SAFETY HINTS FOR USERS OF LIFTING GEAR

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ABOUT THIS BOOKLET

Many accidents have occurred throught the failure or misuse of lifting gear. The aim of this booklet is to provide concise information on the selection, care and safe use of lifting gear which will help you, the user, to avoid injury and will also lessen the chance of damage to equipment and materials.

Even if you are experienced in the use of such equipment, a few minutes taken to read this booklet will be time well spent. If you are less experienced, it is suggested that you study the advice in here more closely — and re-reading it from time to time would also be well worth while.

The term "lifting gear" used in this booklet includes chains, ropes, slings, shackles, swivels, rings, hooks, or other gear used for the purpose of attaching a load to a lifting machine.

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1. LIFTING GEAR TO COMPLY WITH CODE RULES

All lifting gear should comply with the constructional requirements set out in the *Register of Chains, Ropes, Lifting gear and Lifting machines,* obtainable from the Department of Labour.

It is the owner's responsibility to see that the gear supplied meets with the code requirements, that it is periodically examined and that means are provided to identify its safe working load. Details of the gear should be recorded in the owner's register, which is supplied by the manufacturer of the equipment.

2. SELECTION OF LIFTING GEAR

Select gear appropriate to the job to be performed. Check that it is in good condition — splices, rings, and thimbles in order; no broken ends in wires; no chafe in fibre ropes. Lifting gear should be used only for the purpose for which it was designed. Do not, for example, use fibre rope or wire slings for hot loads.

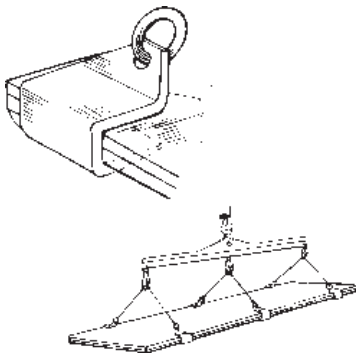

Fig. 1

Special gear may be used in particular locations. For example, it is likely that an engineering shop will provide plate lifting dogs, fig.1. Again, where cases are frequently handled, case hooks should be available, fig.2. The tool store or rigger store should be able to provide component parts for making up mutipleleg slings when required.

More detailed information to help in the selection of the right gear for the job is given in section 6 of this booklet. If there is any doubt about the gear to use, advice should be sought from an experienced person.

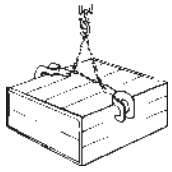

Fig. 2

3. CARE OF LIFTING GEAR

Overloading, misuse and negligence are the three greatest destroyers of lifting gear.

OVERLOADING

☐ Never overload any lifting gear or Take special precautions or use a larger size sling or stronger lifting gear when the exact load is in doubt.

☐ Be careful to avoid shock or the sudden taking up of loads, especially in cold weather.

☐ Always remember that the safe working load of a multiple-leg sling decreases as the angle between the legs increases; also that with a three- or four-leg sling, two of the legs may be taking the greater part, or even the whole of, the load.

MISUSE

☐ Do not cross, twist, kink or knot any chain or sling.

☐ Do not pull the sling from under the load which is resting on it.

☐ Do not drop a sling or any lifting gear from a height.

☐ Do not use a sling over sharp corners without protective padding between the load and the sling.

☐ Never permit fibre rope or wire rope to be run over by vehicles.

☐ Never allow kinks to form. Once a kink has been produced in a rope, no amount of twisting or tension can completely remove it. The rope is weakened and may be unsafe: the kink will chafe on the flange of each sheave it passes over and the rope will wear prematurely at that point.

☐ Never use a chain in which the links are locked, stretched or are without free movement.

☐ Never hammer a chain to straighten a link or force a link into position.

NEGLIGENCE

☐ Always protect gear against salt water damage.

☐ Competent periodic inspection reduces hazards and maintains safety.

☐ Return all lifting gear to the store after use.

☐ Never allow lifting gear to remain on the ground, on wet or damp surfaces, in contact with rusty steel or near corrosive substances, or in situations where electrolytic or galvanic action is likely.

