International Standard 3056

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

Chaînes de levage non calibrées en acier rond et élingues à chaînes — Utilisation et entretien

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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.

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. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 3056 was prepared by Technical Committee ISO/TC 111, *Round steel link chains, lifting hooks and accessories.*

This second edition cancels and replaces the first edition (ISO 3056-1974), of which it constitutes a technical revision.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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Non-calibrated round steel link lifting chain and chain slings — 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, short link chains and chain slings, manufactured in accordance with ISO 1834, ISO 1835, ISO 3075, ISO 3076, ISO 4778 and ISO 7593.

NOTE — Lifting chains and chain slings may be governed by national and local laws and regulations.

2 References

ISO 1834, *Short link chain for lifting purposes — General conditions of acceptance.*

ISO 1835, *Short link chain for lifting purposes — Grade M(4), non-calibrated, for chain slings, etc.*

ISO 3075, *Short link chain for lifting purposes — Grade S6), non-calibrated, for chain slings, etc.*

ISO 3076, *Short link chain for lifting purposes — Grade T8), non-calibrated, for chain slings, etc.*

ISO 4778, *Chain slings of welded construction — Grade M(4), S(6) and T(8).*

ISO 7593, *Chain slings assembled by methods other than welding — Grade T(8).*

ISO 8539, *Forged steel lifting components for use with grade T(8) chain.*

3 Definitions

3.1 working load limit (WLL): The maximum mass which a sling is designed to sustain in general service.

3.2 working load (WL): The maximum mass which a sling should be used to sustain in a particular stated service.

3.3 competent person: A designated person, qualified by knowledge and practical experience, and with the necessary instructions to enable the required examinations to be carried out. (See clause 6.)

3.4 frequent inspection: Regular visual inspection by the operator or other designated personnel.

3.5 periodic inspection: Thorough examination by a competent person, of which records should be made to provide the basis for a continuing evaluation.

4 Chain sling selection

4.1 General

The principles outlined in 4.2 to 4.4 relate to the selection of slings for general purpose use, i.e. slings having branches of equal nominal reach.

4.2 Working load

The working load of the sling selected shall be at least equal to the maximum load to be lifted. This working load will be the same as the working load limit (WLL) in normal circumstances or less than the working load limit under certain conditions.

4.3 Working load limit

4.3.1 General

The working load limit is marked on the sling and is determined by

a) the size and grade of chain selected (see 4.3.2);

b) the geometry of the sling (see 4.3.3);

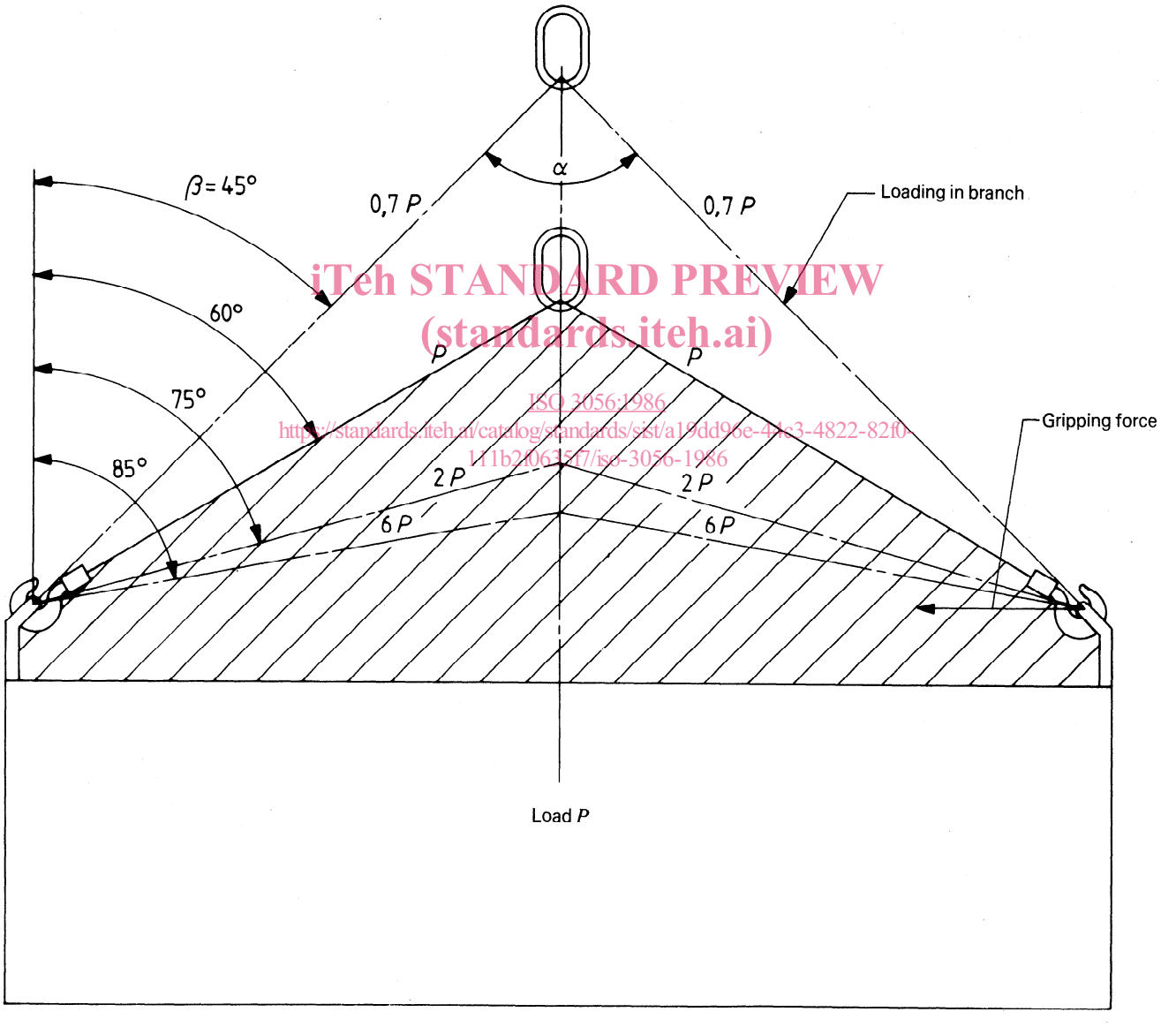
c) the method of rating (see 4.3.4).

