ICHCA
INTERNATIONAL

SAFE SLINGING

Photo from **Pexels**

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Warning

This document provides an introduction to Safe Slinging principles. For detailed advice it is necessary to refer to the latest versions of documentation produced by and about Safe Slinging and read this in conjunction with the relevant national and international legislation.

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	SAFE SLINGING
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1. | INTRODUCTION

This document addresses the slinging of "Break Bulk" cargo with "loose gear[1]" defined as "any gear by means of which a load can be attached to a "lifting appliance[2]". This document does not cover unit load and container lifting methods. Contents include regulations for the manufacture, testing, thorough examination, inspection and recording of the relative information. The materials used and methods of its manufacture and criteria for discard while it is being used are also discussed. The Principles of Slinging, Centre of Gravity, Sling Angles, Mode Factors and SWL's are shown and a selection of slinging methods and specialised gear is explained.

2. | REGULATIONS

In accordance with ILO Convention 152 1979 and ILO Safety and Health in Ports 2016 all loose gear should be:

- of good design and construction, of adequate strength for its intended use and free from patent defect
- made to recognized international or national standard
- maintained in good repair and working order
- tested and thoroughly examined by a competent person before being taken into use
- thoroughly examined by a competent person at least once in every 12 months
- inspected regularly before use
- clearly marked with its S.W.L. and an alphanumeric identification mark
- used in a safe and proper manner, shall not be loaded beyond its safe working load or loads, except for testing purposes as specified and under the direction of a competent person

All loose gear should have:

- a Certificate of Test and Thorough Examination before being placed in service and
- a Certificate of Thorough Examination issued in the last 12 months or at shorter intervals prescribed by the competent authority or administration.

The authenticated records (certificates) for the tests, thorough examinations and inspections should be kept in a form prescribed by the competent authority, account being taken of the models recommended by the International Labour Office. A record of an inspection need only be kept if there is a defect to disclose. These documents should be kept for 5 years.

[1] any gear by means of which a load can be attached to a lifting appliance but which does not form an integral part of the appliance or load

[2] all stationary or mobile cargo-handling appliances, including shore-based power-operated ramps, used on shore or on board ship for suspending, raising or lowering loads or moving them from one position to another while suspended or supported

All testing should be carried out in accordance with relevant national and international regulation. Appendix D of the ILO Code of Practice on Health and Safety in Ports refers.

A Competent Person should have such appropriate practical and theoretical knowledge and experience of the loose gear to be thoroughly examined as will enable them to detect defects or weaknesses and to assess their importance in relation to the safety and continued use of the loose gear.

3. | SLINGING MATERIALS

The IOL Code of Practice on Health and Safety in Ports identifies the following quality grade marks to be placed on any steel component of loose gear:

Quality Grade Mark	Grade of steel	Mean stress (N/mm^2)
L	Mild	300
M	Higher Tensile	400
P	Alloy	500
S	Alloy	630
T	Alloy	800

3.1. Chain Slings

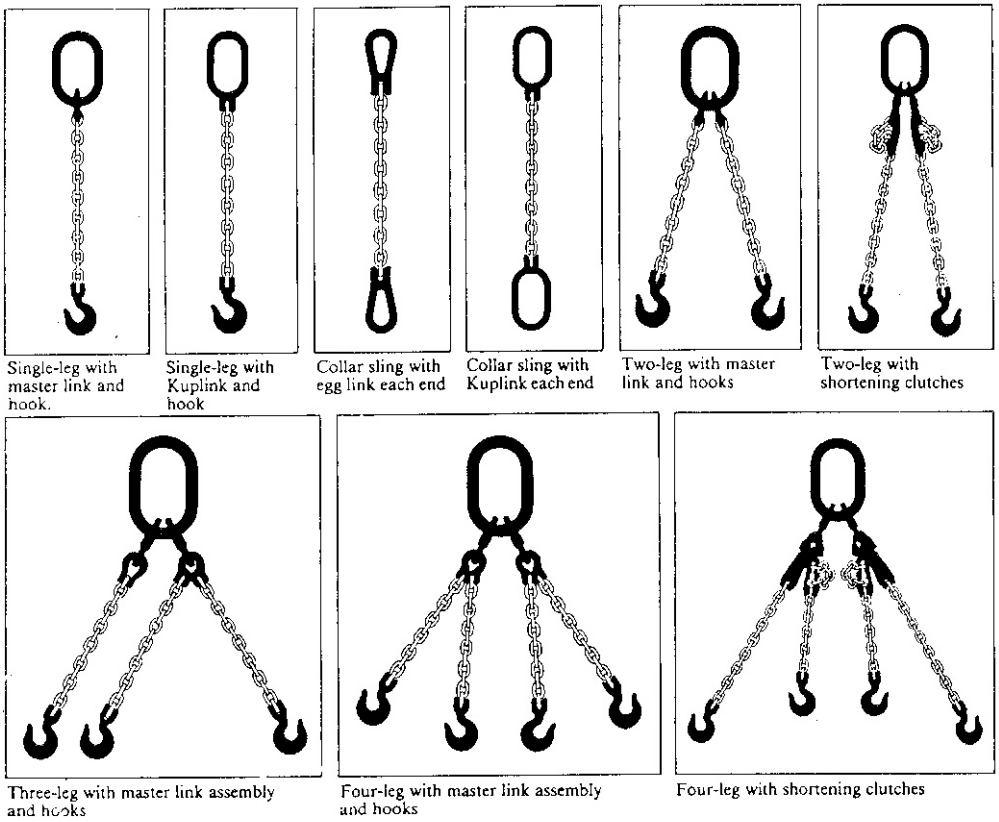
Chain slings are usually made from Grade M, S, T or Grade 100 steel