☐ Never use an excessively pitted, corroded, or worn chain.

4. PRECAUTIONS WHEN RAISING AND LOWERING LOADS

☐ Avoid shocks due to the load being applied (or released) suddenly.

☐ Lift the load a few centimetres to test its security before raising it fully.

☐ Seek help and use suitable signals if you cannot see the load when operating a lifting machine.

☐ Do not attempt to lift or pull loads which are out of reach or out of line of the lifting machine. This places excessive loads on the lifting machine structure and the lifting gear, and introduces the danger of the load swinging. If the lifting machine cannot be moved, the load should be transported, rolled, or skidded to a position where it can be picked up directly under the hook.

☐ Loads are difficult to handle in high winds, so take extreme care where wind is likely to upset the equilibrium.

☐ Remember that a load pulled from under a pile of material may impose many times the strain of lifting that load. This action may therefore overload the lifting gear.

☐ Never carry loads over people. Do not walk under or work beneath a suspended load, no matter how small the load may be. Warn everyone in the vicinity to keep well clear.

☐ Be careful when a load is suspended that it does not catch against part of the building or other stacked articles and knock the load out of the sling or upset the stacked articles.

☐ When attention is concentrated on placing an article exactly in position, it is easy to forget to move a hand or a foot out of the way.

☐ Never place a load on an insecure foundation or leave a load in an unstable condition. Even if it remains in position, the person who later supervises the lifting off may be injured if the support falls.

☐ Slings should never be pulled out from under loads or objects as they may catch and overturn the object, possibly causing injury. This action also causes severe damage to the sling eye and splices. Always provide sufficient dunnage or packing under loads to enable the slings to be removed by hand.

Slings reeved round a load to form a bight are known as a "choker hitch" or "snotter", and require particular attention. When the strain is taken on the sling, it crowds in and squeezes the load. To ensure that it grips the load firmly, it is good practice to knock down the bight that bears on the hauling part. Failure to do so may result in articles falling out of the sling.

☐ Remember, however, that if the bight is knocked down too far the sling will be damaged. When the sling is

bent too sharply at the bight it becomes "cranky" — that is, it develops a permanent deflection so that when the strain is relieved it gnarls and forms a kink. Whenever practicable, the bight should be knocked down no further than would form an included angle at the legs of the sling of 120°.

Knocking the bight down too roughly, e.g. with a crowbar, may also damage the sling, so use a piece of wood to tap it into place.

When a sling is reeved round a load, and the eye, hook, ring, or egg link is in the bight of the sling, the bight may be forced down as low as possible to ensure a firm grip on the load. Fig. 3 shows that when the bight is only one-quarter of the length of either inclined leg of the sling above a load, such as that shown, the tension in both the inclined legs is twice the load. In this situation it is advisable to adopt other methods of slinging where possible, especially as such a sling is liable to damage a case or article by crushing it.

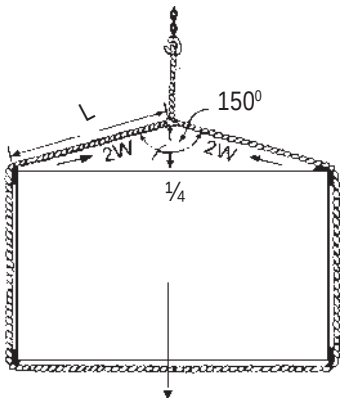

Fig. 3

Where the use of such a reeved sling is unavoidable, it should be of at least twice the strength of the sling used for the same weight on a straight lift, and the bight must be no nearer the load than the distance indicated in fig. 3.

☐ Remember the hazards of power lines. Regulations under the Electricity Act 1968 provide that no part of a crane or any other similar equipment may approach any power line closer than 3.5 m in any direction unless special precautions are observed. The licensee or owner of the power line is to specify the precautions, of which there are several alternatives such as:

(a) Providing a physical barrier between the crane and power line;
(b) Disconnecting power in the line;
(c) Personally supervising and directing the operator of the crane.

