INTERNATIONAL STANDARD 3056

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Non-calibrated round steel link lifting chain and chain slings — Safe use and maintenance

Chaînes de levage non calibrées en acier rond et élingues à chaînes — Sécurité d'emploi et entretien

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up 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.

Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 3056 was drawn up by Technical Committee ISO/TC 111, *Round steel link chains, chain wheels, lifting hooks and accessories*, and circulated to the Member Bodies in April 1973.

It has been approved by the Member Bodies of the following countries :

Belgium	Japan	Thailand
Bulgaria	Netherlands	Turkey
Egypt, Arab Rep. of	New Zealand	United Kingdom
France	Romania	U.S.S.R.
India	South Africa, Rep. of	
Ireland	Sweden	

The Member Body of the following country expressed disapproval of the document on technical grounds :

Germany

Printed in Switzerland

Non-calibrated round steel link lifting chain and chain slings – Safe use and maintenance

1 SCOPE AND FIELD OF APPLICATION

This International Standard constitutes a guide to the selection, use, inspection, testing, maintenance and repair of non-calibrated round steel link chains and chain slings.

NOTE – Lifting chains may be governed by national and local laws and regulations.

This International Standard may be helpful when new or revised laws and regulations are being considered for adoption. Alternatively, it is recommended to users and inspectors in those juridictions lacking comprehensive regulations on the subject.

2 CHAIN SELECTION

Each grade and size of chain has a maximum working load rating (called the working load limit). Under all normal lifting conditions, and provided that the other components of the lifting sling or lifting device have similar properties to the chain, the tension in the sling leg may be equal to the working load limit, and in these circumstances the working load limit will have the same value as the safe working load.

Used vertically, under normal conditions a sling leg can be used to lift its working load limit. If, however, the sling leg is applied at an angle to the direction of lift, there is increased tensile force in the sling leg (see figure 1). Each situation must be examined and the loading restricted so as not to exceed the safe working load for that sling leg. Figure 2 shows the effect of inclination on lifting capacity. The use of sling legs at angles greater than 60° to the vertical is not recommended.

When doubt exists as to the precise tension likely to arise in the chain due to lack of accurate information on the weight of the object being lifted, high acceleration given by the lifting device, liability to shock loading, misjudgement of the angles in the sling legs or the use of chain at high or low temperatures, a safe working load less than the working limit should be used.

To raise a static weight or to stop a descending one requires more than nominal force. When loads are handled gently, the dynamic forces are small and may be neglected. If the acceleration forces are large, allowance must be made by decreasing the allowable load or increasing the chain size for a given load. High acceleration forces may be caused by the crane or lifting device, by not taking up the slack chain before starting to lift and by the impact of falling loads.

National standards which follow International Standards grade chains in relation to the mean stress (in newtons per square millimetre) at the guaranteed minimum breaking load specified for that grade of chain.

The following grades are provided for :

Grade L, having a mean stress at the specified minimum breaking load of 300 N/mm^2. This chain is made from mild steel generally of low carbon content, giving a soft chain with high ductility. It is liable to strain age embrittlement and to brittleness at low temperature if not made from fully killed steel.

Grade M, having a mean stress at the specified minimum breaking load of 400 N/mm^2, and at the working load limit of 100 N/mm^2. It is made from medium carbon steel and is used for general lifting and slinging purposes.

