

MATERIAL AND EQUIPMENT STANDARD

FOR

HOOKS, SHACKLES, EYE BOLTS AND CHAINS

0. INTRODUCTION

This Standard has been prepared in four parts as follows; and each part can be used independently.

Part 1:	Hooks
Part 2:	Shackles
Part 3:	Eye bolts
Part 4:	Chains

Part one gives the amendment and supplement to British Standard BS 2903: 1980 "Higher Tensile Steel Hooks for Chains, Slings, Blocks and General Engineering Purposes".

Part two gives the amendment and supplement to International Standard ISO 2415, Second Edition: 1987, "Forged Shackles for General Lifting Purposes-Dee Shackles and Bow Shackles".

Part three gives the amendment and Supplement to International Standard ISO 3266: 1984 Edition "Eyebolts for General Lifting Purposes", Technically equivalent standard to BS-4278.

Part four gives the minimum requirements for chains for general lifting applications.

For ease of reference, the clause (or paragraph) numbering of Supplemented Standard have been used throughout of Parts 1, 2 and 3.

For the purpose of this Standard the following definitions shall hold.

Sub. (substitution):	"The Supplemented Standard clause is deleted and replaced by a new clause".
Del.(Deletion):	"The Supplemented Standard clause is deleted without any replacement".
Add.(Addition):	"A new clause with a new number is added".
Mod.(Modification):	"Part of the Supplemented Standard clause is modified and/or a new statement or comment is added to that clause".

PART ONE**HOOKS**

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1. SCOPE

This Standard covers minimum requirements for hooks for general purpose applications. It is intended to be used in Iranian Petroleum Industries.

No deviation from this Standard is permitted without explicit approval of the Company.

The intended deviations shall be clearly indicated and separately listed in the Vendor's proposal. (Mod.)

4. SPECIAL HOOKS

Delete this clause. (Del.)

5. MATERIAL

The material of hooks shall contain phosphorus not exceeding 0.03% and sulfur not exceeding 0.035% and shall satisfy the performance requirements of hooks. (Mod.)

5.1 Hooks shall be formed by forging. The shank section shall be formed by forging or be formed by machining. Hooks shall be subjected to a suitable heat treatment. Materials of the hooks shall be specified by ASTM or AISI designations. (Add.)

5.2 The hook material shall have sufficient ductility to permanently deform before losing the ability to support the load at the temperature at which the specific hook will be used. (Add.)

18. INSPECTION

18.1 Shape, Main Dimensions, and Appearance

The inspection of hooks for the shape, main dimensions, and appearance shall as a rule be performed with sample extracted from each lot*, and judgment on acceptability shall be made based on the results of inspection. (Add.)

19. IDENTIFICATION MARKING

The following items of information shall be marked at suitable position of the hook body by a method having no risk of degrading the performance of the hook. (Mod.)

21. ATTACHMENTS (Add.)

21.1 When a latch is provided, it shall be designed to retain such items as, but not limited to, slings and chains under slack conditions. The latch is not intended to support the load. (Add.)

21.2 Attachments such as handles, latch supports, etc., shall not be welded to finished hook in field applications. If welding of an attachment such as these is required, it shall be done in manufacturing or fabrication prior to any final heat treatment. (Add.)

* A lot means a group of hooks belonging to each melting charge and produced from the same material and applied the same heat treatment. (Add.)

22. CONFLICTING REQUIREMENTS

In case of conflict between this Standard and documents relating to the inquiry or order, the following priority of documents shall apply:

- **First Priority:** Purchase order and variations thereto.
- **Second Priority:** This Standard specification.
- (Add.)

23. PREPARATION FOR SHIPMENT (Add.)

Equipment shall be suitably prepared for the type of shipment specified.

24. GUARANTEE AND WARRANTY (Add.)

All hooks supplied shall be guaranteed by the Vendor against faulty design, defective or improper materials, poor workmanship, and failure due to normal usage for one year after being placed in the service. If any defects or malfunctions occur during this period, the Vendor shall make all necessary alteration, repairs, and replacements free of charge. (Add.)

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1. SCOPE

This Standard specification covers minimum requirements for shackles for general purpose applications for use in Iranian Petroleum Industries.

No deviations from this Standard is permitted without explicit approval of the Company.

The intended deviations shall be clearly indicated and separately listed in the Vendor's proposal. (Mod.)

4. FORMS AND DIMENSIONS

4.4 Appearance (Add.)

The surface shall be smooth and free from injurious defects such as chaps, cracks and flaws. (Add.)

