INFORMATION FOR THE USE AND MAINTENANCE OF CHAIN SLINGS

A.1 Use of chain slings

A.1.1 *Chain sling selection*

A.1.1.1 *General*

The relevant parts of EN 818 and EN 1677 define working load limit using the term General Lifting Service. This reflects the fact that lifting accessories can be and are used in a wide variety of circumstances in terms of configuration, types of load, methods of attachment. Design considerations and working load limit ratings are given in the relevant parts of EN 818 and EN 1677 take account of these circumstances.

EN 818-4:1996+A1 and EN818-5:1999+A1 permit an alternative method of rating where a chain sling is to be used exclusively for a single specific lifting application where all of the circumstances of use are known.

A.1.1.2 *Use in adverse environments*

A.1.1.2.1 *High and low temperature conditions*

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. Table A.1 summarizes the necessary variation in WLL due to temperature.

Chain slings of Grades 4 and 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.

A.1.1.2.2 *Acidic conditions*

####### A.1.1.2.2.1 *Chain slings of Grade 8*

Chain slings of Grade 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 in these circumstances the manufacturer’s advice should be sought.

For the same reasons, chain slings should not be galvanized or subjected to any plating processes without the approval of the manufacturer.

####### A.1.1.2.2.2 *Chain slings of Grade 4*

Chain slings of Grade 4 may be used in acidic conditions. The following precautions should be adopted:

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

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

c) the chain sling should be given an inspection by a competent person each day before use.

A.1.1.3 *Conditions in which the chain sling is likely to be subjected to attack (chemical, abrasive etc.)*

The manufacturer of the chain sling should be consulted, particularly if the chain sling is to be exposed to highly concentrated chemicals combined with high temperatures.

A.1.1.3 Use in exceptionally hazardous conditions

The rating of lifting accessories in European Standards assumes the absence of exceptionally hazardous conditions. Exceptionally hazardous conditions include offshore activities, the lifting of persons and lifting of potentially dangerous loads such as molten metals, corrosive materials or fissile materials. In such cases the degree of hazard should be assessed by a competent person and the working load limit adjusted accordingly.

Table A.1 — Variation in working load limit due to temperature[1)]

Grade	Working load expressed as a percentage of working load limit				
	Temperature, t, °C				
	$-40 < t \leq 200$	$200 < t \leq 300$	$300 < t \leq 400$	$400 < t \leq 475$	$t \geq 475$
4	100	100	75	50	Not permissible
8	100	90	75	Not permissible	

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

A.1.2 ***Chain sling verification before first use and in service***

A.1.2.1 *Before first use*

Before first use of the chain sling it should be ensured that:

a) the chain sling is precisely as ordered;

b) the manufacturer's certificate is to hand;

c) the identification and working load limit marking on the chain sling correspond to the information on the certificate;

d) full details of the chain sling are recorded.

A.1.2.2 *Before each use*

Before each use the chain sling should be inspected for obvious damage or deterioration

(see **A.2.1**). If faults are found during this inspection, the procedure given in **A.2.1** should be followed.

A.1.3 ***Handling the load***

A.1.3.1 *Preparation*

Attention should be given to any specific instructions provided for the handling of the load. Before starting the lift, it should be ensured that the load is free to move and is not bolted down or otherwise obstructed.

A.1.3.2 *Mass of the load*

It is essential that the mass of the load to be lifted is known. If the mass is not marked the information should be obtained from the consignment notes, manuals, plans etc. If such information is not available the mass should be assessed by calculation.

A.1.3.3 *Centre of gravity*

The position of the centre of gravity of the load should be established in relation to the possible points of attachment of the chain sling. To lift the load without it tilting or toppling the following conditions should be met.

a) For single leg and endless chain slings the attachment point should be vertically above the centre of gravity.

b) For two leg chain slings the attachment points should be either side of and above the centre of gravity.

c) For three and four leg chain slings the attachment points should be distributed in plan around the centre of gravity. It is preferable that the distribution should be equal (but see **A.1.3.5**) and that the attachment points should be above the centre of gravity.

When using two-, three- and four-leg chain slings the attachment points and chain sling configuration should be selected to achieve angles between the chain sling legs and the vertical within the range marked on the chain sling. Preferably all angles to the vertical (angle β in Figure A.1) should be equal (but see **A.1.3.5**). Angles to the vertical of less than 15° should be avoided if possible as they present a significantly greater risk of load imbalance.

