend by more than one-half diameter on either side of the centre.

2.2 Pitch

The nominal pitch p of the link is as shown in column 3, Table 1, and is subject to the tolerances shown in column 4.

2.3 Width of link

2.3.1 *Inside width*

The minimum inside width of the link a is as shown in column 5, Table 1, except at the weld.

2.3.2 *Outside width*

The maximum outside width of the link b is as shown in column 6, Table 1, except at the weld.

2.4 Effective length

2.4.1 *Nominal length*

The nominal effective length l is the nominal pitch of the chain multiplied by the number of links specified. The number of links per length should be stated at the time of ordering, and should be an odd number.

2.4.2 *Tolerance on effective length*

The effective length of the chain is measured on the chain in the finished condition under a tensile stress of about 2.5 kgf/mm² (1.6 tonf/in²).

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

$$\pm \frac{p}{100}(1+0.15\ N)$$

where p is the nominal pitch.

N is the specified number of links

2.5 Matching of lengths

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

When measured under a tensile stress of about 2.5 kgf/mm² (1.6 tonf/in²) (see Table 4, page 12), the variation in length should not be greater than,

for lengths up to 2 m (6 ft 6 in), 2 mm (0.08 in)
for lengths greater than 2 m, 0.15 % of total length.

NOTE. — It is recommended that for lengths less than 1 m (3 ft 3 in), the variation in length should not exceed 1 mm (0.04 in).

2.6 Mass

The approximate mass per metre of single chain is given in column 7, Table 1.

3. MATERIAL AND MANUFACTURE

3.1 Quality of material

The steel used in the manufacture of the chain should be fully killed and should be such that the finished chain, suitably heat treated, meets the specified requirements with regard to its mechanical properties.

In addition to possessing reliable welding quality, the steel should not be of a type liable to any kind of embrittlement, including strain-age embrittlement.

Subject to the above limitations, the selection of the steel is the responsibility of the manufacturer of the chain.

3.2 Heat treatment

Any chain covered by this ISO Recommendation should be heat treated in the course of manufacture.

Heating to a temperature between 30 and 50 deg C above the upper critical point (AC_3) of the steel used forms part of such heat treatment.

3.3 Workmanship

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

3.4 Links inserted in the course of manufacture

Any links which have been inserted should be processed, tested and inspected in the same manner as the chain itself, so as to ensure that every link in the chain is in a uniform condition.

3.5 Conditions at delivery

Unless otherwise agreed between purchaser and manufacturer, chains should be supplied unpolished and free from any coating. Different quality grades may, however, be identified by markings or by different colours.

Surface finishes such as those listed below should be specified at the time of ordering:

Rust preventing coating,
Polished finish,
Coloured coating,
Rumbling without abrasives.

3.6 Method of marking

Where inspection marking (see clause 5.2.2) or identification marking (see clause 5.2.1) is applied by means of stamping the chain,

(*a*) impressed marks should be placed on the straight sides of the links and should in no case coincide with the weld,

(*b*) the stamps should have a concave surface and the indentation should be neither too sharp nor of excessive depth.

3.7 Proof loading

The manufacturer should subject the whole of the chain to a proof load which should be at least 90 % of the test load specified in Table 3, page 12.

3.8 Inspection after proof loading

The whole of the chain after proof loading is subject to a thorough visual examination by the manufacturer's competent personnel. Any fractured or defective links should be replaced (see clause 3.4).

4. TEST REQUIREMENTS

4.1 General

The dimensions and the basic mechanical properties and dimensions required for each of the three quality grades of chains are summarized in Tables 1 and 2 respectively. Actual test loads are given for each size of chain and for each quality grade in Table 3. Ranges of loads for the dynamic (pulsator) test are given in Table 5, page 12. These values apply to tests carried out by the manufacturer, as well as by the inspector, in the course of final acceptance tests (see section 5.).

A graphical explanation of terms used in this section is given in Annex A, page 13.

4.2 Selection of samples

Unless otherwise specified by the purchaser, the following sampling arrangement applies:

Test samples should be selected at random by the inspector and at his discretion (see also section 5). The samples should be representative of the bulk of the chain and free from any coating which might obscure defects.

The chains should be tested in lots, one lot meaning 200 m (656 ft) of chain or 200 lengths of chain; an excess fraction should be considered as a complete lot.

