Product Application Seminar Workbook

Fundamentals of Rigging
Metric version



KITO CROSBY™

edition 9E

Product Application Seminar Workbook

Our University programs are specially designed for end users, including riggers, crane operators, safety professionals, trainers, job site leaders, and more.

The Academy programs are exclusively designed for our valued channel partners and provide in-depth training into the features, benefits, value propositions, and frequently asked questions about our industry-leading lifting and securement products.

WHAT IS OVERHEAD LIFTING?

ASTM A906 states that it is the process of lifting which would elevate a freely suspended load to such a position that dropping the load would present a possibility of bodily injury or property damage.

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University

- End user focused
- Fundamentals of Rigging
- Advanced Rigging

Academy

- Distributor focused
- Product Training
- Repair, Maintenance, Calibration
- Swage & Socketing

Kito Crosby training sessions provide basic application information for the Kito Crosby products and their use with selected other lifting devices. Refer to all manufacturer's warnings, the current Kito Crosby workbook, the Kito Crosby General Catalogue, and current CEN standards and ASME standards as they apply. Refresher training must be accomplished frequently as requirements change and any time there is an indication that an employee needs additional training.

You should refer to additional materials covered in this workbook, as the length of the sessions does not allow complete discussion of all available information.

Determination of your level of competence or qualifications can only be made by your employer after additional training, relevant to the work being accomplished and effective testing, is completed.

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Applications & Warnings

Misuse of Kito Crosby products may result in damage to property, and injury or death to persons.

Specific applications and warnings are discussed in detail in the Crosby catalog section, “Applications & Warnings.”

Need assistance? Contact Kito Crosby at training@kitocrosby.com, or reach out to your Regional Contact for support.





This symbol in the Workbook indicates critical steps in the rigging process. Failure to perform these steps or inspections may result in death, injury or damage to property.

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All drawings and pictures in this workbook are for illustrative purposes only. They are intended to assist in the understanding of the text in describing specific situations and apply to the specific information being discussed.

Welcome to

Risk management & The basic rigging plan

1

Based on applicable standards and product application information for

Module 1 slide 1

RIGGING CARD

1

RISK MANAGEMENT

DEFINITION
Comprehensive set of actions that reduces the risk of a problem, a failure, an accident

YOU NEED
- Product knowledge
- Application knowledge
- Manufacturer of known capability
- Products that are clearly identified with the following:
  1. Manufacturer's name and/or logo
  2. Load rating or size that refers to ratings
  3. Material class (if applicable)
  4. Traceability code (P.I.C.)
  5. CE (+local legal requirements)

A GOOD RISK MANAGEMENT PROGRAM RECOGNIZES
Performance requirements include the following:
1. Load rated products
2. Quenched and tempered
3. Ability to deform when overloaded
4. Ability to withstand real world loading in day to day use, toughness

TERMINOLOGY

WORKING LOAD LIMIT (WLL)
The maximum mass or force which the product is authorized to support in a particular service

PROOF TEST
A test applied to a product solely to determine injurious material or manufacturing defects

ULTIMATE LOAD
The minimum load or force at which the product fails or no longer supports the load

DESIGN FACTOR (D.F.)
An industrial term denoting a products theoretical reserve capability: usually computed by dividing the catalogue ultimate load by the working load limit. Generally expressed as a ratio, e.g. 5 to 1.

Load Rated®

ADDITIONAL SUPPORT

training@kitocrosby.com
kitocrosby.com/training

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Directive 2009/104/EC: Use of work equipment

This directive lays down mimimum safety and health requirements for the use of work equipment by workers at work.

Module 1 slide 4

NOTES:

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Directive 2009/104/EC: Use of work equipment

The employer shall ensure that Workers receive adequate training, Including risks and specific training on Specific-risk equipment.

Module 1 slide 5

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Code of practice: Training and use

Employers are obligated to ensure the equipment is properly used and that the operatives are suitably trained in the use of that equipment.

Employees are equally obliged to use only equipment for which they have received training and to use it in the manner in which they have been trained.

LEEA – CODE OF PRACTICE: 1.3.4.5

Module 1 slide 6

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Code of practice: Information on care and use

Manufacturers and suppliers must provide the purchaser with information on the care and safe use of the equipment.