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

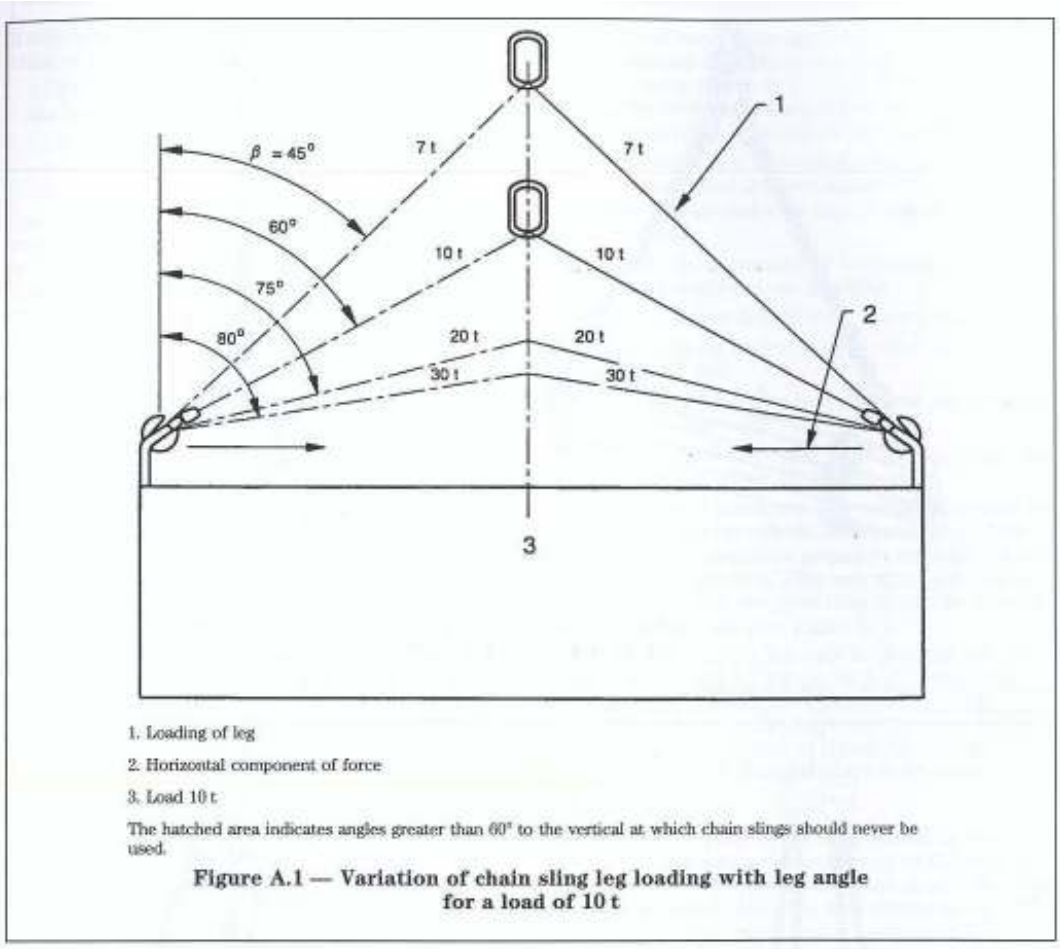
The hook to which the chain sling is attached should be directly above the centre of gravity.

A.1.3.4 *Method of connection*

A chain sling is usually attached to the load and the lifting machine by means of terminal fittings such as hooks and links. Chains should be without twists or knots. The lifting point should be seated well done in a hook, never on the point 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 hook to which it is fitted.

The chain may be passed under or through the load to form a choke hitch (see Figure A.2) or basket hitch (see Figure A.3). Where it is necessary, due to the danger of the load tilting, to use more than one chain sling leg in a basket hitch, this should preferably be done in conjunction with a lifting beam.

When a chain sling is used in a choke hitch, the chain should be allowed to assume its natural angle and should not be hammered down.



1. Loading of leg
2. Horizontal component of force
3. Load 10 t

The hatched area indicates angles greater than 60° to the vertical at which chain slings should never be used.

Figure A.1 — Variation of chain sling leg loading with leg angle for a load of 10 t

Chain sling legs may be attached to the load in several ways.

a) *Straight leg*

In this case, lower terminals are connected directly to the attachment points. Selection of hooks and attachment points should be such that the load is carried in the seat of the hook and tip loading of the hook is avoided. In the case of multi-leg chain slings hook tips should point outwards unless the hooks are specifically designed to be used otherwise.

b) *Choke hitch*

In this case, chain sling legs are passed through or under the load and the lower terminal back hooked or reeved onto the chain (see Figure A.2).