6. MATERIAL

6.3 Shackle materials shall be specified by ASTM, or AISI designation codes. When such designations were not possible the nearest ASTM equivalent material shall be submitted by the Vendor.

17. INSPECTION (Add.)

The appearance, form and dimensions inspection shall be performed and shall comply with requirements specified in Section 4. (Add.)

18. GUARANTEE AND WARRANTY

All shackles supplied shall be guaranteed by the vendor against faulty design, defective or improper materials, poor workmanship, and failure due to normal usage for one year after being used. If any defects or malfunctions occur during this period the Vendor shall make all necessary alteration, repairs and replacements free of charge. (Add.)

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EYE BOLTS

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1. SCOPE

This Standard covers minimum requirements for shackles for general purpose lifting applications. It is intended to be used in Iranian Petroleum Industries.

No deviations from this Standard is permitted without explicit approval of the Company.

The intended deviations shall be clearly indicated and separately listed in the Vendor's proposal. (Mod.)

5. MATERIAL

Materials shall be identified by reference to appropriate ASTM or AISI specification. When no such appropriate designation is available, the nearest ASTM or AISI equivalent designation shall be specified or chemical composition and significant physical properties of the material shall be presented in the proposal. (Mod.)

13. INSPECTION (Add.)

The inspection of bolts covers items explained in Clauses 13.1 through 13.3.

The method of sampling inspection shall be the subject of agreement between the purchaser and the manufacturer. (Add.)

13.1 Dimensions and Tolerances Inspection

The dimensions and tolerances inspection on bolts shall be made by the direct measurement, or by other methods and shall conform to the requirements of Clause 4. (Add.)

13.2 Appearance Inspection

The appearance inspection shall be made by the direct viewing of the product. Bolts shall be free from harmful effects in use by cracks, flaws, burrs and rust. (Add.)

13.3 Material Inspection

The material inspection for bolts shall be made as a rule, by the determination of test sheet result on ladle analysis of chemical composition whether or not it conforms to the material specified. (Add.)

14. PACKAGING (Add.)

The packaging of bolts shall be made suitably to protect the screwed portion against damage.

For bolts not applied with surface treatment shall be packed after suitably coated with rust preventing oil. (Add.)

15. GUARANTEE AND WARRANTY (Add.)

All bolts supplied shall be guaranteed by the vendor against faulty design, defective or improper materials, poor workmanship, and failure due to normal usage for one year after being used. If any defects or malfunctions occur during this period the vendor shall make all necessary alteration, repairs and replacements free of charge. (Add.)

PART FOUR

STANDARD FOR

CHAINS FOR GENERAL LIFTING

APPLICATIONS

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1. SCOPE

This Standard covers minimum requirements for chains for general lifting applications. It is intended to be used in Iranian Petroleum Industries.

No deviations from this Standard is permitted without explicit approval of the Company.

The intended deviations shall be clearly indicated and separately listed in the Vendor's proposal.

2. DEFINITIONS

For the purpose of this Standard the following definitions apply.

2.1 Size

Nominal diameter of the steel wire or bar from which the chain is made (d_n).

2.2 Material Diameter

Diameter of the material in the chain link as measured (d).

2.3 Pitch of Chain

Internal length of a link (p).

2.4 Proof Force

Force to which after processing (see definition below) the whole of the chain is subjected as (F_e).

2.5 Breaking Force

Maximum force which the chain withstands during the course of a static tensile test to destruction (F_m).

2.6 Working Load Limit (Lifting Capacity)

Maximum mass which the chain hanging vertically is authorized to support in general service (C_p).

2.7 Total Ultimate Elongation

Total extension at the point of fracture of the chain expressed as a proportion of the gage length.

2.8 Processing

Any treatment of the chain subsequent to welding, for example, heat treatment, polishing or calibrating.

2.9 Lot

Specified length of chain from which a test sample is selected.

3. DIMENSIONS

3.1 Size of Chain

The size of chain shall be one of the sizes listed in Table 2, Column 1 corresponding to the nominal diameter (d_n) of the steel wire or bar from which the chain is made.

3.2 Material Diameter

The material diameter of any section of a finished link which is to accord with the size within stated tolerances, is the mean of two measurements of the section at right angles in the same plane. The measurements shall be made away from the weld.

3.2.1 Tolerance on material diameter

For sizes less than 18 mm the diameter of the material in the finished link shall nowhere differ from the nominal diameter by more than $^{+2}_{-6}\%$, except at the weld.

For sizes 18 mm and over, the diameter d of the material in the finished link shall nowhere differ from the nominal diameter by more than $\pm 5\%$, except at the weld.