Employers providing equipment for persons at work to use, must ensure that the equipment they provide is safe and suitable for the intended purpose.

LEEA – CODE OF PRACTICE: 1.3.4.2, 1.3.4.3

Module 1 slide 7

NOTES:

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Code of practice: Definitions

Competent person

A person having such practical and theoretical knowledge and experience of the equipment which is to be thoroughly examined that will enable him/her to detect defects or weaknesses and assess their importance to the safety of the equipment.

LEEA – CODE OF PRACTICE: 1.2.2

Module 1 slide 8

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Code of practice: Definitions

Responsible person

A person who has sufficient knowledge and training to enable him/her to recognize obvious defects and is responsible to his/her employer for the “in-service” inspection of equipment.

LEEA – CODE OF PRACTICE: 1.2.20

Module 1 slide 9

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WLL: Working Load Limit Definitions

The maximum mass or force which the product is authorized to support in general service when pull is in-line, unless noted otherwise. With respect to the centerline of the product, this term is used.

Interchangeable with the following terms:

1. WLL
2. Rated load value
3. Resultant working load

General Catalog



Module 1 slide 10

Code of practice: Definitions

Safe Working Load

The safe working load is the maximum load as assessed by a competent person which an item of lifting equipment may raise, lower or suspend under the particular service conditions.

LEEA – CODE OF PRACTICE: 1.2.21

Module 1 slide 11

Code of practice: Definitions

Working Load Limit (WLL)

The maximum load that an item of lifting equipment is designed to raise, lower or suspend.

The working load limit is the load under ideal conditions and in most cases the working load limit and safe working load will be the same. Depending on the conditions of use, it may be necessary for the competent person to reduce this to a lower safe working load.

LEEA – CODE OF PRACTICE: 1.2.26

Module 1 slide 12

NOTES:

Working Load Limit : establishing

$$\text{Working Load Limit} = \frac{\text{Ultimate Load}}{\text{Design Factor}}$$

The ultimate load is determined by the testing the product in a steady pull, in-line at room temperatures.

The design factor is established by industry standards.

Module 1 slide 13

NOTES:

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Code of practice: Definitions

Proof test or test load

A load applied by the competent person for the purpose of a test.

This load appears on reports of thorough examinations if a proof test has been made by the competent person as a part of the examination, and on a test certificate.

LEEA – CODE OF PRACTICE: 1.2.17

Module 1 slide 14

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Code of practice: Definitions

Factor of safety

The ratio between minimum breaking strength and safe working load, sometimes referred to as working coefficient or coefficient of utilization.

LEEA – CODE OF PRACTICE: 1.2.5

Module 1 slide 15

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Code of practice: Definitions

Minimum Breaking Load (MBL)

The MBL is the specific load below which the item of equipment does not fail either by fracture or distorting to such an extent that the load is released.

LEEA – CODE OF PRACTICE: 1.2.14

Module 1 slide 16

NOTES:

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Code of practice: Definitions

In-service inspection

A visual inspection carried out by the responsible person to check for obvious signs of damage or wear which might affect the equipment's fitness for use.

LEEA – CODE OF PRACTICE: 1.2.7

Module 1 slide 17

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Code of practice: Definitions

Lifting appliance
Any machine which is able to raise, lower or suspend a load.

Lifting accessory
Item of equipment used to attach the load to the lifting appliances (previously referred to as lifting gear or lifting tackle).

Lifting equipment
Generic term that applies to all lifting accessories, lifting gear and appliances.

LEEA – CODE OF PRACTICE: 1.2.8, 1.2.9, 1.2.10

Module 1 slide 18

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Inspection and thorough examination

Every employer shall ensure that before lifting equipment is put into service for the first time by him/her, it is thoroughly examined for any defect.

Every employer shall ensure that, where the safety of lifting equipment depends on the installation conditions, it is thoroughly examined as per local legislation.

LEEA – CODE OF PRACTICE: 1.3.4.7

Module 1 slide 19

NOTES:

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Code of practice: Inspection and thorough examinations

In addition to maintenance programs, the condition of lifting equipment must be monitored while it is in use.