This method can, therefore be used where no suitable attachment points are available and has the additional advantage that the chain sling legs tend to bind the load together.

Where choke hitch is employed the working load limit (WLL) of the chain sling should be no more than 80% of that marked.

c) *Basket hitch*

The chain sling is passed through or under the load as in b) but in this case the lower terminals are connected directly to the master link or to the hook of the lifting machine. Generally this method requires two or more chain sling legs and should not be used for

lifting loads which are not held together. Where the load geometry permits, a single leg chain sling can be used provided that the chain sling passes through the load directly above the centre of gravity of the load. Examples of basket hitches are given in Figure A.3.

d) *Wrap and choke or wrap and basket hitch*

These methods are adaptations of b) and c), designed to provide extra security of loose bundles and involve taking an extra loop of chain completely around the load.

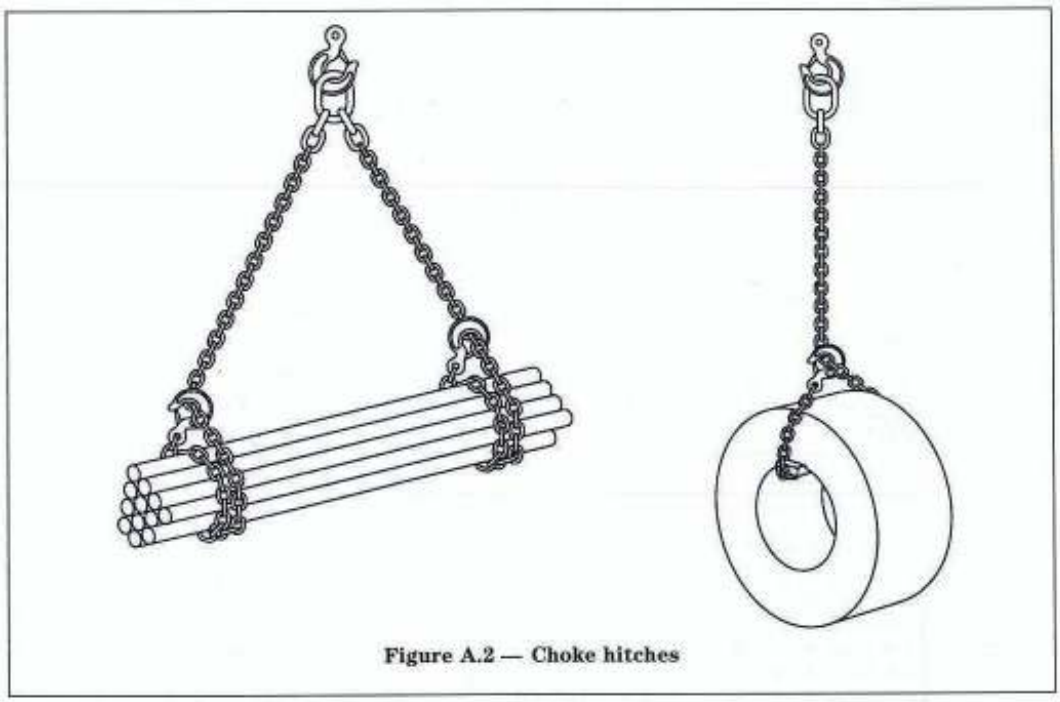


Figure A.2 — Choke hitches

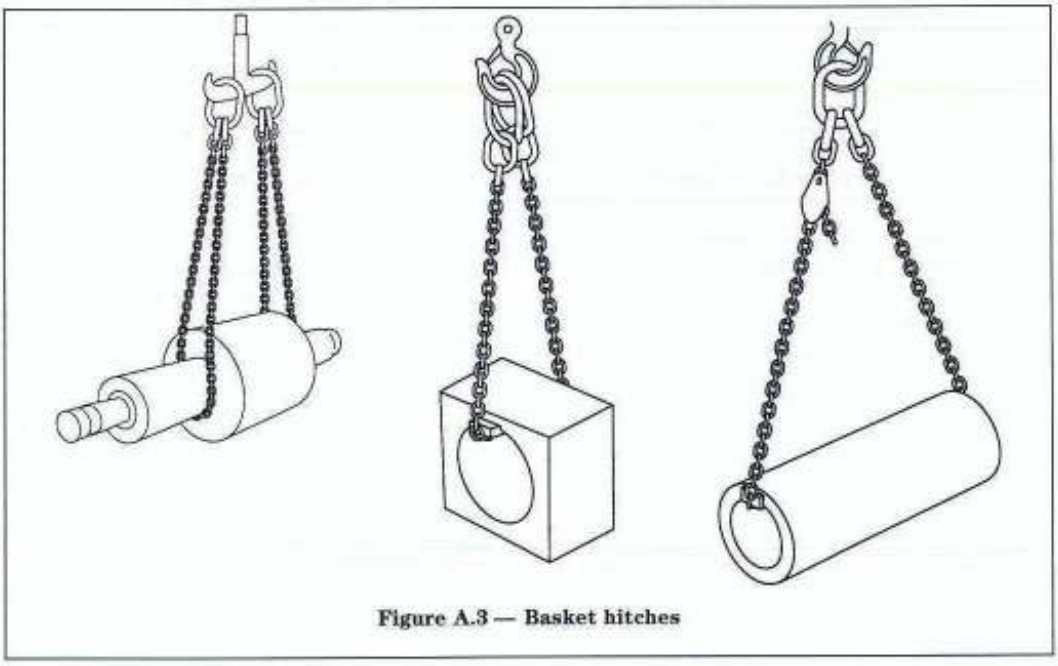


Figure A.3 — Basket hitches

If two or more chain sling legs are used in a choke hitch or a wrap and choke hitch care should be taken:

a) if it is important to avoid imparting a torque to the load, to align the chokes; or

b) if it is important to avoid the load rolling or moving laterally when first lifted, to ensure that (at least) one leg passes either side of the load.

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, since sharp corners of hard material may bend or damage the chain links or, conversely, the chain may damage the load because of high contact pressure. Packing, such as wooden blocks, may be used to prevent such damage.

In order to prevent dangerous swaying of the load and to position it for loading, a tag line is recommended.

When loads are accelerated or decelerated suddenly, 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.

Edge protector should be used to prevent sharp edges from damaging the lifting equipment. A general rule is that the radius of the edge should be >2X the chain diameter. When lifting with chain directly on lugs, it is recommended that lug diameter >3X the pitch of the chain is used. If a lug diameter of less than stipulated above is used, the WLL need to be reduced by 50%.