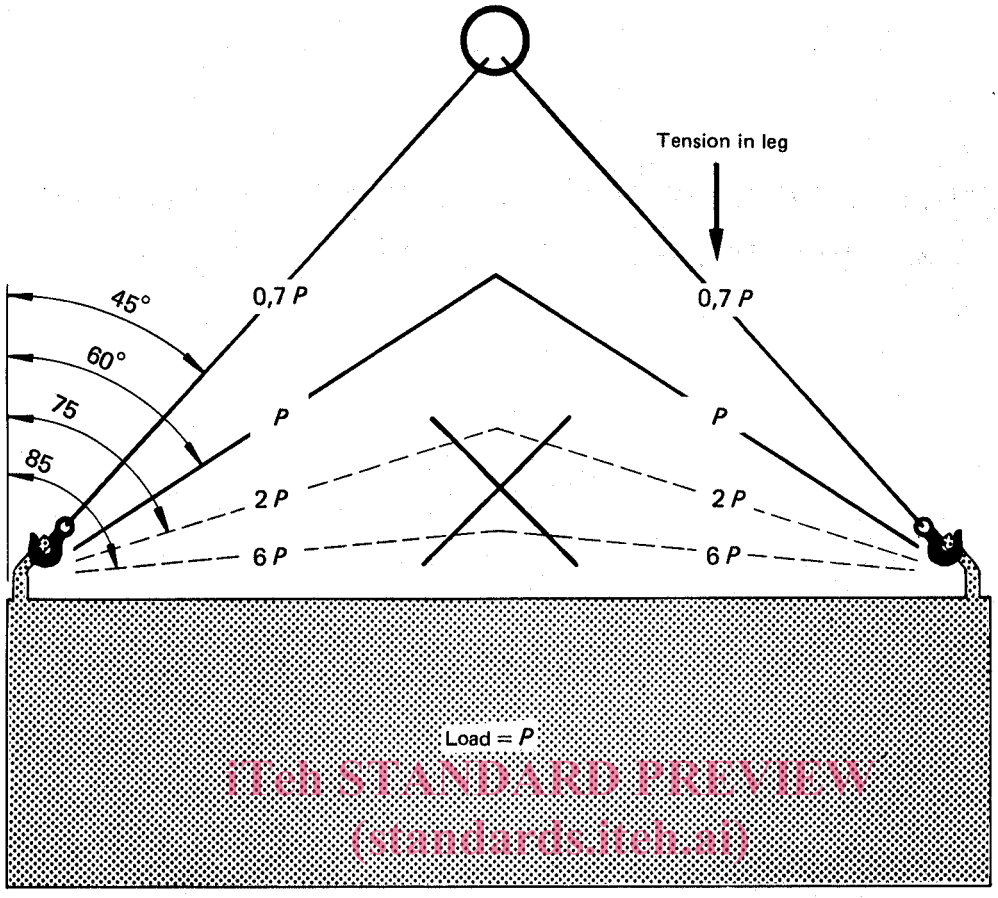

FIGURE 1 — **Sling leg tension increases rapidly with change of leg angle**

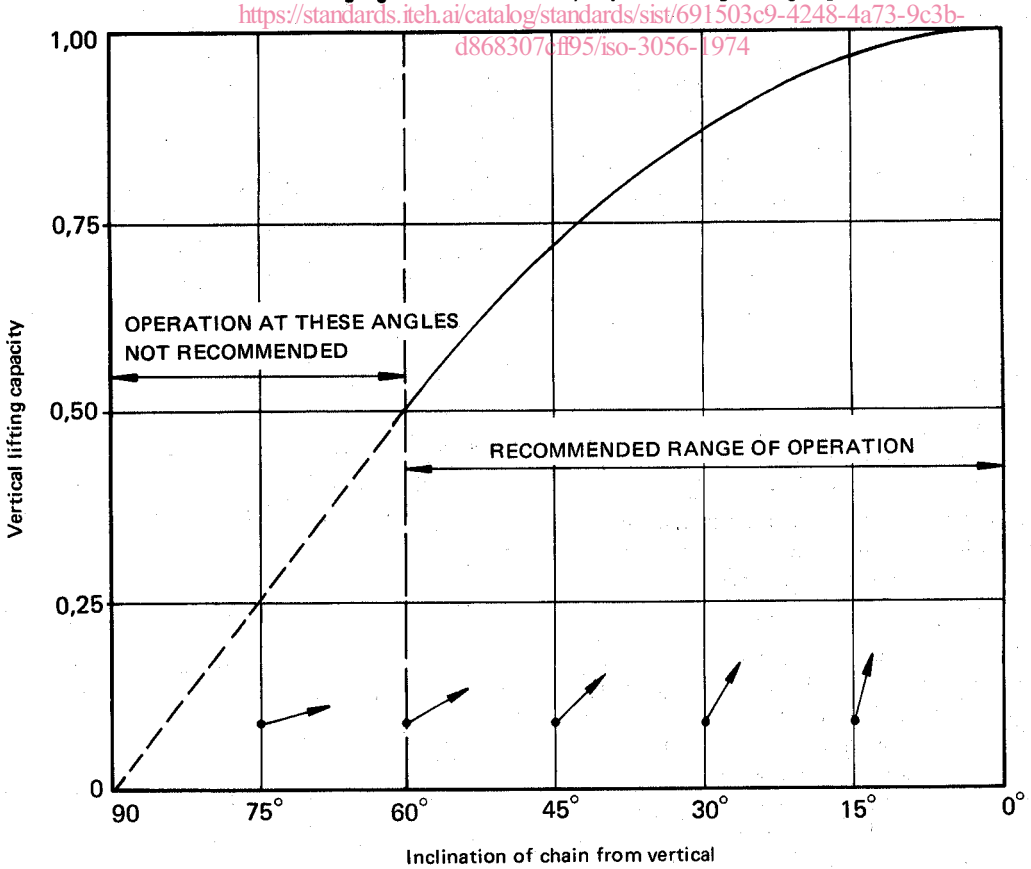

FIGURE 2 — **Ratio of vertical lifting capacity to working load limit for inclined leg of chain sling**

Grade S, having a mean stress at the specified minimum breaking load of 630 N/mm², and at the working load limit of 160 N/mm². Made from alloy steel, this chain is stronger by a factor of 1,6 than grade M. This chain is suitable for arduous duties and in situations where abrasion is likely to occur.

Grade T, having a mean stress at the specified minimum breaking load of 800 N/mm² and at the working load limit of 200 N/mm². Made from alloy steel, it is stronger than grade M by a factor of 2. This chain is suitable for the most severe duties. It is harder than the lower grades and gives greater resistance to abrasive wear.

Grades S and T allow the use of progressively lighter chains to lift a given load.

NOTE — Grade L is not the subject of an International Standard.

3 USE OF CHAIN AT LOW TEMPERATURES

Chains made in accordance with the International Standard grades M, S and T will not develop low temperature brittleness down to a temperature of − 40 °C.

However, in the case of chains not to International Standards the makers should be consulted.

Grade L chains are often liable to low temperature embrittlement and should not be used at temperatures less than 1 °C, unless specific assurances have been given by the makers that they are suitable for use at lower temperatures.

4 USE OF CHAINS AT HIGH TEMPERATURES

Where chains are used in contact with, or in close proximity to, loads at high temperatures, it is not possible to determine accurately the temperature of the chain. Consequently, ample allowance should be made in reducing the working load limit (W.L.L.), according to the values suggested below :