4.3.2 Size and grade of chain selected (see table 1)

It will be noted that as the grade of chain selected increases from M to S to T, chain slings of progressively smaller nominal size can be used to achieve equivalent strength, e.g. a grade T sling will have twice the working load limit of a grade M sling of the same size.

4.3.3 Geometry of the sling

By geometry of the sling is meant the number of chain branches and, in the case of multi-branch slings, the included angle between them or the angle to the vertical. Included angles or angles to the vertical should be assessed as described in ISO 4778 and as illustrated in table 2. The greater the included angle between branches, the lower the load a particular sling can carry without exceeding the permissible loading in the branches (see figure 1). Each situation should be checked to ensure that the permissible loading in any branch is not exceeded. The use of sling branches at angles greater than 60° to the vertical (included angles of greater than 120° for two- or four-branch slings) is not recommended.



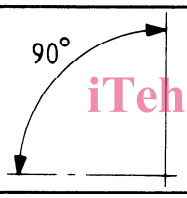
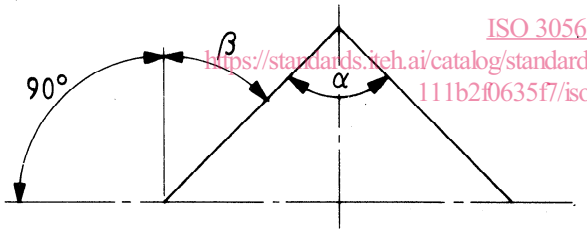
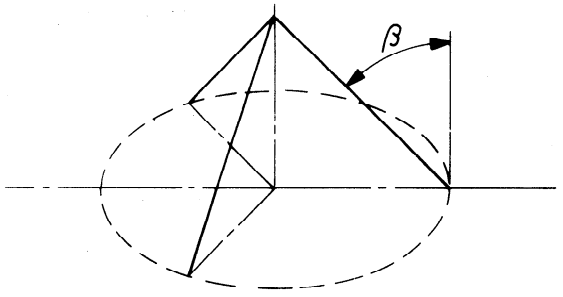
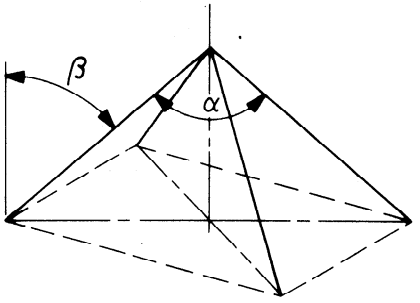
The hatched area indicates included angles between branches of greater than 120° (60° to the vertical) at which angles slings should not be used.