A.1.3.5 *Symmetry of loading*

In EN 818-4:1996+A1 and prEN 818-5:1999+A1 working load limits are given for chains slings of Grades 8 and 4 in a range of sizes and for different configurations. These WLL values have been determined on the basis that the loading of the chain sling is symmetrical. This means that when the load is lifted the chain sling legs are symmetrically disposed in plan and subtend the same angles to the vertical (see Figure A.4)

In the case of three leg chain slings, if the legs are not symmetrically disposed in plan the greatest tension will be in the leg where the sum of the plan angles to the adjacent legs is greatest. The same effect will occur in 4 leg chain slings except that the rigidity of the load should also be taken into account, with a rigid load the majority of the mass may be taken by only three or even two legs with the remaining leg or legs serving only to balance the load (see Figure A.5).

I the case of two-, three- and four-leg chain slings, if the legs subtend different angles to the vertical the greatest tension will be in the leg with the smallest angle to the vertical. In the extreme case, if one leg is vertical, it will carry all the load (see Figure A.5).

If there is both a lack of symmetry in plan and unequal angles to the vertical the two effects will combine and may either be cumulative or tend to negate each other (see Figure A.5).

The loading can be assumed to be symmetric if all the following conditions are satisfied:

a) the load is less than 80% of marked WLL; and

b) chain sling leg angles to the vertical are all not less than 15°; and

c) chain sling leg angles to the vertical are all within 15° to each other; and

d) in the case of three- and four-leg chain slings, the plan angles are within 15° of each other.

If all of the above parameters are not satisfied then the loading should be considered as asymmetric and the lift referred to a competent person to establish the safe rating for the chain sling. Alternatively, in the case of asymmetric loading, the chain sling should be rated at half the marked WLL (see Figure A.5).

If the load tends to tilt, it should be lowered and the attachments changed. This can be accomplished by re-positioning the attachment points or by using compatible shortening devices in one or more of the legs. Such shortening devices should be used in accordance with the manufacturer's instructions.