- Grade M and S slings usually have welded component connections
- Grade T and 100 slings usually have mechanical component connections
- Grade T chains can be susceptible to HYDROGEN EMBRITTLEMENT, where acid and/or sulphur is present in the atmosphere, as a critical loss strength may occur
- Chain slings can be terminated with rings, hooks or shackles and fitted with shortening clutches
- The factor of safety applicable to chain slings is usually 4:1

3.1.1. In-service Inspection

Chain slings should normally be discarded if any of the following are found. This list is not exhaustive. The duty holder should identify appropriate triggers (e.g. percentage wear) based on applicable regulation and taking into account other factors such as risk assessment, context, operational activity type.

- wear (example 8% in links, rings or connectors)
- distortion
- cracking
- discolouration due to heat or other damage to any part of the sling
- Markings are illegible or not present



3.2. Fibre rope slings

Fibre rope slings are manufactured usually from polyester but may be of polyamide (nylon), polypropylene or natural fibre. Flat webbing slings manufactured from polyester are 50mm to 300mm wide with flat eyes which may be reduced in width by folding.

- The eyes may have a protective sleeve fitted
- The slings can be colour coded for SWL
- They can be manufactured double thickness and endless

The factor of safety applicable to flat webbing slings is a minimum of 5:1

Three-strand fibre rope slings are manufactured from natural or synthetic fibres with a spliced eye at each end

- For natural fibre ropes the minimum number of tucks against the lay should be 3.
- For synthetic ropes the minimum number of tucks against the lay should be 4.
- The factor of safety applicable to three strand fibre rope slings is usually 8:1 but with a minimum of 6:1

3.2.1. In-service inspection

Flat Webbing Slings should normally be discarded if any of the following is found. This list is not exhaustive. The duty holder should identify appropriate triggers based on applicable regulation and taking into account other factors such as risk assessment, context, operational activity type.

- Damaged, chaffed, cut webbing or loose stitching
- Heat Damage (including friction)
- Chemical damage
- Solar degradation
- Markings are illegible or not present

3.3. Three Strand Fibre Rope slings

Three Strand Fibre Rope slings should normally be discarded if any of the following are found. This list is not exhaustive. The duty holder should identify appropriate triggers (e.g. degree of damage or wear) based on applicable regulation and taking into account other factors such as risk assessment, context, operational activity type.

- chaffed rope
- damaged or incorrect splices
- heat damage
- chemical damage
- solar degradation
- markings are illegible or not present

3.4. Wire Rope Slings.

Wire rope slings are manufactured from Grade 180 wire with a tensile strength of 1770 N/mm² and are constructed from 6X19 or 6X36 or 8X36 wire rope with either fibre or wire core.

- wire rope slings are usually terminated with soft eyes each end made with compressed metal ferrules or splices
- they may be made endless
- wire rope slings can be terminated with hooks, rings or shackles
- when either alloy metal ferrules or fibre core rope is used the temperature should not exceed 100ºC
- the factor of safety applicable to wire rope slings is 5:1

3.4.1. In-service inspection

Wire rope slings should normally be discarded if any of the following is found. This list is not exhaustive. The duty holder should identify appropriate triggers (e.g. percentage wear) based on applicable regulation and taking into account other factors such as risk assessment, context, operational activity type.