4.1 Grades S and T

Chain temperature, °C	Reduction in W.L.L., %
Up to 200	0
200 to 300	10
300 to 400	25

Grades S and T chains should not be used at temperatures above 400 °C. If accidentally exposed to temperatures over 400 °C, they should be returned to the makers for re-servicing.

4.2 Grade M

Chain temperature, °C	Reduction in W.L.L., %
Up to 300	0
Up to 350	16
Up to 400	27
Up to 450	41
Up to 475	51

Grade M chains should not be used at temperatures above 475 °C.

Grade L chains should not be used at high temperatures.

5 STRAIN AGE EMBRITTLEMENT

Certain steels are liable to develop brittleness gradually at atmospheric temperatures and more quickly at higher temperatures after plastic straining.

The material specifications in national standards which are based on International Standards are such that these chains will be free from strain age embrittlement.

In the case of other chains, particularly grade L, there is a risk of strain age embrittlement unless the chain is made from a fully killed steel.

6 HANDLING THE LOAD

A lifting chain is usually attached to the load and the lifting device by means of integral terminal fittings such as hooks and end links. Chains should be straight, without twists, knots or kinks. The load should be seated well down in a hook, never on the point or wedged in the throat; the hook should be free to incline in any direction so as to avoid bending. The end link should be free to incline in any direction on the lifting device hook, for the same reason. An egg- or pear-shaped end link should have the large end on the crane hook and the small end toward the chain.