The electrical supply authority concerned knows the proper precautions that must be taken. Owners and operators of cranes and other elevated equipment should contact the appropriate supply authority, or the Railways Corporation when railway overhead lines are involved, if such equipment is likely to come within 3.5 m of any power line.

5. WEIGHT OF LOAD AND CAPACITY OF LIFTING MACHINE

Ascertain the weight of the load to be lifted. The size of the lifting gear will be determined by the weight of the load, and also by the angle between the legs of the sling, or the position and manner in which it is to be used.

On railways and wharves the weights are generally marked on the loads, and it is easy to determine the lifting gear required. But often the actual weight to be lifted will not be accurately known, and in such cases a wide margin of safety must be allowed.

There are a number of reasons for allowing this safety margin. Timber, for instance, may be 50 percent heavier when wet or green than when dry and well seasoned. Similarly in foundries where large castings have to be raised from a mould, it often happens that the sand is not freed from the sides of the castings. In steelworks, the removal of slag containing metal from furnaces or casting pits also places unknown loads on lifting machines and gear.

The time taken to calculate the approximate weight of any object is well spent, and may prevent a serious accident through the failure of lifting gear.

Table 1 on page 17 lists the weights of various materials and this should enable any rigger or slinger to compute the approximate weight of a given load. When in doubt, seek advice from an engineer or foreman. Never take chances.

☐ Select tackle of adequate strength. Consult the marking tags or stamps and refer, if necessary, to details in the *Register of Lifting Gear* to determine the safe working load of the lifting gear selected.

☐ Check that the load does not exceed the capacity of the lifting machines.

☐ If you are using a chain block or other type pf hoist block not permanently fixed in position, take care when rigging it that:

(a) The overhead support is strong enough to carry the load; and
(b) The block is properly secured to it.

Should it be necessary to rig a pole, sheerlegs, or other appliance to take the load, get advice from a competent person on how to rig it safely.

6. SAFE METHODS OF SLINGING LOADS

Definite rules for slinging methods cannot be given, as the method used must vary according to the circumstances and the load to be lifted, but following the general principles and precautions described in this section should ensure safe working.

The size of the sling will be determined by the weight of the load, and also by the angle between the legs of the sling, or the position and manner in which it is to be used.

SINGLE-LEG SLING, Fig. 4

Load is taken on one part. Select a sling having a safe working load of at least the load to be lifted.

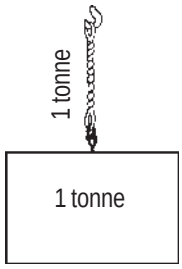

Fig. 4

"U" OR BRIDLE SLING, Fig. 5

Load is taken on two parts, Select a sling having a safe working load at least half of the load to be lifted.

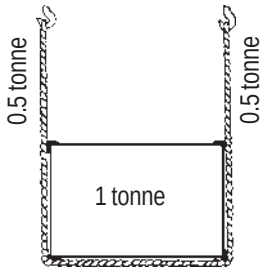

Fig. 5

DOUBLE-LEG SLING, Fig. 6

Load is taken on two parts. It is sometimes assumed, with disastrous results, that a multiple-legged sling will safely lift a load equal to the safe load of one leg multiplied by the number of legs in the sling. When the legs of slings are inclined at any angle with the vertical line through the point of support, the greater the included angle "A" the greater the tension in the sling legs.

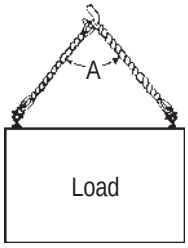

Fig.6

LEAD BLOCK, SLING, AND ANCHORAGE, Fig. 7

The actual load on the lead block sling or anchorage is the sum of the load being raised and the downward pull.

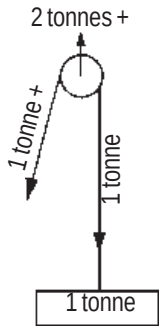

Fig. 7

BACK HOOKING, Fig. 8

The safe working load which can be carried by a two-leg sling used in this way, for angles up to 120^0, is only twice that given in the table for a single-leg sling. This is because the bearing ring of a British Standard two-leg sling has a proof load equal to only twice that of the chain itself.