- a set percentage of outer wires are broken in a given length (example the number of broken wires or needles in any length of six diameters exceeds 5 per cent of the total number of wires in the rope – ILO Safety and Health in Ports)
- broken wires are closely grouped or are adjacent to a termination
- there is movement in terminations
- they show significant signs of corrosion, particularly internal corrosion
- there is any tendency towards “bird caging” (separation of the strands or wires)
- they show signs of excessive wear indicated by flats on individual wires
- markings are illegible or not present

3.5. General

Bolted Clamps (bulldog grips) should not normally be used for lifting.

Pre-slung Slings should always have a certificate before being taken into use onboard ship (either individual or batch).

If slings are ‘reusable’ they should have a certificate of thorough examination in the previous 12 Months.

If slings are “one trip” they should be destroyed after use.

A careful inspection should be carried out before and during the discharge to make sure no chafing has taken place during the voyage.

The factor of safety applicable to pre-slung slings is a minimum of 5:1.

4. | SLINGING EQUIPMENT

All the following items are manufactured from Grade M, S, T, 100 steel or Mild Steel.

4.1. Shackles.

Shackles are manufactured from grade M and grade T material.

Shackles manufactured as a

- “DEE” are to be used for straight pull use
- “BOW” are to be used for angled lifting with two slings in bow

Shackles are usually manufactured with a screw collar pin but may have nut and bolt pin for use in permanent positions. The pin is always a larger diameter in Lifting Shackles than the body.

Size for size Grade T shackles are twice as strong as grade M shackles.

Care must be exercised in the selection of shackles to ensure that matching Safe Working Loads are found.

Size		Grade M (HT)	Grade T (Alloy)
13mm	(1/2")	1t	2t
25mm	(1")	4.5t	8.5t
50mm	(2")	19t	35t

4.1.1. In-service Inspection

Shackles should normally be discarded if any of the following is found. This list is not exhaustive. The duty holder should identify appropriate triggers (e.g. percentage wear) based on applicable regulation and taking into account other factors such as risk assessment, context, operational activity type.

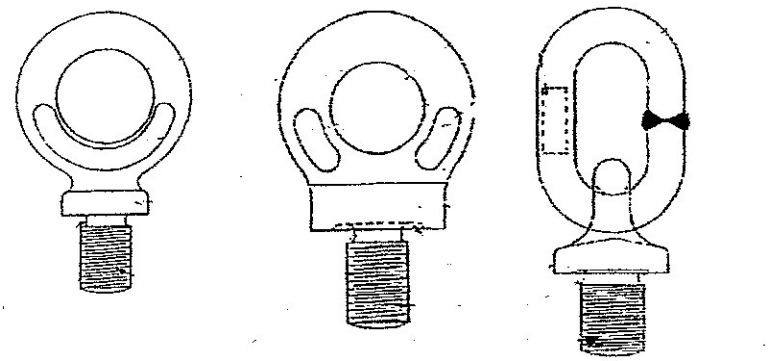
- wear (example: 8% in crown or pin)
- distorted, bent or corroded body or pin
- damaged threads
- incorrect pin
- markings are illegible or not present

4.2. Eyebolts

Eyebolts are usually manufactured with grade M steel but may be grade T.

Dynamo eyebolts should only be used for vertical lifting.

Eyebolts with links should be used for angled lifting.