3.2.2 Tolerances at the weld

The dimension of the steel at the weld shall nowhere be less than the diameter d of the steel adjacent to the weld, or exceed it by more than the following tolerances. (See Fig. 1 and Table 2).

Type 1: 8% of the nominal diameter in any direction.

Type 3: 8% of the nominal diameter in the direction perpendicular to the plane of the link and 17% in other planes.

3.2.3 Area affected dimensionally by welding

The area affected dimensionally by welding shall not extend by more than 0.6 of the material diameter to either side of the centre of the link.

3.3 Length and Width

The dimensions of the length and width of the links shall be as specified in Table 2 and illustrated in Fig. 2. Preferred nominal dimensions are as follows:

- **Pitch p (i.e. inside length):** 3 times the nominal chain size (d_n).
- **Outside width w :** 3.25 times the nominal chain size (d_n).

Where the chain has to fit a load wheel designed for different dimensions, the nominal pitch (inside length) and the nominal outside width shall be clearly specified at the time of the enquiry and order.

4. MATERIAL AND MANUFACTURE

4.1 Quality of Material

The steel shall be produced by the open hearth or electric process or by an oxygen blown process.

In its finished state as supplied to the chain maker it shall meet the following requirements as determined by check analysis on the rod, wire or finished link.

It shall be fully killed, shall possess reliable welding quality and shall contain alloying elements in sufficient quantities to guarantee the mechanical properties of the chain after appropriate heat treatment. The alloy steel used shall contain nickel and at least one of the following alloying elements:

- Chromium;
- molybdenum.

Its content of sulfur and phosphorus shall be restricted as follows:

	CAST ANALYSIS	CHECK ANALYSIS
Sulfur max.	0.035 %	0.040 %
Phosphorus max.	0.035 %	0.040 %

The steel shall be made in conformity with fine grain practice to give an austenitic grain size of 5 or finer.

This could be accomplished, for example, by ensuring that it contains sufficient aluminum or an equivalent element to permit the manufacture of chain stabilized against strain age embrittlement during service; a minimum value of 0.02% metallic aluminum is given for guidance.

Within the above limitations it is the responsibility of the chain maker to select steels so that the finished chain suitably heat treated, meets the mechanical properties specified in this Standard.

4.2 Heat Treatment

All chain shall be hardened and tempered before being subjected to the manufacturing test force.

4.3 Manufacturing Test Force

During manufacture, the heat treated chain shall be subjected to a force of 60% of the minimum breaking force specified in Table 4.

4.4 Proof Force (Acceptance)

The proof force shown in Table 4, Column 2 shall be applied only when called up in connection with acceptance testing and inspection, since, in this grade, the manufacturing test force (see 4.3) assumes the function prescribed in ISO 1834, Clause 6.5.

5. TEST REQUIREMENTS

5.1 Mechanical Properties and Test Forces

The mechanical properties shall be as specified in Table 3 and the test forces to be applied for each size are specified in Tables 4 and 6.

5.2 Selection of Samples

At least one test sample sufficient to provide a gage length shall be selected by the inspector from each lot or part lot.

The length of the lot from which the inspector selects the samples shall be 200 m or lesser length.

5.3 Static Tensile Test

5.3.1 Tensile test sample

Test samples shall consist of the number of links specified in Table 1, constituting the gage length. Two additional links may be required to engage the jaws of the testing machine unless this is done by half-links or some other method; these additional links will not be taken into account when determining total elongation.

TABLE 1 - GAGE LENGTHS

NOMINAL SIZE OF CHAIN mm	MINIMUM NUMBER OF LINKS IN GAGE LENGTH ACTUALLY TESTED N
Up to and including 6	9
Over 6 up to and including 17	7
Over 17	5

5.3.2 Procedure

The tensile test shall be carried out using an autographic recorder to produce a force/extension diagram.

The chain shall be gripped in such a manner that the links can be freely loaded. The grips shall be designed and constructed so that slip does not occur. The rate of loading shall be evenly applied (for example at 10 N/mm²/s) until fracture occur.

The breaking force shall be not less than that specified in Table 4 Column 3.

5.3.3 Total ultimate elongation

The total ultimate elongation shall be not less than 10%.