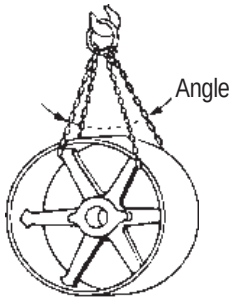

Fig. 8

GUIDE TO SLING ANGLES	
Sling angle	Distance apart of legs at point of contact
30^0	One half of leg length
60^0	Equal to leg length
90^0	One and one-third leg length
120^0	One and two-thirds leg length

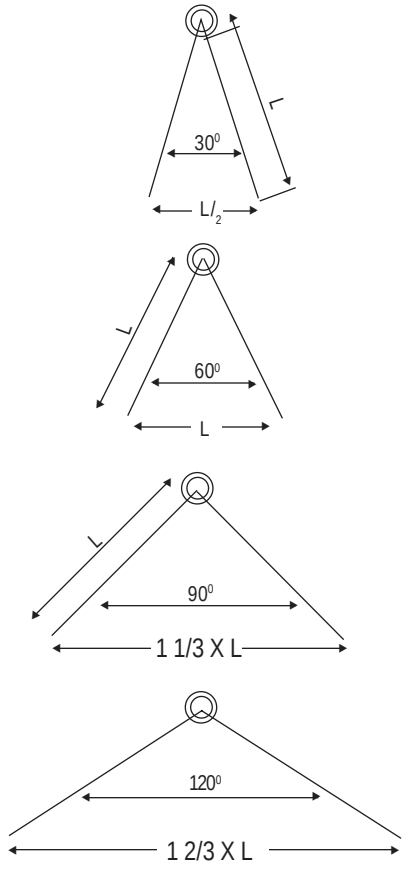

Fig. 9

THREE-LEG SLING, Fig. 10

The legs should be equally spaced and equally loaded, and the angle measurement must not exceed 90^0 by the method shown in fig. 9. The correct chain size for 30^0, 60^0 and 90^0 angles will then be as for two-leg slings.

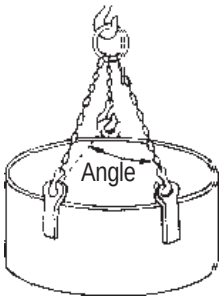

Fig. 10

FOUR-LEG SLING, Fig. 11

Owing to the practical impossibility of ensuring the even loading of legs, the safe working load is only the same as for two-leg slings. The angle is measured between the legs furthest apart.

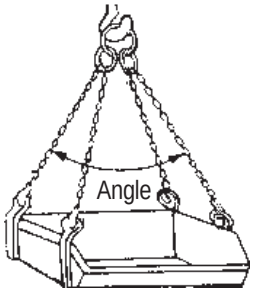

Fig. 11

LIFTING LONG BARS

When long bars are lifted by means of two-legged slings there is a risk of accident because of the tendency of the slings to slip towards the centre of the load. This tendency is controlled to some extent if the load is slung as shown in fig. 12a, and better still if a turn is taken round the bars as shown in fig. 12b.

Another hazard when long bars are being handled, particularly where there is a lack of head-room, is the extra tension put on the sling when the legs are opened at too wide an angle.

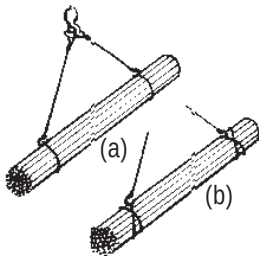

Fig. 12

THE LIFTING BEAM

Both the difficulties referred to above can be overcome by the use of a lifting beam, fig. 13a. The arrangement illustrated in fig. 13b is particularly useful when hot material is being handled. The chain can be put underneath the load and the rings placed on the beam slings by the use of hooks or shunting poles.