Figure 1 — Variation of sling branch loading with branch angle for a given load *P*

Table 1 — Grades of short link chain designed for use in chain slings

Grade	Relevant ISO International Standard	Mean stress at working load limit (WLL)	Mean stress at proof force (F_e)	Mean stress at minimum breaking force (F_m)	Ratio F_m : WLL
		MPa (N/mm²)	MPa (N/mm²)	MPa (N/mm²)	
M(4)	ISO 1835	100	200	400	4:1
S(6)	ISO 3075	157,5	315	630	4:1
T(8)	ISO 3076	200	400	800	4:1

Table 2 — Factors for working load limits calculated using uniform load method

Slings	Number of branches	Angle of inclination α	Angle to the vertical β	Factor for WLL
	1	—	—	1
	2	0° to 90°	0° to 45°	1,4
		90° to 120°	45° to 60°	1
	3	—	0° to 45°	2,1
		—	45° to 60°	1,5
	4	0° to 90°	0° to 45°	2,1
		90° to 120°	45° to 60°	1,5

4.3.4 Method of rating

4.3.4.1 Rating with a symmetrically distributed load

There are two methods of rating to determine the working load limit, the uniform load method and the trigonometric method. Details of both methods are given in ISO 4778 and ISO 7593.

NOTE — It is strongly recommended that only one of these methods be adopted in any given premises where slings are in use.

Table 2 shows the factors to be applied for calculating the working load limit of multi-branch slings by the uniform load method.

For the trigonometric method, the working load limit is calculated using the following formulae:

Double branch sling:

WLL = 2 × WLL of single branch × $\cos\beta$

Three- and four-branch slings:

WLL = 3 × WLL of single branch × $\cos\beta$

NOTE — In the case of a four-branch sling, if proper measures are taken to achieve the equal distribution of the load between each branch, all four branches may be considered as supporting the load. The rating of a four-branch sling may, in such circumstances, be based on the following formula:

4 × WLL of a single branch × $\cos\beta$

Tables of working load limits for particular angles are given in ISO 4778 and ISO 7593.

4.3.4.2 Rating with an asymmetrically distributed load

If it is known that the load is likely to tilt when lifted, there will be a higher tension in the branch nearest to the centre of gravity of the load, i.e. the branch where the angle to the vertical, β, is the smallest (see figure 2).

If the sling has to be used under these circumstances (see clause 5), the following rating factors should be applied:

Uniform load method

Where $\beta_{max} \leqslant 45°$:

WLL for double-branch sling = WLL of single branch

WLL for three- and four-branch slings = 1,4 × WLL of single branch

Where $45° < \beta_{max} \leqslant 60°$:

WLL for double-branch sling = WLL of single branch

WLL for three- and four-branch slings = WLL of single branch

Trigonometric method

Where $\beta_{max} \leqslant 60°$:

WLL for double-branch sling = WLL of single branch × 2 $\cos\beta_{max}$

WLL for three- and four-branch slings = WLL of single branch × 3 $\cos\beta_{max}$

NOTE — The use of a sling where any angle β exceeds 60° is not recommended.

The formulae given above only relate to cases in which angles to the vertical are not too dissimilar (see figure 2) and not to those cases involving extreme differences between angles to the vertical, in such cases, a competent person should be consulted.

4.4 Working load limit in adverse environments

4.4.1 General

The working load limit should be reduced to a working load in accordance with the recommendations outlined in 4.4.2 to 4.4.4.

4.4.2 High- and low-temperature conditions

As the temperature which a chain sling attains in service increases, its strength decreases. Care should be taken to take account of the maximum temperature which can be reached by the chain sling in service. This is difficult in practice but underestimation of the temperature involved should be avoided. The effect of increasing temperature on the working load of the various grades of chain sling is indicated in table 3.

Chains slings of grades M(4), S(6) and T(8) will not be adversely affected by temperatures down to −40 °C and no reduction from the working load limit is therefore necessary on this account. Where chain slings are to be used at temperatures below −40 °C, the manufacturer should be consulted.

4.4.3 Acidic conditions

4.4.3.1 Grades S(6) and T(8)

Chain slings manufactured to grades S(6) or T(8) should not be used either immersed in acid solutions or exposed to acid fumes. Attention is drawn to the fact that certain production processes involve acidic solutions and fumes and that the use of grades S(6) or T(8) slings for lifting in these circumstances should be avoided.