6. INSPECTION

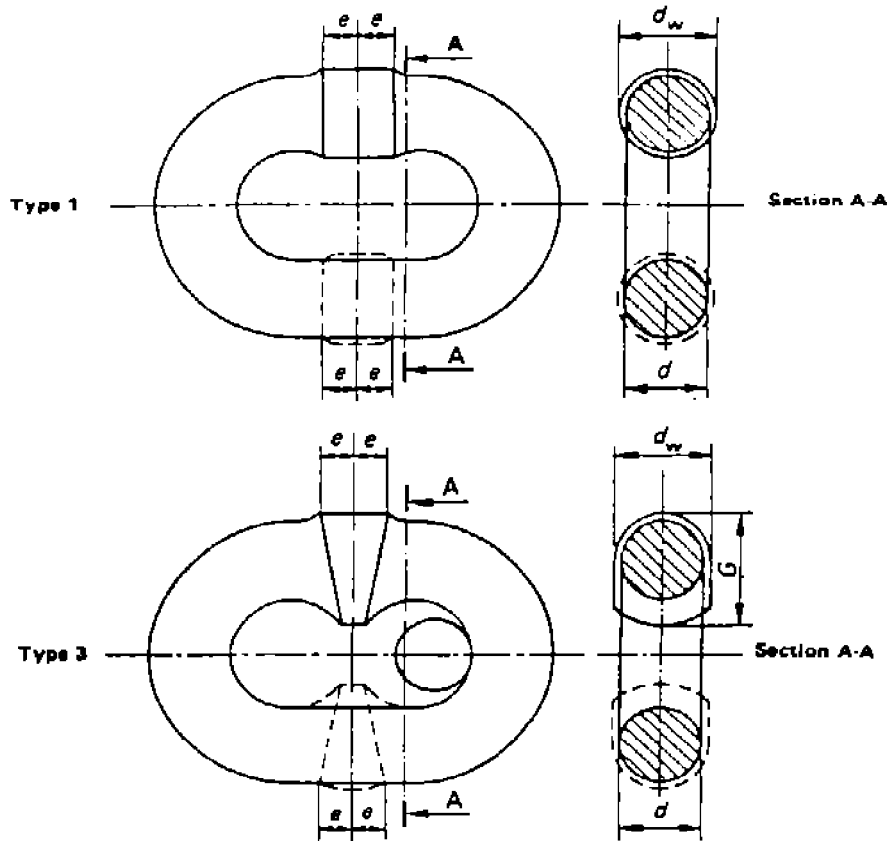
Where an inspector is required by the purchaser, he shall have access to the works of the manufacturer at all reasonable times for the purpose of witnessing the specified tests and inspecting the testing machine and method of examination. The manufacturer shall provide the inspector, at the time of inspection, with copies of the test sheets giving the results of all the tests made in his presence.

7. MARKING

Marks shall be legibly stamped or embossed upon all end links of the chain(s) or upon idle links or upon substantial metal tabs, tallies or links permanently attached to the end links. Alternatively the marking may be at the same intervals for quality marking (see 9.1). The marking shall include the name of the manufacturer of the chain by trade-mark or symbol.

8. GUARANTEE AND WARRANTY

Chains supplied shall be guaranteed by the vendor against faulty design, defective or improper materials, poor workmanships, and failure due to normal usage for one year being used. If any defects or malfunctions occur during this period the Vendor shall make all necessary alteration, repairs and replacements free of charge.



- d_n = size (nominal diameter of the material)
- d = measured diameter of the material except at the weld
- d_w = measured diameter of the material at the weld or the weld dimension perpendicular to the plan of link
- G = dimension in other planes
- e = length affected by welding on either side of the centre of the link

For all Welds

Weld Tolerance:

$$e \leq 0.6 d_n$$

$$d_w = d \begin{matrix} + 0.08 d_n \\ 0 \end{matrix}$$

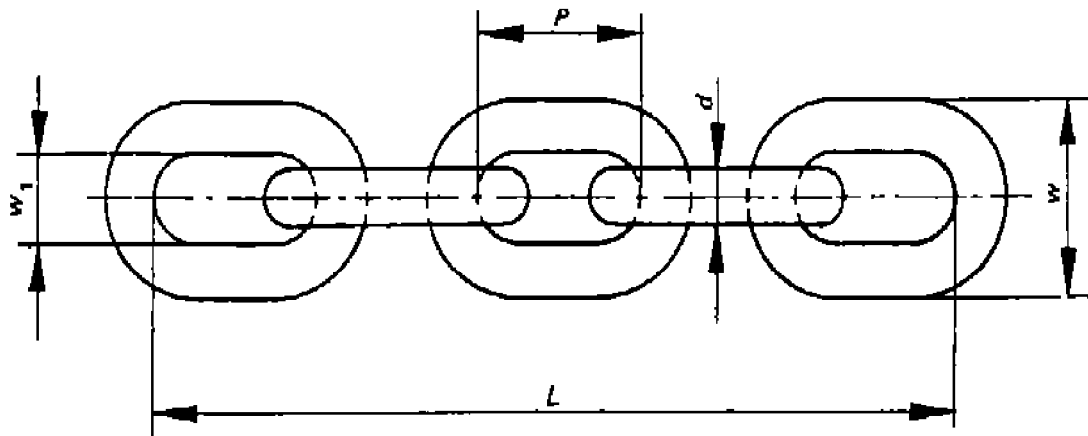
$$\text{For } d_n < 18 \text{ mm, } d = d_n \begin{matrix} +2 \\ -6 \end{matrix} \%$$