Operatives should look for any obvious signs of damage, deterioration, or malfunction and report these to the responsible person.

It is a legal requirement that the lifting equipment is inspected at suitable intervals to ensure the continued safety.

Module 1 slide 20

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Code of practice: Inspection and thorough examinations

The regulations require that all lifting equipment is thoroughly examined by a competent person throughout its life and the results recorded.

Local legislation requires the thorough examinations to be within a maximum fixed period.

The maximum fixed period will depend on local legislation and will vary country per country.

Module 1 slide 21

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Code of practice: In-service inspection

Regular “in-service” inspections should be instituted, at appropriate intervals.

The “in-service” inspection should be carried out by the responsible person.

In addition to “in-service” inspection, all lifting equipment is required to be thoroughly examined by a competent person

LEEA – CODE OF PRACTICE: 1.7

Module 1 slide 22

NOTES:

Rigger’s responsibilities

The inspection of rigging gear
- Initial inspection
- Frequent inspection
- Periodic inspection

Responsibilities for rigging
- Inspection
- Connection

The capacity of rigging gear
- Know the working load limit
- Use within the working load limit
- Do not modify

Module 1 slide 23

Around the world there are several common basic requirements for rigging safety.

These requirements always define responsibilities that must be accepted by the rigger.

The responsible rigger is sometimes called:
- The competent rigger
- The qualified rigger
- The responsible rigger
- The rigger in charge

See ANSI/ASME A10.42 and/or ASME B30.5 for information on rigger responsibilities.

These requirements also define requirements for the equipment used in overhead lifting.

Minimum design factors for rigging equipment is required around the world.

Design factor of wire rope slings and the hardware used with them is at least 5/1.

Design factor of chain slings and the hardware used with them is at least 4/1.

In Europe and some parts of Asia the design factor of synthetic slings must be 7/1.

The identification of hardware, slings and other rigging equipment is also defined by the requirements.
Not all Crosby hardware does have the capacity marked or forged into the component. It may be necessary to reference the applicable charts in the Kito Crosby catalog for Working Load Limits.

OSHA1926.250-.251 applies to construction industry.

OSHA 1910.176-.190 applies to general industry.

Rigging equipment

Storage of equipment
- Not in immediate work area
- Protect from damage

Fabrication of slings
- No knots to form eyes
- Follow industry practices

Below the hook rigging devices and custom equipment
- Designed
- Tested
- Traceability

Design factors as required

Module 1 slide 24

Identification

Manufacturer's name or logo
Capacity
Size
Material (if applicable)

Slings
- Chain
- Synthetic webbing
- Synthetic round slings
- Wire rope

Hardware
- Shackles and eye hooks
- Turnbuckles and eye bolts
- Other

Module 1 slide 25

NOTES:

The identification of hardware, slings and other rigging equipment is also defined by the requirements.

All Crosby hardware does not have the capacity marked or forged into the component.
It may be necessary to reference the applicable charts in the Crosby catalog for Working Load Limits.

OSHA 1926.250-.251 applies to construction industry.
OSHA 1910.176-.190 applies to general industry.

Evaluating the use of rigging gear: problems at the start



- Competent (trained) riggers not assigned
- Use of improper hand signals
- Not inspecting gear "frequently"
- No knowing what to inspect for
- Slings missing tags or tags not legible
- Capacity of rigging gear not known
- Improperly made below the hook devices
- Wire rope slings formed with clips

Module 1 slide 26

As we continue to develop the list of key questions that need to be answered when planning rigging, it is useful to review common rigging problems. The items noted here can be used as a partial check list of what to look for when evaluating the effectiveness of planning in any environment.

Indications of improper techniques also include "problems at the start" with improper gear and training or inspection.

Evaluating the use of rigging gear: problems at the hardware



- Too small hardware connected to sling eye
- Too large hardware connected to sling eye
- Bunching or pinching of synthetic slings
- Loose shackle pins or other connections
- Missing latches on hoist hooks
- Placing too many slings in hoist hook, shackles or other hardware
- Improper side loading or misalignment of hardware

Module 1 slide 27

Indications of improper rigging techniques include "problems when connecting slings and loads to hardware".