The beam is also useful for lifting irregularly shaped loads where the

centre of gravity is not in the centre of the load. Fig. 13c shows how a shaft and pulley can be easily and safely slung on the beam. If the ropes or chains were taken directly to the crane hook, the problem of level and safe slinging would be much more difficult.

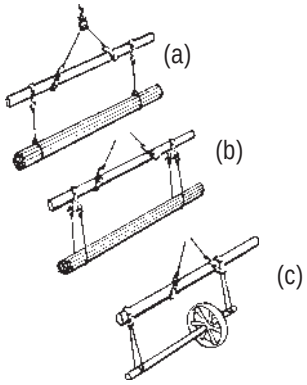

Fig. 13

LIFTING OF COILS

Fig. 14 shows a special hook for the handling of pipe in coils. Note that there is a handle fitted at the back of the hook. This is used for guiding the hook into and out of the coils, and avoids the risk of fingers being trapped between the hook and the first coil.

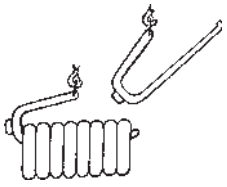

Fig. 14

LIFTING PLATES ON EDGE

The safest way of lifting single plates with holes near the edge is by attaching the lifting slings to shackles in the holes. For plain plates without holes, clamps are used. Clamps which depend on gripping are not as reliable as tackle which is shackled or hooked on to the load because slipping is more likely than the breakage of tackle.

Take care in the use of clamps or gripping appliances. The gripping clamp should always be attached squarely to the plate. Never insert packing between the clamp and plate.

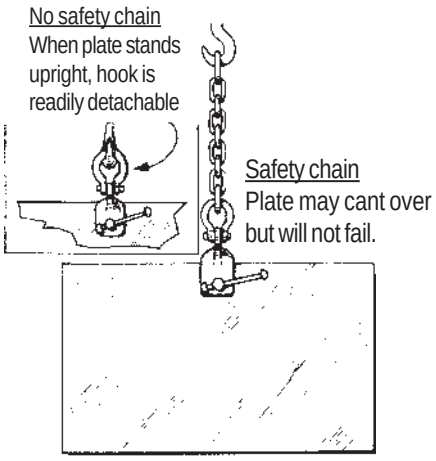

Fig. 15

Never attach a crane hook directly to a clamp shackle, fig. 15, or to a shackle through a hole in a plate, as the overlowering of the crane hook is

liable to detach it from the shackle, and the plate will be free to fall over.

The risk of detachment is greatly reduced by having a short length of chain between the shackle and the crane hook. This chain allows for a reasonable margin of error in lowering the load hook. As a maximum, the hook might be lowered by nearly twice the loose length of the sling without detachment. The plate would cant but not be free to fall.

SLINGING OF ELECTRIC MOTORS, ARMATURES, ROTORS, ETC.

For lifting purposes, small motors are usually fitted with a screwed eyebolt in the outer casing. If this eyebolt is not the "collar" type, i.e., one which has a collar above the screw thread, it must be replaced.

It is good practice to renew all eyebolts which have been in service for long periods. Many failures of eyebolts in motors, gearboxes, etc., have occurred and are probably due to bending and fatigue.

As a precaution against the loosening of the eyebolt, the load must be prevented from spinning.

If a suitable eyebolt is not available, slings or a wire lashing crossed over the top of the load should be used. Take care to ensure that all the slings fit well under the casing (see fig. 16).

For lifting split motor casings or the top half of gearboxes, the eyebolt, if provided, should be examined for defects and replaced if necessary. Always lift slowly and steadily and do not bump the armature or rotor.