The chain may be passed under the load in a basket or choke hitch. It is recommended that in the case of a basket hitch more than one chain sling be applied to the load, preferably in conjunction with a spreader beam.

Damage to a chain may be caused by dragging it from under the load or by rolling a load on to it; these practices should be avoided.

When a choke hitch is employed, attention shall be paid to angularity, which may impose very high tensile forces and necessitate the use of a larger chain (see figure 3). Care should also be taken to ensure against repetitive engagement of the terminal fitting in the same link, as this will eventually cause damage (see figure 4). Figure 5 illustrates a preferred method of attachment which will minimize this hazard.

Padding may be required where a chain contacts a load, to protect either the chain or the load or both. A sharp corner of hard material may bend or cut the chain links. Conversely, the chain may damage the load because of high unit pressure. Wooden blocks may be used to increase the contact area and avoid such damage. Blocks should be large and hands should be kept away from the plane of the chain to prevent pinching as the slack is taken up.

A tag line is recommended to prevent swaying or rotation of a load and to position for landing.

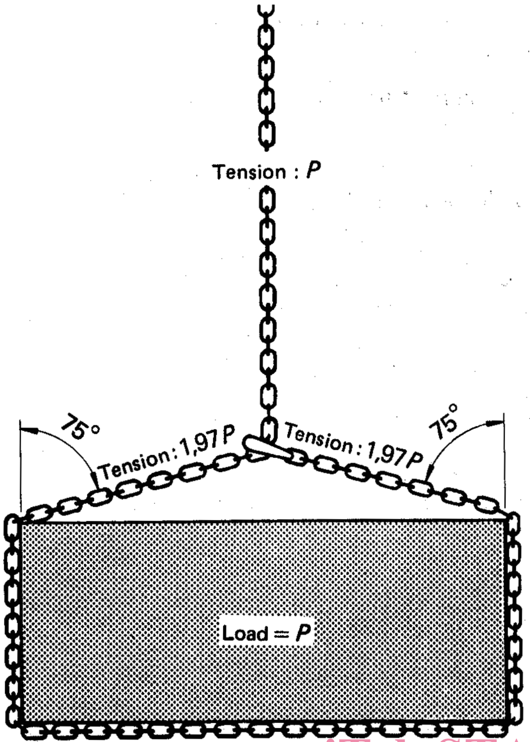

FIGURE 3 — Illustration shows how chain can be greatly overloaded by critical hitch angles even if the load does not exceed capacity. Chain may also be distorted by hook used in choke hitch

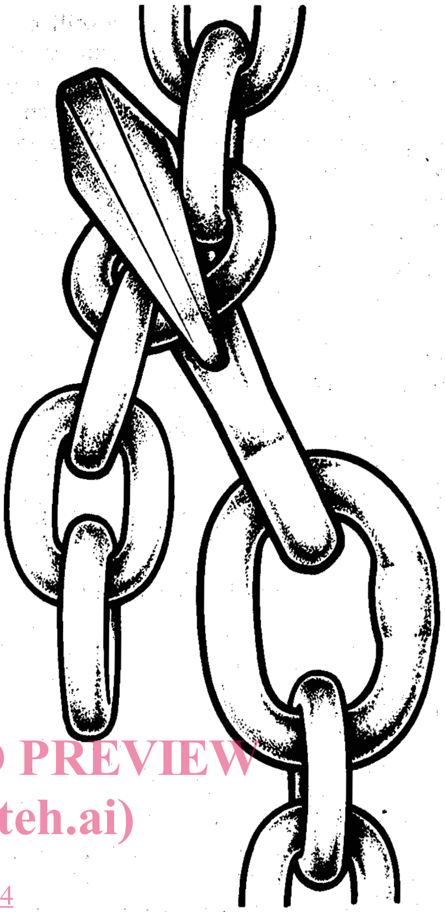

FIGURE 4 — Illustration shows angles resulting in higher stresses in chain used with grab hook, or ordinary hook used in choke hitch