For *dimensional tests,* five sample lengths should be selected from each lot of finished chain.

For *static tensile tests,* one sample should be taken from each lot for chains of quality grades A and B, and two samples for chains of quality grade C. Each sample length to be tested should contain at least five links.

For *dynamic tests,* one sample consisting of at least three links should be selected for every five lots. In the case of a smaller number of lots at least one sample should be tested during inspection.

4.3 Dimensional tests

The requirements of section 2 for link dimensions are verified.

4.4 Static tensile test*

4.4.1 *Testing machine*

The testing machine used and the grips employed should be such as to satisfy the requirements of this test procedure.

The type and accuracy of the testing machine should be in accordance with the relevant national standards. The testing machine should be used only within its appropriate range as shown by the test certificate for the machine.

The straining mechanism of the testing machine should be sufficiently long to allow a chain of the full length of the testing bed to be subjected to the proof load without the necessity for taking a fresh hold to complete the strain.

The testing machine should be equipped with an autographic recorder which permits a load extension diagram to be taken during the test (see Annex A, page 13).

4.4.2 *Elongation under test load*

The test is carried out in the following manner:

The sample is inserted into the grips of the testing machine and is subjected to a setting load not exceeding half the test load.

The load is then decreased to provide a stress of 2.5 kgf/mm² (1.6 tonf/in²) (see Table 4).

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* Whatever the gauge length of the sample it should be related, by calculation, to the unit length, i. e. one metre.

With the sample held under this tensioning load a gauge length (see Table 4) should be marked out, and the extensometer, where used, is attached to the sample. The load is then raised at the rate of approximately 1 kgf/mm² (0.63 tonf/in²) per second to the test load specified in Table 3. When the specified test load has been reached, the amount of elongation is recorded.

The extension thus measured is divided by the gauge length and multiplied by 100.

The total elongation determined in this manner should not exceed the appropriate value shown in Table 2.

4.4.3 *Breaking load*

Following the application of the test load (and removal of the extensometer, if necessary), the load should be raised further until the sample breaks.

The breaking load (see definition in clause 1.2.3) should be not less than the appropriate load stated in Table 3.

4.4.4 *Elongation under ultimate breaking load*

Both the ultimate total and the ultimate permanent extension of the sample are derived from the load extension diagram which is made during the test (see Annex A).

The value measured is multiplied by 100 and divided by the gauge length, the results giving the ultimate total elongation and the ultimate permanent elongation as a percentage.

The ultimate total elongation should be not less than the appropriate value listed in Table 2.

The ultimate permanent elongation forms the basis for the calculation of the energy absorption factor (see clause 4.4.5).

4.4.5 *Calculation of energy absorption factor (optional)** (see Annex B, page 14)

The ultimate permanent elongation (see clause 4.4.4) should be multiplied by the ultimate breaking load in the course of tensile testing.

The value thus obtained should be not less than the appropriate value shown in Table 3.

4.5 Dynamic test (optional)*

The sample is subjected to a frequency of not more than 2000 pulsations per minute between the upper and lower stress limits specified in Table 5, page 12. The temperature of the chain during the test should not exceed 50 °C.

The total number of alternating pulsations withstood by the sample is recorded and should be not less than the appropriate number listed in Table 2.

5. INSPECTION PROCEDURE

5.1 Acceptance tests

If the samples taken from a lot of chain (see clause 4.2) fulfil all the specified test requirements, the lot complies with the requirements of this ISO Recommendation. If not, the lot does not comply.

If one of the samples fails to meet any one of the specified tests, two further samples are selected from the same lot.

If both the additional samples meet all the specified tests, the lot complies with the requirements of this ISO Recommendation. If not, the lot does not comply.

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* By agreement between purchaser and manufacturer, either the minimum energy absorption factor or the dynamic test may be specified. Both tests need not necessarily be specified.

5.2 Marking

5.2.1 *Identification marking*

Identification marks are legibly stamped on the chain as stated below. By agreement between purchaser and manufacturer, one or both of these parties will be responsible for actually marking the chain.

The position of marks is as follows:

(*a*) Chain up to and including 2 m (6 ft 6 in) in length – one mark in the middle of the chain;

(*b*) Chain greater than 2 m (6 ft 6 in); up to and including 10 m (33 ft) in length – one mark in the middle of the chain and one mark at each end;

(*c*) Where chains are used in longer lengths they should be marked at intervals of not more than 5 m (16 ft 6 in).