4.4.3.2 Grade M(4)

Chain slings of grade M(4) may be used in acidic conditions, but, in the absence of specific recommendations from the manufacturer, the following precautions should be adopted:

a) the working load of such a sling should not be greater than 50 % of the working load limit;

b) the sling should be thoroughly washed in clean water immediately after use;

c) the sling should be given a thorough examination by a competent person each day before use (see clause 6).

4.4.4 Other conditions in which the sling is likely to be subjected to attack (chemical, abrasive, etc.)

The manufacturer of the sling should be consulted if such conditions apply.

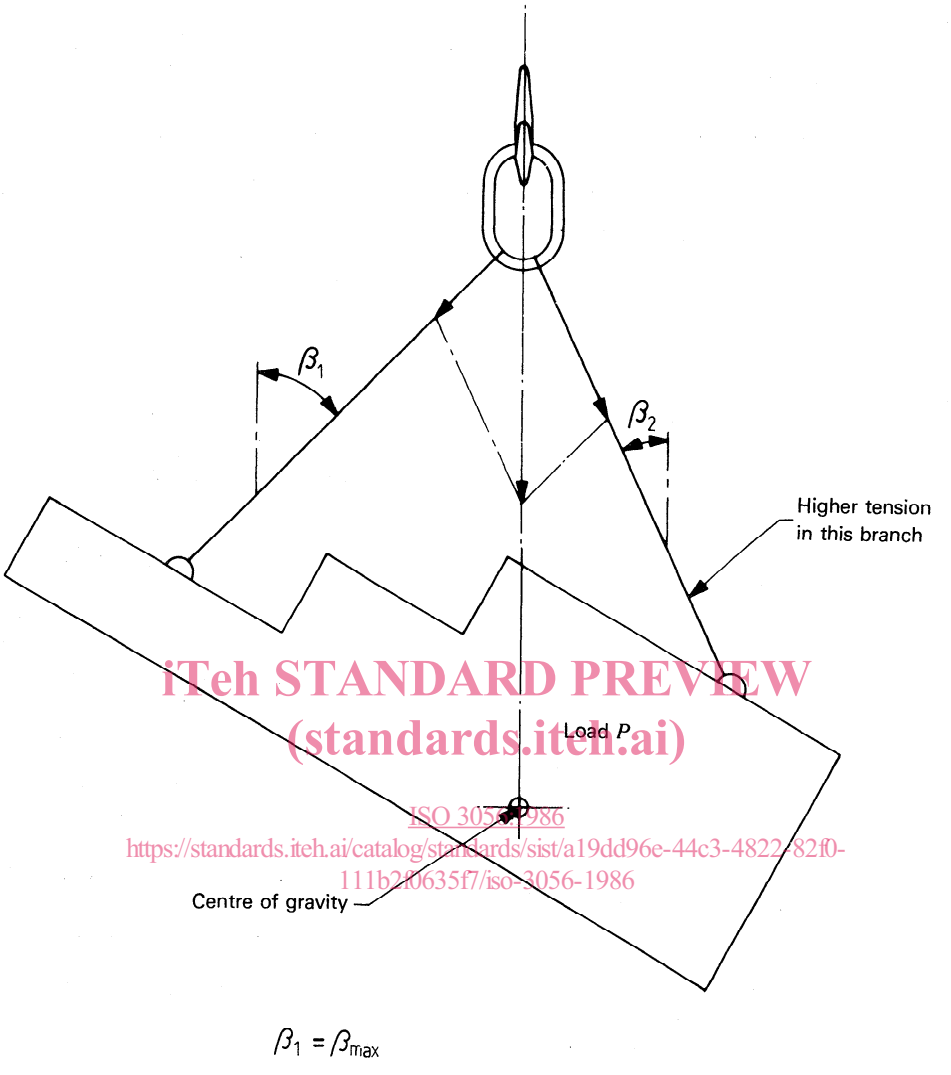


Figure 2 — Asymmetric loading

Table 3 — Working load as a function of temperature[1)]

Grade	Temperature, t, °C					
	$-40 < t \leqslant 200$	$200 < t \leqslant 300$	$300 < t \leqslant 350$	$350 < t \leqslant 400$	$400 < t \leqslant 475$	$t \geqslant 475$
	Working load expressed as a percentage of working load limit					
M(4)	100	100	85	75	50	DO NOT USE
S(6)	100	90	75	75	DO NOT USE	
T(8)	100	90	75	75	DO NOT USE	

1) The use of chain slings within the temperature ranges given in the table does not imply any permanent reduction in working load limit when the chain is returned to normal temperatures. If chain slings are accidentally exposed to temperatures in excess of the maximum permissible temperatures indicated in the table, they should be withdrawn from service and referred to the manufacturer.