Evaluating the use of rigging gear: problems with the hitch

- Beating down choker hitch
- Basket capacity used when not vertical
- Basket hitch (wire rope) over small diameter
- Capacity of bridle not adjusted for angle
- Sling loads not properly distributed
- Use of vertical sling angles greater than 60 degrees
- Choker and basket hitches at vertical sling angle larger than 30 degrees



Module 1 slide 28

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NOTES:

Indications of improper rigging techniques also include “improper use of the basic rigging hitches”.

Any one of these problems may not result in an accident on any given day, but keep in mind that most serious riggings accidents result from a combination of problems.

Any rigging situation that has a number of these indications has clearly been poorly planned.

Evaluate the rigging technique

01



02



03



04



05



06



07



08



09



10



Evaluate the rigging technique

11



12



13



14



15



16



17



18



19



20



Risk management
Identify questions to be answered

- Identify risk potential
- Take action to reduce risk
- Identify questions to be answered

Module 1 slide 45

NOTES:

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THE BASIC RIGGING PLAN

1. **Who is responsible (competent) for the rigging?**
   Are communications established?
2. **Is the equipment in acceptable condition?**
   Appropriate type, proper identification?
3. **Are the working load limits adequate?**
   Capacity of lifting gear known?
   What is the weight of the load?
   Where is the centre of gravity?
   What is the vertical sling angle?
   Will there be any angular or side loading?
   Are the slings padded against corners, edges, protrusions and abrasive surfaces?
4. **Will the load be under control?**
   Is the load rigged to the centre of gravity?
   Is the hitch appropriate?
   Is a tag line needed?
   Is there any possibility of fouling? Clear of personnel?
5. **Are there any unusual loading or environmental conditions?**
   Wind, temperature, other?
6. **Your special requirements?**

RESPONSIBILITY 2

USER RESPONSIBILITY

- Utilize appropriate rigging gear suitable for overhead lifting.
- Utilize the rigging gear within industry standards and the manufacturer's recommendations.
- Conduct regular inspection and maintenance of the rigging gear.

MANUFACTURER RESPONSIBILITY

- Product and application information
- Product that is clearly identified
  - Name and/or logo
  - Load rating and/or size
  - Quality control
  - Traceability
  - CE (+ local legal requirements)
- Material class (if applicable)
- Product performance
  - Working load limit
  - Ductility
  - Fatigue properties
  - Impact properties



Code of practice
Adequate planning

The lifting operation must be adequately planned.

For **routine operations, a general plan** will be sufficient. For **special or complex operations, a specific written plan** will be required.

Complex operation will require a supervisor in overall charge, with the means to communicate with others involved.

Lifting technology solutions such as load monitoring could be helpful and should be considered.

LEEA – CODE OF PRACTICE: 1.3.4.4

Module 1 slide 51

Code of practice
General procedures

1. **Determine the weight of the load**, the centre of gravity in relation to lifting points, and do not exceed safe working load on any item.
2. **Decide upon the method of lifting and slinging.** Ensure equipment and method of use is suitable for the load and the slings. Make sure the lifting appliance is secure.
3. **The slinging method must ensure that the load is level & balanced.**

LEEA – CODE OF PRACTICE: 1.8.1

Module 1 slide 52

Code of practice
General procedures

4. **Care must be taken to ensure that the load is not damaged** by the lifting equipment, and that the lifting equipment is not damaged by the load.
5. **The lifting equipment must be carefully inspected** for obvious defects before use.
6. **Consider whether ropes or "tag lines" are required** to control the load.

LEEA – CODE OF PRACTICE: 1.8.1

Module 1 slide 53

NOTES:

A. OSHA requires a qualified (competent) person to be responsible for connecting the load and inspecting the rigging gear.

B. Establish clear communications by use of hand signals or radio.

C. Make sure that gear is suitable for overhead lifting. The manufacturer must say it is suitable for overhead lifting and must meet ANSI/ASME. Check that the manufacturer has their name or logo in the product, and that the size or working load limit is clearly marked.