A.1.3.6 *Safety of lift*

Hands and other parts of the body should be kept away from the chain to prevent injury as the slack is taken up. When ready to lift, the slack should be taken up until the chain is taut. The load should be raised slightly and a check made that it is secure and assumes the position intended. This is especially important with basket or other loose hitches where friction retains the load. Reference should also be made to ISO 12480-1 for planning and management of the lifting operation and the adoption of safe systems of working.

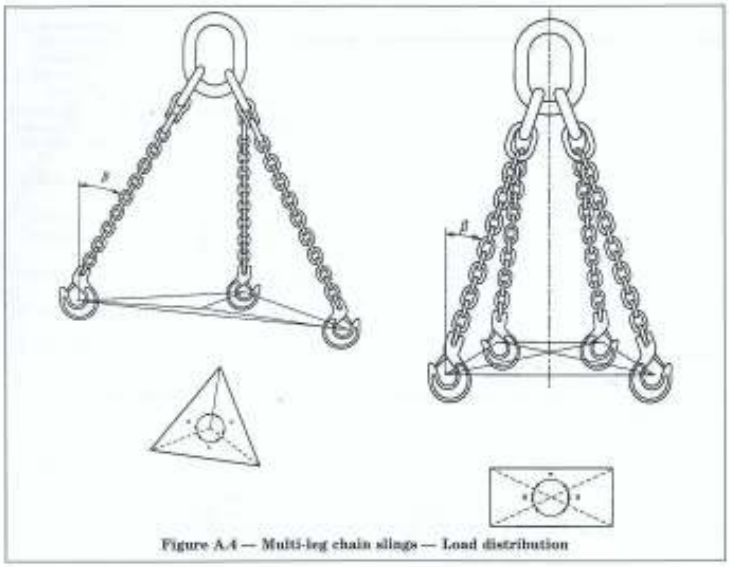
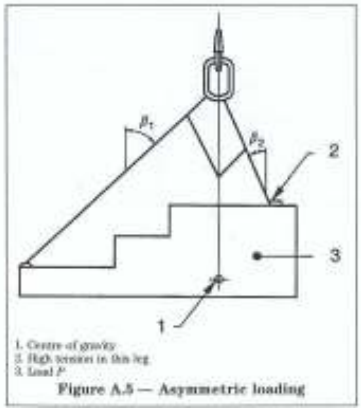


Figure A.4 — Multi-leg chain slings — Load distribution



1. Centre of gravity
2. High tension in this leg
3. Load P

Figure A.5 — Asymmetric loading

A.1.3.7 *Multi-legs chain slings with less than the full number of legs in use*

As a general principle, chain slings should be used only for the purpose for which they have been designed. In practice, however, occasions may arise when a lift needs to be made using a smaller number of legs than the number of legs in the chain sling. In such cases the WLL should be reduced from that marked on the chain sling by applying the relevant factor given in Table A.2.

Legs that are not in use should be hooked back to reduce the risk of such legs swinging freely, or snagging when the load is moved.

Table A.2 – Working load limit (WLL) factors

Types of chain sling	Number of legs used	Factor to apply to marked WLL
two-leg	1	1/2
three- and four-leg	2	2/3
three- and four-leg	1	1/3

A.1.3.8 *Working load limit (WLL)*

Taking into consideration **A.1.3.1** to **A.1.3.7** and the cumulative effects of de-rating, the method of chain slinging should be decided and a suitable chain sling or chain slings selected, having a WLL equal to or greater than the mass to be lifted.

A.1.3.9 *Landing the load*

The landing site should be prepared. It should be ensured that the ground or floor is of adequate strength to take the weight taking account of any voids, ducts, pipes etc. which may be damaged or collapse. It should also be ensured that there is adequate access to the site and that it is clear of any unnecessary obstacles and people. It may be necessary to provide timber bearers or similar material to avoid trapping the chain sling or to protect the floor or load or to ensure the stability of the load when landed.

The load should be landed carefully. Care should be taken to avoid trapping the chain sling beneath the load as this may damage it. Before allowing the chain to become slack, the load should be checked to ensure that it is properly supported and stable. This is especially important when several loose objects are in basket hitch and choke hitch. When the load is safely landed the chain sling should be removed by hand. The chain sling should not be dragged out with the lifting machine since it may thereby be damaged or it may snag and cause the load to topple over. The load should not be rolled off the chain sling as this may damage the chain sling.

A.1.3.10 *Storage of chain slings*

When not in use, chain slings should normally be kept on a properly designed rack. They should not be left lying on the ground where they may be damaged.

If the chain slings are to be left suspended from a crane hook, the chain sling hooks should be engaged in an upper link to reduce the risk of sling legs swinging freely or snagging.