5 Handling the load

A lifting chain is usually attached to the load and the lifting device by means of 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 [see figure 3b)] or wedged in the opening; the hook should be free to incline in any direction so as to avoid bending. For the same reason, the master link should be free to incline in any direction on the lifting device hook. Egg- or pear-shaped links should not be used as master links or as lower terminals in any situation where the link could be inverted leading to a wedging action and subsequent distortion of the link.

The chain may be passed under the load in a basket hitch (see figure 4) or choke hitch (see figure 5). It is necessary that in the case of a basket hitch where there is a danger of the load tilting, more than one chain sling be applied to the load, preferably in conjunction with a spreader beam (see figure 6).

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, very high tensile forces are imposed and the use of a larger chain for a given load may be necessary. Alternatively, the sling should be derated as recommended by the manufacturer, national legislation or standards. In the absence of such recommendations or requirements, the working load should not exceed 80 % of the working load limit. Care should also be taken to avoid repeated engagement of the terminal fitting in the same link, as this will eventually cause damage.

All multi-branch slings exert a gripping force (see figure 1) on the load which increases as the angle between sling branches is increased. Where hooks or other fittings are threaded on a loop of chain, e.g. case slings and drum slings, the gripping force is much greater and consequently the angle between such branches should not exceed 60° (30° to the vertical). Care should always be taken to ensure that the load to be moved is able to resist the gripping force without being damaged.

Packing may be required where a chain comes into contact with a load in order to protect either the chain or the load, or both. A sharp corner of hard material may bend or damage the chain links. Conversely, the chain may damage the load because of high contact pressure. Packing, such as wooden blocks, may be used to prevent such damage. Hands and other parts of the body should be kept away from the chain to prevent injury as the slack is taken up.

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

When ready to lift, the slack should be carefully taken up until the chain is taut, the load raised slightly and a check made that the load is secure and remains level; this is especially important with basket or other loose hitches where friction retains the load. If the load tilts, it should be lowered and the lifting device hook re-positioned towards the low end. This can be accomplished by re-positioning the lifting points or by the use of shortening devices in one or more legs. When all is in order, the lift can proceed.

The load should be landed carefully. Before slackening the chain, a check should be made that the load is properly supported; this is especially important when several loose objects are in basket hitch and choke hitch.

When loads are accelerated or decelerated quickly, high dynamic forces occur which increase the stresses in the chain. Such situations, which should be avoided, arise from snatch or shock loading, e.g. from not taking up the slack chain before starting to lift or by the impact of arresting falling loads.

The following common malpractices shall be avoided:

a) overloading slings and continuing to use chain after it has been stretched by overloading;

b) using long-link chain (i.e. pitch > 3*d*) for lifting;

c) using hoist chains as sling chains;

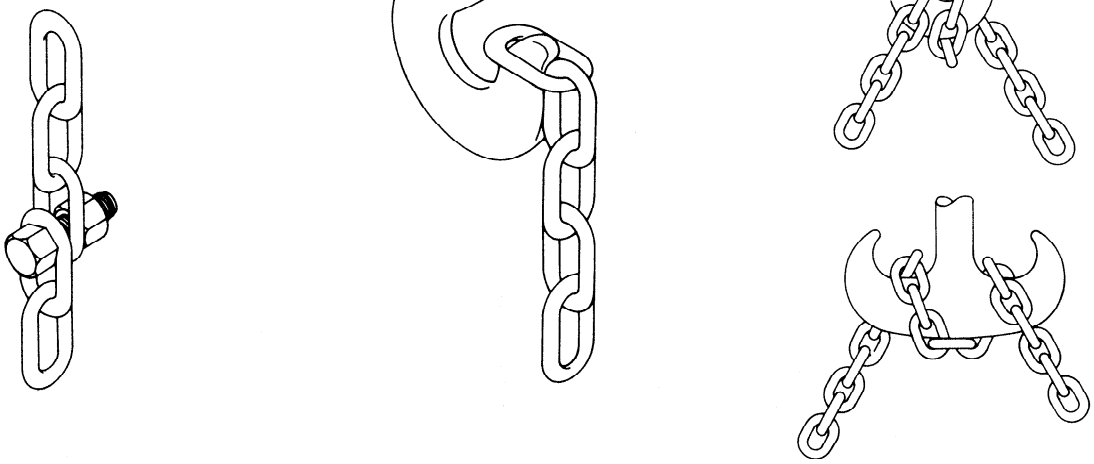
d) using components of lower grade than the chain;

e) using a sling with any broken or deformed links;

f) connecting chain links with bolts or wires [see figure 3a)];

g) loading chains on the point of hooks [see figure 3b)];

h) wrapping the chain several times around a hook [see figure 3c)].