D. The gear we use must have adequate working load limits. We must know the capacity of all our gear.

E. The weight of the load must be known, calculated, estimated or measured. The loading on the slings will depend on where the Centre of Gravity (COG) is located.

F. The forces on the slings and connections at the load are affected by the vertical sling angle. At 60 degrees the forces are doubled.

G. The WLL of most equipment is based on in-line loading. If the sling pulls off at an angle, we need to find three more pieces of information: Does the manufacturer allow it? Is the WLL affected? Are there any special requirements?

H. Protect equipment from sharp edges. The strength of slings can be reduced dramatically. Pad all edges or surfaces to avoid cutting or abrasion.

I. Proper load control means that the load lifts level and is stable. Placing the load hook over the Centre of Gravity is an essential first step. Placing the slings around the COG is the second step. Selecting a hitch that will attach to the load securely at the sling angle being used is next. The sling should attach (or convert) above the COG to avoid flipping the load.

J. Good load control requires the use of a tag line where needed. Make sure that the load or rigging does not foul or snag as it is moved. Do not expose personnel to suspended loads.

K. It is important to also consider environmental and other special requirements that may affect the rigging.

Code of practice
General procedures

7. **Consideration should be given to any obstacles** which may have to be avoided.
8. **Before commencing the operation, a suitable landing site should be prepared.**
9. **Ensure that the load is free to lift** and not restrained.
10. **Ensure that any loose parts of the load are adequately secured.**

LEEA – CODE OF PRACTICE: 1.8.1

Module 1 slide 54

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Code of practice
General procedures

11. **Ensure that there is a clear method of communication** between the operative responsible for the slinging and the driver or operator responsible for the lifting appliance.
12. **Unless unavoidable, no one should be allowed under a suspended load** and as far as possible, all people should be kept clear of the area of operation.

LEEA – CODE OF PRACTICE: 1.8.1

Module 1 slide 55

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Code of practice
General procedures

13. **The load should be lifted a nominal distance in the first instance.** This trial lift allows check estimates of balance, stability and general security.
14. **When lowering the load, it should be brought to halt a short distance above the landing site** to allow it be steadied, position checked, and that all personnel are clear of danger area.

LEEA – CODE OF PRACTICE: 1.8.1

Module 1 slide 56

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NOTES:

Review each accident and identify which issues from the rigging plan were not planned properly.

Accident notes

Basic rigging principles violated

1. **AS THE LIFT WAS STARTED, TWO EMPLOYEES GOT UNDER A SUSPENDED FRAME TO SHIFT TIMBERS** – The frame shifted and one of the workers under the load was pinned against the ground. → .....

2. **ONE END OF A WOODED BEAM WAS LIFTED UP OFF A TRAILER TO ALLOW CONNECTION OF SLING IN CENTRE** – The beam rolled off the trailer and fell on supervisor. → .....

3. **6.75 TON BEARING SWUNG FREE AS IT WAS LIFTED** – It hit an employee in the chest. → .....

4. **SHEET METAL PANELS WERE RIGGED USING NYLON SLINGS, NOT PADDED** – As the load was swung, one of the slings broke and the load pinned an employee. → .....

5. **100 KG COMPRESSED GAS TANK WAS HOISTED BY A CRANE 10 M OVER THE HEAD OF AN EMPLOYEE** – The tank, carried by a single choker hitch, fell and hit a worker. → .....

6. **A WORKER WAS STANDING ON A FAN ABOUT TO BE LIFTED** – The crane's cable snapped and worker was killed by falling wire rope and gear. → .....