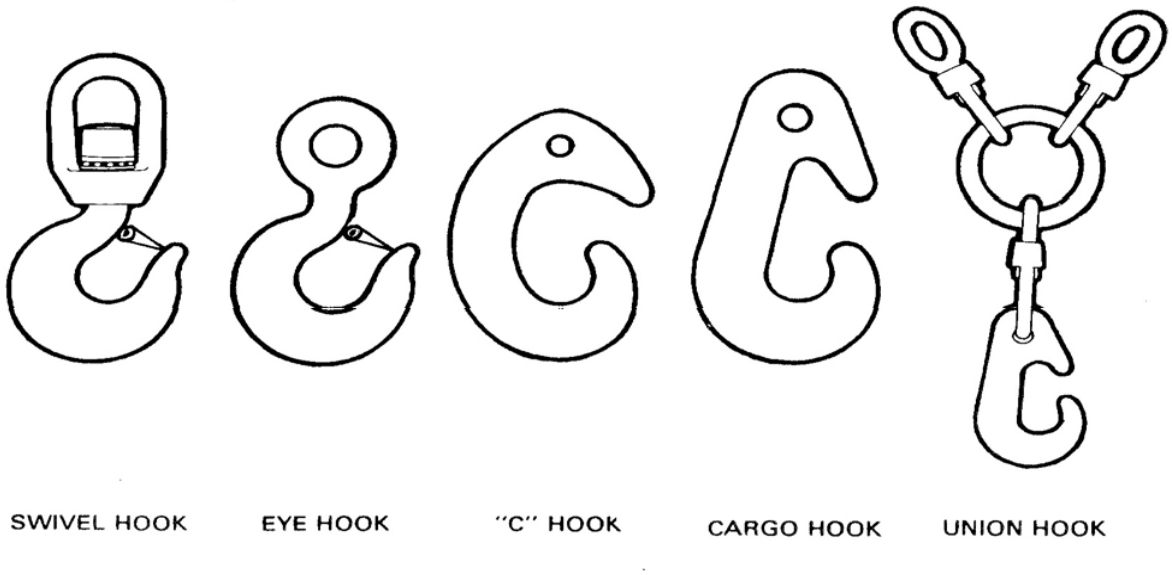
4.2.1. In-service Inspection

Eyebolts should normally be discarded if any of the following is found. This list is not exhaustive. The duty holder should identify appropriate triggers (e.g. percentage wear) based on applicable regulation and taking into account other factors such as risk assessment, context, operational activity type.

- wear (example: 8% in the eye)
- damaged threads,
- distortion, corrosion or cracks
- markings are illegible or not present

4.3. Hooks

Hooks are manufactured from grade S, T and 100 steel and always drop forge.



The hooks shown above are designed to have a means of preventing the sling from becoming inadvertently displaced. This does not mean that they all must have a safety catch. Self-locking safety hooks can also meet these requirements.

Hooks should not be 'crowded'. Suitable and fit for purpose shackles may be used to separate slings and 'ease' the hook.

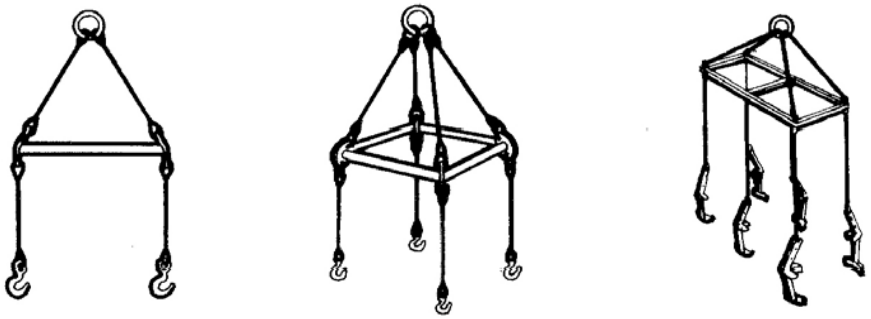
4.3.1. In-service inspection

Hooks should normally be discarded if any of the following is found. This list is not exhaustive. The duty holder should identify appropriate triggers (e.g. percentage wear) based on applicable regulation and taking into account other factors such as risk assessment, context, operational activity type.

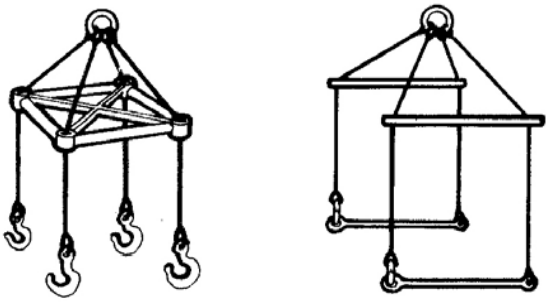
- wear (example: 8% in eye or bow of hook or 10% in opening of Jaw)

- distorted, bent or corroded body,
- missing safety catch,
- markings are illegible or not present

4.4. Spreaders and Lifting beams



LIFTING BEAMS
(LOAD THROUGH END PLATES)



SPREADERS
(WIRE PASSES THROUGH)

Spreaders and lifting beams are usually manufactured from mild steel with wire rope and chain attachments. Lifting beams have the load passing through the structure of the beam. Spreaders have the load passing through the structure on wire, chain or webbing. All structures are subject to design calculations although they are not necessarily built to specific or published standards.

All loose equipment, being part of a lifting beam or spreader, should be stored with the beam and not used for other purposes.

The tare weight should be marked if it is a significant part of the load.