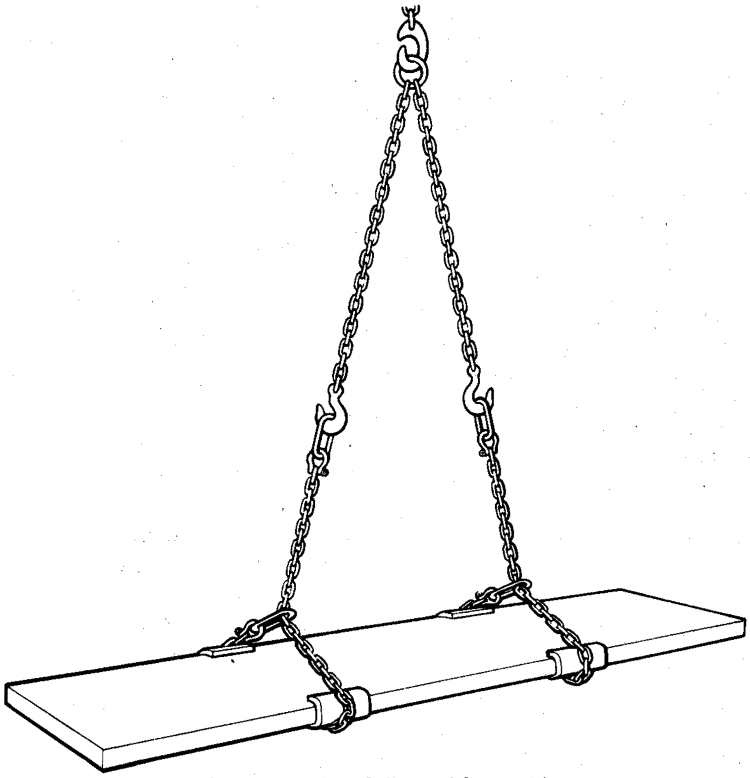

FIGURE 5 — Use of slings with reevable eyes

When ready to lift, the slack should be carefully taken up until the chain is taut. Inspect all load hitches to be certain that they are secure. Raise the load slightly and check that it remains level; this is especially important with basket or other loose hitches where friction retains the load. If it tilts, lower the load and re-position the lifting hook toward the low end. When all is in order, proceed with the lift.

Land the load carefully. Before slackening the chain, be certain that the load is properly supported; this is especially important with basket or choke loads of several loose objects.

7 VISUAL INSPECTION

Chains must be inspected regularly. The examination shall be carried out in adequate light free from shadows.

Chains should be thoroughly cleaned so as to be free from oil and dust prior to inspection. Any cleaning method which does not damage the parent metal is acceptable. Methods to avoid are those that may cause hydrogen embrittlement, over-heating, removal of metal or movement of metal which may cover cracks or surface defects.

Where possible, as an initial inspection procedure, it is recommended that the overall length of the sling be measured and checked against the original length as indicated on the chain sling identification tag or manufacturer's certificate. This procedure allows a rapid indication of major deviation from the original product.

Fittings attached to chain slings should be checked to ensure that they possess strength characteristics compatible with the rated load capacity of the assembly.

The two principal kinds of deterioration that occur in lifting chains are loss of metal and deformation.

Loss of metal may be caused by wear, abrasion or corrosion. Abrasion by contact with other objects usually occurs on the outside of the straight portions of the links, where it is easily seen and measured. Wear between adjoining links is hidden (see figure 6). The chain must be slack and adjoining links rotated to expose the inner end of each link, as shown in figure 7.

The chain should be inspected for bent and twisted links and for cracks, nicks and gouges. Shallow and rounded indentations in areas of low tensile stress are insignificant. Deep nicks in high tension areas are damaging and sharp transverse nicks are unacceptable.

Elongation may occur in a few links or only one link. Each pair of links should be flexed; the slightest evidence of binding indicates collapse due to elongation.

8 TESTING

A proof test load value has been established for each grade and size of lifting chain. These are given in the relevant national and International Standards, which should be consulted.

The tension test load should be applied gradually to a straight length of chain, which may also include terminal fittings. The testing devices which apply the load shall not cause local damage to the chain or fittings.

After the proof test load has been applied and removed, the chain should be visually inspected. Any defects should be repaired and the assembly retested or the assembly should be discarded.