Code of practice
General procedures

15. **The operative should always be careful not to set the load down on his or** anyone else's toes and ensure that fingers do not become trapped. The lifting appliance should never be used to drag a sling out from under a load.
16. **When the lifting operation is complete, return the equipment to proper storage.**

LEEA – CODE OF PRACTICE: 1.8.1

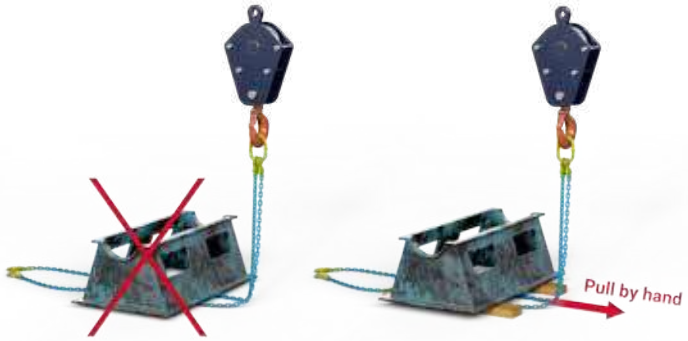
Module 1 slide 57

NOTES:

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Prepare a landing site

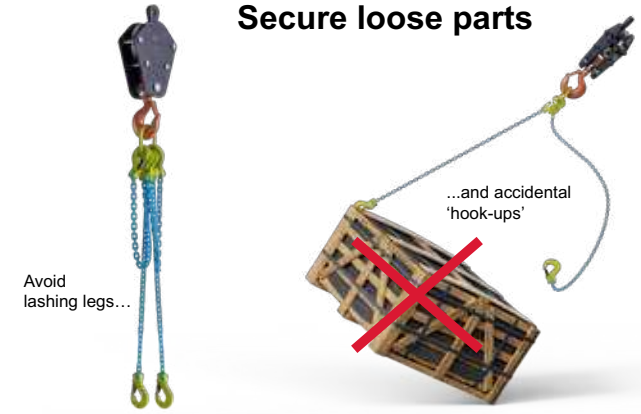


Module 1 slide 58

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Secure loose parts



Module 1 slide 59

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The user's responsibilities

Utilize appropriate rigging gear suitable for overhead lifting.

Utilize the rigging gear within industry standards and the manufacturer's recommendations.

Conduct regular inspection and maintenance of the rigging gear.

Module 1 slide 60

NOTES:

Manufacturer's responsibilities

Product and application information
Product that is clearly identified

- Manufacturer's name or logo
- Load rating and size
- Traceability
- CE marking if applicable

Product performance

- Working load limit
- Ductility
- Fatigue properties
- Impact properties

Module 1 slide 61

Manufacturer's responsibilities Legislation

The manufacturer is mandated by legislation with elementary minimum requirements for his material.

The legislator expects from the employer that all lifting equipment available in his company will comply anytime with these minimum requirements and will ensure that employees will use it with the required know-how.

Module 1 slide 62

Machinery Directive
2006/42/EC

Conditions:
The product must comply with a broad range of essential requirements concerning safety and health.
An EC-Declaration of conformity with the directive is to be supplied with the product
Marking on the product:
- Identification of the manufacturer
- CE - stamp
- Material grade (for Grade 80)
- Identification of the working load limit (W.L.L., Size of chain)

Instructions for use are to be provided in the language of the country.

Module 1 slide 63

NOTES:

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Machinery Directive
2006/42/EC

Technical conditions
Minimum Safety Factors:
- Chain and fittings 4
- Wire rope 5
- Webbing & roundslings 7

Min. Proof load 1,5 x WLL
EC Declaration can be supplied conditioning a technical calculation file is available.

Module 1 slide 64

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Machinery Directive
Explanation on the European Legislation

Contains the essential requirements about safety and hygiene, protection of environment and user.

The directive is mandatory and must become law in all countries in the community.

Products being conformed to the directive have free admittance to the European market.

A product which conforms with the directive cannot be denied access to the market, only for technical reasons.

Module 1 slide 65

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Standards

Explanation on the European Legislation

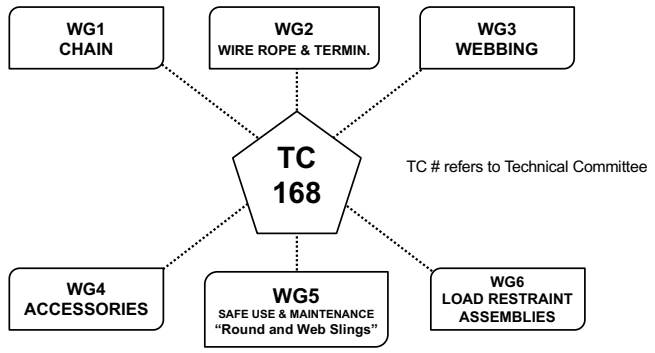
The standards contain the detailed technical specifications with which a product must comply to conform with the directive.