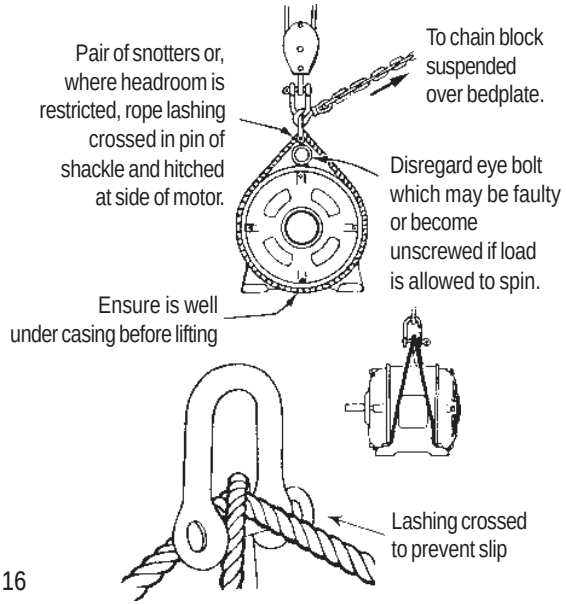

Fig. 16

TURNING LOADS OVER

Particular attention should be paid to the fitting of slings to a load prior to lifting and turning. Place the slings so that when lifted the load has a slight cant. If the slings have not been set correctly, lower the load and adjust again. Repeat this procedure until the desired cant is obtained.

The bight of the slings must never be rendered around to the underside of the load as, when lifted, the load will immediately spin round and overturn, resulting in possible damage to slings, lifting machine, ropes, and possible injury.

Slings should be reeved so that the crane eye pulls up through the standing eye. If reeved in this manner, the sling has less tendency to slip around the load.

When auxiliary crane hooks are not available on the overhead crane, the safest method of turning machines, or other bulky or heavy objects, is as shown in fig. 17.

Suitable-capacity chain blocks or purchases and winch are utilised.

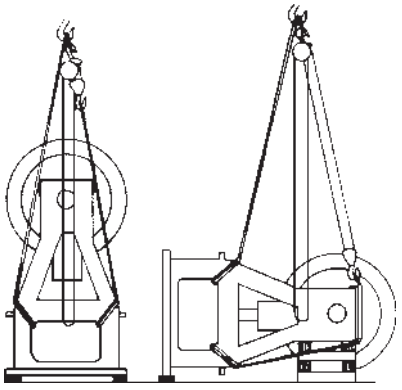

Fig. 17

Blocks should be attached to the crane hook by means of a suitable size bow shackle. The illustration shows a typical layout of slings and use of chain blocks.

EYEBOLTS

These will either be the plain or collar type. Eyebolts without collars should not be used except for steady vertical lifts, and then only when the eyebolt is of ample size.

The safest eyebolt is the type with a collar. This prevents bending where the pull is inclined from the vertical. The underside of the collar should be machined smooth, and the seating upon which the eyebolt is tightened should also be machined. The tension in any leg of a sling attached to an eyebolt should always be applied so that it does not tend to bend the eye sideways. (See Fig. 18.)

☐ Never insert the point of a hook in an eyebolt— always use a shackle.

☐ Do not use a sling reeved through an eyebolt or through a pair of eyebolts. One sling leg only should be attached to each eyebolt.

☐ Where eyebolts cannot be kept in line with each other and at the same time tightened, then washers or shims may be inserted under the collars to permit the eyebolts being tightened and turned in line with each other.

☐ Do not heavily hammer an eyebolt on the crown to tighten it. This is bad practice. A light hammer may be used after tightening to check the "solid feeling" which indicates a properly fitted eyebolt

Nominal size "A" mm	TOTAL SAFE LOAD (kg)			
	Plain or collar type	Collar type only		
		Up to 30⁰	Up to 60⁰	
10	320	400	256	
13	630	787	500	
16	1000	1300	800	
18	1250	1600	1000	
20	1600	2000	1250	
23	2000	2500	1600	
26	2500	3200	2000	
29	3200	4000	2500	
32	4000	5000	3200	
36	5000	6300	4000	
51	10,000	12,500	8000	
64	16,000	20,000	12,500	

Plain eyebolt

Collar eyebolt

This table is in accordance with BS 4278:1968

Fig. 18

HOOKS

Fig. 19 shows the shape of a modern hook and the names of its parts.

The centre line of the hook and the load should coincide, so never insert a hook in a ring, shackle, or link if it is likely to jam and bear in some part of the hook which is not plumb with its support.