4.4.1. In-service inspection

Spreaders and lifting beams should normally be discarded if any of the following is found. This list is not exhaustive. The duty holder should identify appropriate triggers (e.g.

percentage wear) based on applicable regulation and taking into account other factors such as risk assessment, context, operational activity type.

- the beam is distorted or corroded
- there is reason to doubt the soundness of wealds
- bolts are insecure or locking devices are not in place
- attachment points or eyes are worn
- markings are illegible or not present

Lifting beams and spreaders in use

5. | The Principles of Slinging.

The fundamental principle of slinging must be to ensure that the load is safe and when slung, is as secure in the air as it was on the ground.

The slinging method should be suitable for the type of load to be lifted having adequate means of attachment to both the load and lifting appliance.

The weight of the load should not exceed the S.W.L. of the slinging gear and the capacity of the lifting appliance.

The load must not damage or be damaged by the slinging gear.

The following principles and methods of slinging apply regardless of the type of lifting appliance used.

5.1. Safe Slinging

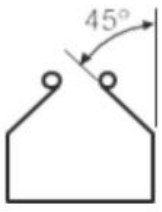
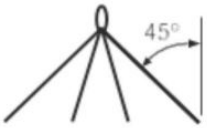
- know or find the weight of the load
- select the correct sling
- fit the sling correctly to the load paying particular attention to the load's transverse and longitudinal centres of gravity
- make a trial lift
- set the load down using bearers
- release the slings carefully – beware of snagging the load
- return gear to its designated storage location (gear room/gear store etc).

5.2. Sling Angles

Single leg slings have a SWL for a vertical lift. ***When the sling is no longer vertical its lifting capacity is reduced*** by a variable amount depending on its angle from the vertical.

NOTE: Sling angle "a" measured from the vertical

5.2.1. Mode factors

	Angle	Mode			Angle	Mode	
Straight vertical lift	**90^0**	**1**		**Choke hitch**	**---**	**0.8**	
Basket hitch	**45^0**	**1.4**		**Single leg hooked back**	**---**	**1**	
Two equal single legs	**45^0**	**1.4**		**Three or four equal single legs**	**45^0**	**2.1**	

The **Mode Factors** above (0.8, 1.0, 1.4, and 2.1) are shown with the sling either vertical or at an angle of 45º to the vertical and this is the usual way this information is shown on chain, fibre and wire rope slings.

To use these mode factors, the marked SWL of the single sling is multiplied by the mode factor of the configuration to be used at angles between 0º and 45º. This will give the permissible mass that can be lifted.

This is known as the Uniform Method and can be shown as follows:

UNIFORM LOAD METHOD

Single Leg Sling = 1.0 X SWL of single leg

Two Leg Sling = 1.4 X SWL of single leg

Three and Four Leg Sling = 2.1 X SWL of single leg

5.2.2. Centre of Gravity.

Consideration has to be given to the position of the Centre of Gravity of a load; longitudinally, transversely or both.

The sling lengths may have to be adjusted so that the centre of gravity is under the hook and the load is level.

When this adjustment is carried out, the load on each leg and its angle to the vertical may be different and will require calculating.

This calculation may be carried out with the Trigonometric Load Method and using slings of different size legs for the lift.

Where the load is rectangular rather than square and equally rated slings are used it may only be necessary to consider the worst plane with the largest angle between the legs.

TRIGONOMETRIC LOAD METHOD

Single Leg Sling = 1 X SWL of single leg X Cos a

Two Leg Sling = 2 X SWL of single leg X Cos a

Three and Four Leg Sling = 3 X SWL of single leg X Cos a

Where “a” is the angle from the vertical.

The load should always be balanced.

REFERENCES

ILO Safety and Health in Ports – Code of Practice – 2016

https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---sector/documents/normativeinstrument/wcms_546257.pdf

C152 - Occupational Safety and Health (Dock Work) Convention, 1979 (No. 152)

https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100_INSTRUMENT_ID:312297

About The Authors

Tom Sims Master mariner and Marine Consultant

Served at sea for 11 years with Prince Line on worldwide general cargo trades starting as an Apprentice in 1949 and going through to Chief Officer.

Came ashore and joined the London stevedoring company of Smith Coggins as Superintendent handling break bulk cargoes, small parcels of editable oils, Ro-Ro and container services. Latterly in charge of all lifting and mechanical equipment for the Group in London and Tilbury.

Became Stevedoring Equipment Co-ordinator for Coubro & Scrutton, designers, manufacturers and suppliers of all types of lifting equipment, container securing equipment, container lifting frames and advice & methodology on all lifting systems.

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International Cargo Handling Coordination Association

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