Chains which pass inspection after proof testing are suitable for further use.

9 MAINTENANCE AND REPAIR

Wear and abrasion may be tolerated until the diameter or thickness of material has been reduced by 10 %.

The repair or replacement of individual links, fittings or lengths of chain should only be carried out by the manufacturer or by those organizations which have the necessary knowledge and equipment (such as welding, heat treating, proof testing and crack detecting facilities).

Links that are cracked, visibly bent or twisted should be rejected.

The repair of nicks and gouges disclosed by inspection may be carried out by grinding or filing. The surface should blend smoothly into the adjacent material without abrupt change of section. The complete removal of the defect should not reduce the diameter by more than 10 %.

Where the repair is carried out by the user, a complete length of chain or an end fitting must be replaced, using an approved mechanical connecting link to attach the new chain or terminal fitting. In the case of cold repair, care must be taken that the chain and fittings used are of the same size and strength as the original.

Chains which are made from other than "non-aging" steels are often covered by national regulations which provide for periodic heat treatment.

Each repaired chain shall be tested and inspected, according to the requirements herein, before it is returned to use. In the absence of adequate facilities for testing and qualified inspection personnel, users shall not undertake the repairing and testing of lifting chains.

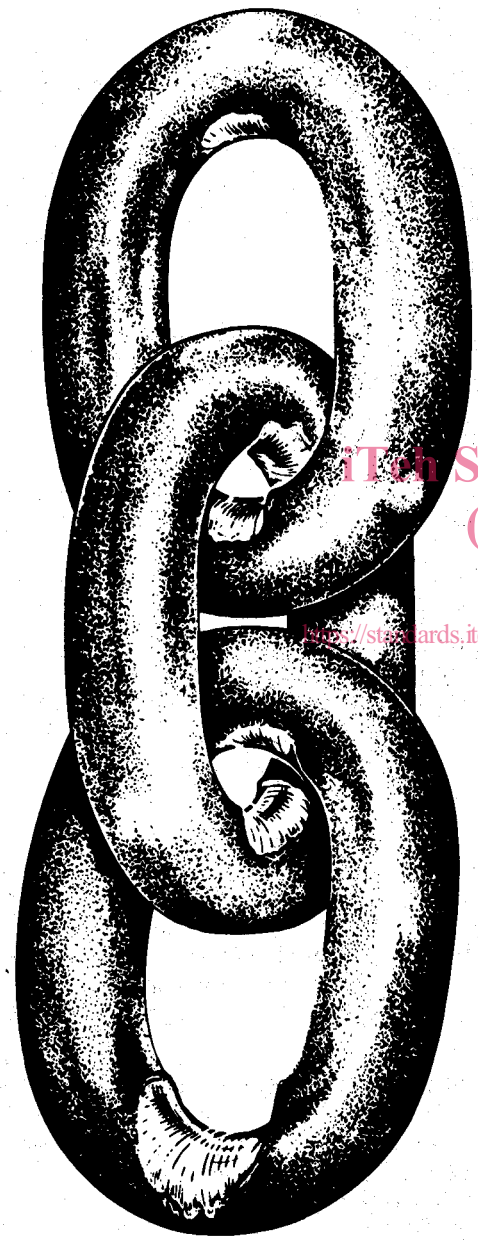

FIGURE 6 — **Wear on links**

FIGURE 7 — **Visual inspection for wear**

Chains may be damaged if dropped from a height and this should be avoided.

Chains not in use should be stored where they are not subject to deterioration or damage. A good method is to hang them from racks or pins. For long-term storage a rust preventive coating should be applied.

10 RECORD KEEPING

Adequate records are essential for the safe use of lifting chains. Suggested forms are attached (see figures 8 and 9).

The initial record is a description of the chain and its identifying markings. Inspection periods and test intervals should be determined and entered in the record.

After each inspection the condition of the chain should be noted in the record. The results of each test should be recorded.

Each time the chain is repaired, the reason for, and the details of, the repairs are entered in the record.

The record is a continuous history of the chain and shows that it has been regularly inspected, tested and maintained in good operating condition.