The marks comprise series of not more than four symbols (i. e. letters or numbers).

They should indicate:

(1) the manufacturer's symbol,

(2) the month of manufacture,

(3) the year of manufacture,

(4) the symbol of quality.

The numbers denoting the month and year of manufacture may, at the option of the purchaser, be replaced by numbers to indicate such other information as may be required from the manufacturer.

For details of coding, see Annex C.

For method of marking, see clause 3.6.

Where colour coding is specified by the purchaser, the following coding applies:

Quality Grade A ..... blue
Quality Grade B ..... green
Quality Grade C ..... red

5.2.2 *Inspection marking*

Provided the results of all specified tests are satisfactory and a lot has been accepted, the inspector's acceptance stamp is put on the chain.

5.3 Test certificate

The manufacturer should supply a certificate of test and examination with every consignment of chain supplied to the requirements of this ISO Recommendation and, when so required by the purchaser and agreed between purchaser and manufacturer, identification of the cast number of the steel.

The certificate is signed by the manufacturer and by the authorized representative of the purchaser (inspector), who has witnessed the acceptance tests.

5.4 General inspection

For the purpose of witnessing the specified tests and inspecting the testing machines and methods of examination, the inspector should be given access to the relevant parts of the works of the manufacturer at all reasonable times.

TABLE 1 — **Dimensions and masses**

1	2	3	4	5	6	7
Size of chain		**Pitch**		**Width**		**Mass (approx.)**
Nominal diameter *d*	**Tolerance**	**Nominal** *p*	**Tolerance**	**inside minimum** *a*	**outside maximum** *b*	
mm	mm	mm	mm	mm	mm	kg/m
14	± 0.4	50	± 0.5	17	48	3.9
16	± 0.5	64	± 0.6	20	55	4.9
18	± 0.5	64	± 0.6	21	60	6.5
20	± 0.6	80	± 0.8	23	67	7.7
22	± 0.7	86	± 1.0	26	75	9.4
24	± 0.8	86	± 1.0	28	79	12.5
26	± 0.8	92	± 1.0	31	87	14.7

TABLE 2 — **Mechanical properties: basic table**

		Quality grade		
		A	B	C
Minimum breaking stress	kgf/mm²	50	63	80
Test load – stress	kgf/mm²	35	50	64
Ratio of test load to minimum breaking load	%	70	80	80
Maximum total elongation under test load	%	1	1.4	2.0
Minimum ultimate total elongation	%	10	10	7
Energy absorption factor *	kgf. m/mm²	3.25	3.5	3.6
Total number of alternating pulsations to be withstood, with a stress of between 5 and 25 kgf/mm²		30000	50000	70000

* See Annex B.

TABLE 3 — **Mechanical properties: specified test figures**

Size and pitch	Grade A			Grade B			Grade C		
	Breaking load minimum	Test load	Energy absorption minimum	Breaking load minimum	Test load	Energy absorption minimum	Breaking load minimum	Test load	Energy absorption minimum
mm	t	t	kgf. m	t	t	kgf. m	t	t	kgf. m
14×50	15	11	1000	19	15	1070	25	20	1100
16×64	20	14	1300	25	20	1400	32	26	1440
18×64	25	18	1650	32	25	1780	41	33	1830
20×80	31	22	2040	40	31	2200	50	40	2260
22×86	38	27	2470	48	38	2660	61	49	2730
24×86	45	31	2940	57	45	3160	72	58	3260
26×92	53	37	3450	67	53	3710	85	68	3820

TABLE 4 — **Gauge length and setting load**

Diameter and pitch	mm	14×50	16×64	18×64	20×80	22×86	24×86	26×92
Gauge length	mm	200	250	250	300	350	350	350
Setting load	2.5 kgf/mm² t	0.8	1.0	1.3	1.6	1.9	2.3	2.6

TABLE 5 — **Dynamic test**

Diameter of material *d*	Load range	
	Lower limit (5 kgf/mm²)	Upper limit (25 kgf/mm²)
mm	t	t
14	1.5	7.7
16	2.0	10.1
18	2.5	12.7
20	3.1	15.7
22	3.8	19.0
24	4.5	22.5
26	5.3	26.5