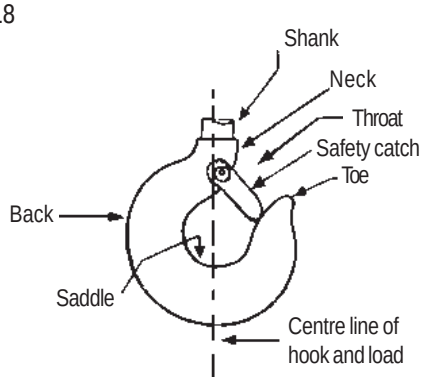

Fig. 19

A cause of failure, often unrecognised, is when a large hook is used with small end links, rings, or shackles. The point of a hook, being tapered, allows a comparatively small link to be placed upon it, but the link will jam and take a bearing on some part of the hook which is not plumb with its support, fig. 20.

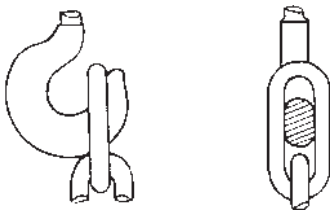

Fig. 20

When a load is so applied, the hook will act like a wedge and tend to split the link, producing cracks on the interior surface, and the hook will itself be overloaded owing to the increased bending moment on the principal section. Even if the link has sufficient opening to reach the usual bearing part of the hook, unless there is good clearance it will jam on the hook and be subjected to this wedge-like action. The same action may occur with "D" shackles, but seldom with rings or bow shackles.

To avoid failures of this nature, all end links, rings, and shackles should ride freely on any hook on which they are used.

See that the load is properly set in the saddle of the hook. Loading on or toward the toe overloads the hook and leads to spreading (fig. 21) and possible fracture. The toe, which is necessary to retain a sling in position, becomes ineffective if the hook is spread and the sling may easily be dislodged. Another danger is that the load line becomes eccentric to the centre line of the hook, with the result that the hook shank is subjected to combined bending and direct tensile stresses. In this event the shank may fail.

Fig. 21

TABLE 1: WEIGHTS OF MATERIALS

Product	Unit	Approximate weight in kg
Aluminium	1 m^3	2700
Aluminium	Ingot	4.5 - 14
Asphalt	200 litre drum	200
Barbed wire co	1	50
Bitumen	200 litre drum	200
Blood and bone	1 bag	50
Bolts	1 bag	50
Brass	1 m^3	8500
Brass sheet	1800 mm x 900 mm x 3 mm	44
Brick - standard	1	3.1
Bronze	1 m^3	8500
Cast iron	1 m^3	7200
Cast steel	1 m^3	7850
Caustic soda	1 m^3	1400
Clay	1 m^3	1900
Cement	1 bag	40
Coal	1 bag	40
Concrete	1 m^3	2400
Corrugated iron	crate	500
Corrugated iron sheet	2400 mm x 900 mm x 0.5 mm	10
Corrugated iron sheet	2400 mm x 90 mm x 0.6 mm	11
Copper	1 m^3	9000
Copper sheet	2400 mm x 1200 mm x 3 mm	78
Copper sheet	2400 mm x 900 mm x 3 mm	58
Drum (empty) motor spirit	200 litre	28
Drum (empty) normal	200 litre	20
Drum (empty) non-flammable	200 litre	17
Fat, tallow, etc.	200 litre	200
Fencing wire	200 litre	50
Fibrous plaster sheet	2400 mm x 1800 mm x 8 mm	37
Galvanised flat iron sheet	1800 mm x 900 mm x 0.5 mm	6.3
Gib board sheet	2400 mm x 1200 mm x 12 mm	23
Gypsum	1 bag	50
Kerosene	200 litre	200
Lead	1 m^3	11,400
Lead sheet	1000 mm x 1000 mm x 3 mm	34
Lead — pig or ingot	1	38.5
Limestone	1 bag	50
Limestone	1 m^3	2550
Particle board sheet	2400 mm x 1200 mm x 12 mm	23
Water	1 m^3	1000
Water	200 litre	200

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