The standards are not an obligation, but a product which complies with the standard, provides the product with presumption of conformity with the directive.

The standards are mandatory for all the countries in the community.

Module 1 slide 66

Explanation on the European Legislation



Module 1 slide 67

Workgroup (WG1)

Program:

- Short-link chain for lifting purpose - general acceptance conditions
- Short-link chain (non-calibrated) for chain slings for lifting purpose: grade 8
- Chain slings Grade 8 - assembled by other methods than welding

Most important elements:

- Safety factor = 4
- Asymmetric welding is not allowed
- Chemical composition of grade 8 chain:
  min. 0,4% NI 0,4% CR or 0,15% MO
- Max. 0,025% S and F
- Tempering temperature: not less than 400°C
- Proof load: 2,5x WLL
- Minimum elongation at failure: min. 20%

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NOTES:

Requirements for instructions for safe use have been extended and now include the addition of the EC Declaration of Conformity.

The words "original instruction" must appear on the language version verified by the manufacturer and any translations must bear the words "translation of the original instruction".

Workgroup (WG2)

Program:
- Wire Rope

Accessories:
- Swage fittings, Flemish eye, turnback
- Hand splice
- Wire rope clips
- Spelter sockets

Most important element:
- Safety factor = 5

Module 1 slide 69

NOTES:

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Workgroup (WG3)

Program:
- Round & Webbing slings

Most important elements:
- Safety factor = 7
- Color code + black line code
- Temperature limitation -40°C/+100°C
- Lifetime: unlimited
- Eyes equipped with padding
- Additional marking:
  - Material (PA/PES/PP)
  - Length
  - Traceability code

Module 1 slide 70

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Workgroup (WG4)

Program:
- Forged accessories for slings and general use
- Welded accessories for slings and general use
- Forged lifting hooks
- Master links used with grade 8 slings, wire rope and webbing: forged links and welded links
- Shackles
- Eye bolts
- Shurloc hooks

Most important elements:
- Safety factor = 4
- Proof load= 2,5x WLL
- Max. Permanent deformation at proof load = 1%
- fatigue life: 20.000 cycles minimum
- Chemical composition:
  - Min. 0,4% NI + CR, 0,15% MO
  - Tempering temperature: not less than 400°C

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EC Declaration of Conformity

An EC Declaration of Conformity is a declaration **made by the manufacturer** that the equipment described complies with the relevant European Directive(s). It is **a legal document** enabling an item to be placed on the market and taken into service.

Module 1 slide 72

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EC Declaration of Conformity

For the user of lifting equipment, the EC Declaration of Conformity is **confirmation that the equipment complies with the community requirements,** and it should be retained as part of the lifting equipment's records.

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NOTES:



Crosby

EC Declaration of Conformity

in accordance with EC Machinery Directive 2006/42/EC

Certificate Number: CC4-20250703000454

Location of Issue: Crosby Europe N.V.
Industriepark B nr 26
2220 Heist-op-den-Berg, Belgium
Phone: 32-15-75-75-25 Fax: 32-15-75-37-64

Stock No: 1382693

Description of Gear: G2130OC 6 ½ OC Bolt Type Anchor Shackle 7/8" Maxtough®

Working Load Limit: 6.5t Proof Load: 13t

Comments: 6:1 Design Factor. Meets the requirements of API-2CCU

Note: Meets the performance requirements of Federal Specification RR-C-271H Type IVA, Grade A, Class 3, except for those provisions required of the contractor.
Meets the requirements of EN 13889: Forged steel shackles for general lifting purposes. Dee shackles and bow shackles - Grade 6 - Safety.
Meets or exceeds all requirements of ASME B30.26.
With the below signature by completion of the technical file for above-mentioned CE marked product, we hereby declare compliance with the applicable essential Health and Safety requirements of EU Machinery Directive 2006/42/EC.
Crosby G2130OC shackles can be used in general service with good rigging practices down to temperatures of -60 °F (-40 °C). 2B/C type approved design temperature is -4 °F (-20 °C).
This item been contaminated by Mercury or Asbestos in the manufacturing process.