If it is likely that chain slings will be out of use for some time they should be cleaned, dried and protected from corrosion, e.g. lightly oiled.

A.2 Maintenance

A.2.1 ***Inspection***

During service, chain slings are subjected to conditions which affect their safety. It is necessary therefore to ensure, as far as is reasonably practicable, that the chain sling should be safe for continued use.

If the tag or label identifying the chain sling and its working load limit becomes detached and the necessary information is not marked on the master link itself, or by some other means, the chain slings should be withdrawn from service.

The chain sling should be withdrawn from service and referred to a competent person for thorough examination if any of the following are observed:

a) the chain sling markings are illegible,

i.e. information on the chain sling identification and/or the working load limit;

b) distortion of the upper or lower terminals;

c) chain stretch;

If the chain links are elongated or if there is any lack of free articulation between the links or noticeable difference in the leg length of multi-leg chain slings, the chain may have been stretched.

d)wear;

Wear 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. The chain should be slack and adjoining links rotated to expose the inner end of each link. Inter-link wear, as measured by taking the diameter indicated (d_1) and one at right angles, (d_2) may be tolerated until the mean of these diameters has been reduced to 90% of the nominal diameter (d_n) (see Figure a.6) provided.

$$\frac{d_1 + d_2}{2} \geq 0{,}9\ d_n \qquad d_1, d_2 \geq 0{,}9\ d_n$$

e) cuts, nicks, gouges, cracks, excessive corrosion, heat discoloration, bent or distorted links or any other defects;

f) signs of “opening out” of hooks, i.e. any noticeable increase in the throat openings or any other form of distortion in the lower terminal.

The increase in throat opening should not exceed 10% of the nominal value or be such as to allow the safety hatch, if fitted, to become disengaged.

A.2.2. *Thorough examination*

A thorough examination should be carried out by a competent person at intervals not exceeding twelve months. This interval should be less where deemed necessary in the light of service conditions.

Records of such examinations should be maintained.

Chains slings should be thorough cleaned so as to be free from oil, dirt and rust prior to examination. Any cleaning method which does not damage the parent metal is acceptable. Methods to avoid are those using acids, overheating, removal of metal or movement of metal which may cover cracks or surface defects.

Adequate lighting should be provided and the chain sling should be examined throughout its length to detect any evidence of wear, distortion or external damage.

A.2.3 *Repair*

Any replacement component or part of the chain sling should be in accordance with the appropriate European Standard for that component or part.

With Grade 8 or Grade 4 chain slings, if any chain link within the leg of a chain sling is required to be replaced then the whole of the chain within that leg should be renewed.

The repair of chain in a welded chain slings should only be carried out by the manufacturer using a resistance butt or flash butt welding process.

Components that are cracked, visibly distorted or twisted, severely corroded or have deposits which cannot be removed should be discarded and replaced.

Minor damage such as nicks and gouges may be removed by careful grinding or filing. The surface should blend smoothly into the adjacent material without abrupt change of section. The complete removal of the damage should not reduce the thickness of the section at that point to less than the manufacturers specified minimum dimensions or by more than 10% of nominal thickness of the section.

In the case of chain slings on which repair work has involved welding, each repaired chain sling should be proof-tested following heat treatment using a force equivalent to twice the working load limit and thoroughly examined before it is returned to use. However, where repair is carried out by inserting a mechanically assembled component, proof-testing is not required providing that the component has already been tested by the manufacturer in accordance with the relevant European Standard.

The accuracy of the tensile test equipment should be of class 2 as given in EN 10002-2.

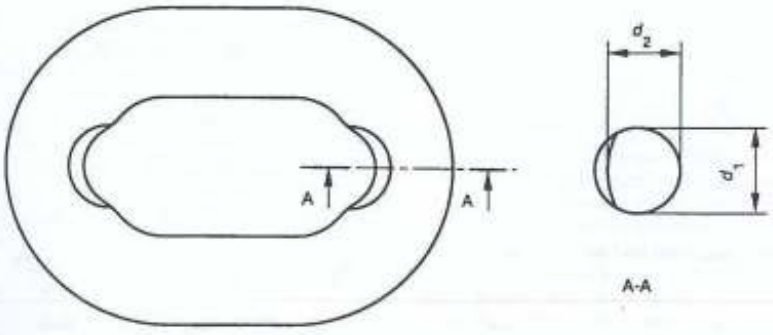


Figure A.6 — Inter-link wear on links