$$G = d \begin{matrix} +0.17 \\ 0 \end{matrix} d_n$$

$$\text{For } d_n < 18 \text{ mm, } d = d_n \pm 5$$

MATERIAL AND WELD TOLERANCES

Fig. 1



Given in terms of the nominal size of the chain d_n :

Pitch P (inside length)-preferred value $3 d_n$.

Outside width w except at the weld; preferred value $3.25 d_n$.

Inside width w_1 ; minimum permitted value $1.25 d_n$ except at the weld, or such minimum value as will prevent kinking.

Length L (see 5.3.2.2).

CHAIN AND LINK DIMENSIONS
Fig. 2

TABLE 2 - DIMENSIONS OF CHAIN

(For symbols see Figs. 1 and 2)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
NOMINAL SIZE	DIAMETER TOLERANCE	MAXIMUM TOLERANCE AT THE WELD (SEE FIG. 1)		PREFERRED PITCH (INSIDE LENGTH) ($3 d_n$)	PITCH TOLERANCE ON THE SINGLE LINK (+ ONLY)	PREFERRED OUTSIDE WIDTH W ($3.25 d_n$)	OUTSIDE WIDTH TOLERANCE (+ ONLY) AWAY FROM WELD ($0.075 d_n$)
d_n	($d-d_n$)	Types 1 & 3 (d_w-d)	Type 3 (G-d)				
4	+ 0.08 - 0.24	0.32	0.7	12	0.23	13	0.30
5	+ 0.10 - 0.30	0.4	0.85	15	0.29	17	0.38
5.6	+ 0.11 - 0.34	0.45	0.95	17	0.33	19	0.42
6.3	+ 0.13 - 0.38	0.5	1.05	19	0.37	21	0.48
7.1	+ 0.14 - 0.43	0.57	1.2	21	0.41	23	0.54
8	+ 0.16 - 0.48	0.64	1.35	24	0.46	26	0.60
9	+ 0.18 - 0.54	0.72	1.55	27	0.52	30	0.68
10	+ 0.20 - 0.60	0.8	1.7	30	0.58	33	0.75
11.2	+ 0.22 - 0.67	0.9	1.9	34	0.66	37	0.84
12.5	+ 0.25 - 0.75	1.0	2.15	38	0.73	41	0.94
14	+ 0.28 - 0.84	1.12	2.4	42	0.81	46	1.05
16	+ 0.32 - 0.96	1.28	2.7	48	0.93	52	1.2
18	± 0.90	1.44	3.05	54	1.04	59	1.35
20	± 1.0	1.6	3.4	60	1.16	65	1.5

TABLE 3 - MECHANICAL PROPERTIES

MECHANICAL PROPERTY	REQUIREMENT
Mean stress at specified minimum breaking force $\frac{2 F_m \min}{\pi d_n^2}$	800 MPa (N/mm ²)
Mean stress at proof force $\frac{2F_e}{\pi d_n^2}$	400 MPa (N/mm ²)
Ratio of proof force (acceptance) to specified minimum breaking force	50%
Specified minimum total ultimate elongation	10%
Mean stress at working load limit	200 MPa (N/mm ²)

TABLE 4 - TEST REQUIREMENTS

(1)	(2)	(3)	(4)	(5)
NOMINAL SIZE d_n mm	FORCE (ACCEPTANCE) kN	MINIMUM BREAKING FORCE kN	WORKING LOAD LIMIT t	MANUFACTURING TEST FORCE kN
4	10.1	20.2	0.5	12
5	15.8	31.6	0.8	19
5.6	19.8	39.6	1.0	24
6.3	25	50	1.25	30
7.1	31.7	63.4	1.6	38
8	40.3	80.6	2.0	48
9	51	102	2.5	61
10	63	126	3.2	76
11.2	79	158	4.0	94
12.5	99	198	5.0	119
14	124	248	6.3	149
16	161	322	8.0	193
18	204	408	10.0	245
20	252	504	12.5	302