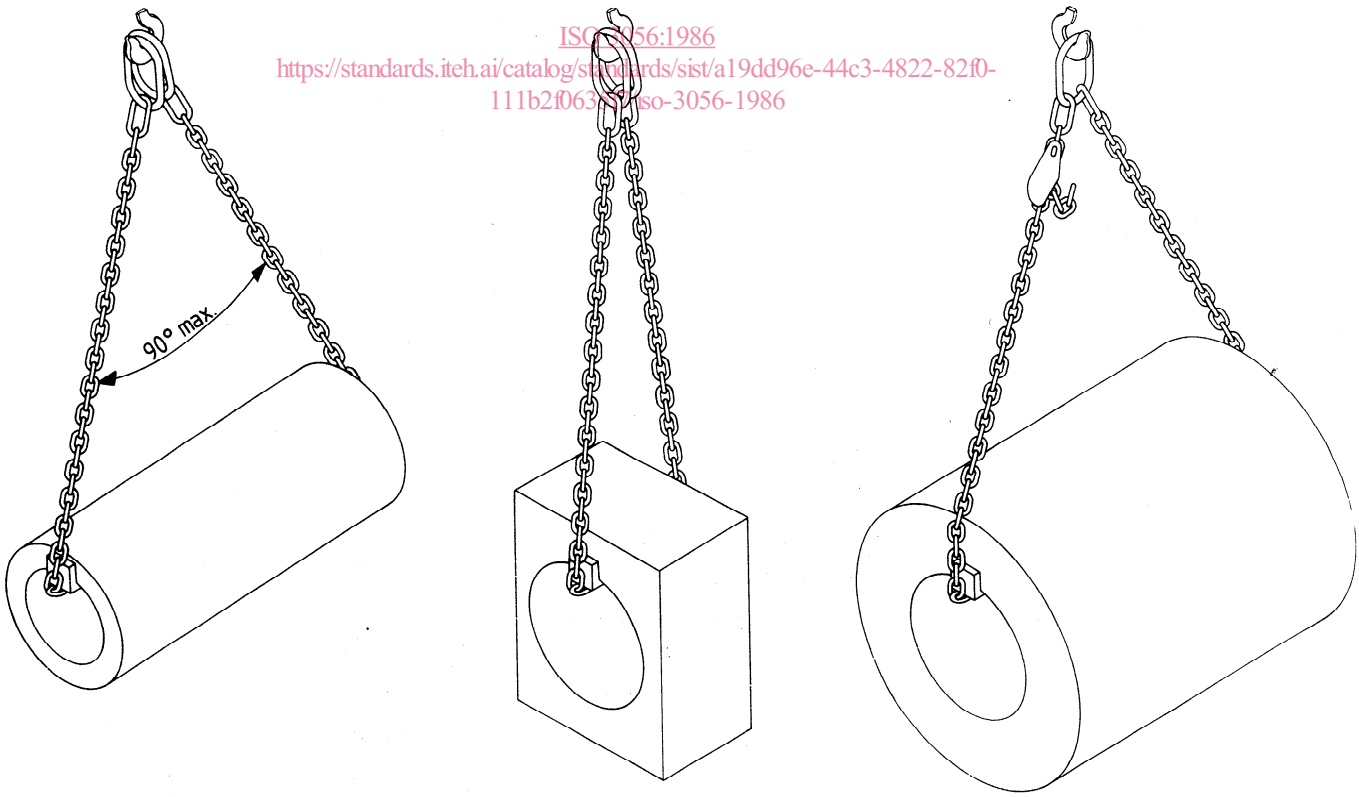


a) Connecting chain links with bolts or wires

b) Loading chains on the point of hooks

c) Wrapping chains several times around a hook

Figure 3 — Examples illustrating common malpractices to be avoided



a) Single branch in basket hitch (back hooked into top link)

b) Reevable collar sling in basket hitch

c) Single adjustable basket sling

Figure 4 — Basket hitches