Number of Pieces: 1 Item: 6520 Distributor Note: Serialize 123
PIDs are based on visual observation
Certificate based on item being the Crosby product described above.

Mentioned products are in conformity to the Crosby literature available at the time of manufacture. We hereby certify that the above described material was manufactured and processed in a manner compatible to meeting the specified load ratings when used under normal and proper applications. This product at the time of manufacture does not contain any ozone-depleting substances.

This product at the time of manufacture does not exceed the threshold for any of the hazardous listed chemicals in Appendix 1 of MEPC.269(68) 2015 Guidelines.

QST Load Rider Fatigue Rider MAXTOUGH CE

For Product Delivered To: **** TO BE ADVISED ****
USA

Date: July 03, 2025
Date of Issuance

Signature:
Liaison Manufacturer, Quality Assurance

See Crosby Application and Warning Information found in the back of the Kito Crosby catalog for more information.

Risk Management and the Rigging Plan

1. _____ is required at least annually.
2. _____ is required before each use.
3. _____ is required before being put into service.
4. Follow _____and the manufacturer's recommendations.
5. Conduct regular inspection and _____.
6. Utilize _____ rigging gear.
7. The _____ is the maximum load that can be applied to rigging gear in service.
8. _____ is a load that can be applied to test the gear solely to determine injurious material of the manufacturer or authorized body.
9.
10. A rigging plan is a set of _____.
11. Rigging gear fails at _____.
12. _____ are obligated to ensure the equipment is properly used and that the operatives are suitably trained in the use of the equipment.
13. The eyes of wire rope slings must not be formed with _____.
14. Proper load control means that the load lifts level and is _____.
15. Consider whether _____ are required to control the load.
16. The design factor of chain slings and the hardware used with them is at least _____.

Choose Answer from the Following List

a. appropriate
b. working load limit
c. Employers
d. wire rope clips
e. ultimate load
f. questions and answers
g. Periodic inspection
h. Initial inspection
i. industry standards
j. stable
k. tag lines
l. Proof load
m. 4/1
n. Frequent inspection
o. maintenance

Welcome to

Rigging principles & Load control

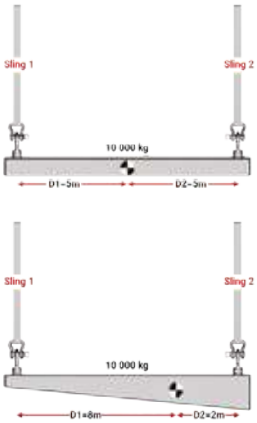
2

Based on applicable standards and product application information for

Crosby GUNNEBO Industries

Module 2 slide 1

CENTRE OF GRAVITY AND SLING LOADING



When lifting vertically, the load will be shared equally if the centre of gravity (COG) is placed equally between the pick points.
If the weight of the load is 10 000 kg, then each sling will have a load of 5 000 kg and each shackle and eye bolt will also have a load of 5 000 kg.

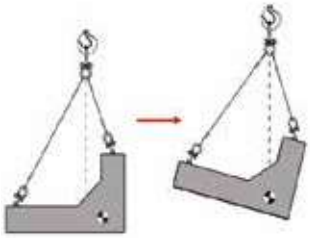
When the centre of gravity (COG) is not equally spaced between the pick points, the slings and fittings will not carry an equal share of the load. The sling connected to the pick point closest to the centre of gravity will carry the greatest share of the load.

Sling 2 is closest to COG. It will have the greatest share of the load.

Sling 2 : 10 000 x 8 / (8 + 2) = 8 000 kg
Sling 1 : 10 000 x 2 / (8 + 2) = 2 000 kg

LOAD STABILITY AND THE CENTRE OF GRAVITY

Connection to the load must be made above the centre of gravity. If not, the load is unstable and will shift. Keep distance from COG to sling as large as possible.



CALCULATE WEIGHT

4

Crosby SP Consider using Crosby SP loadcells for determining weight and COG calculation.

Example - flats

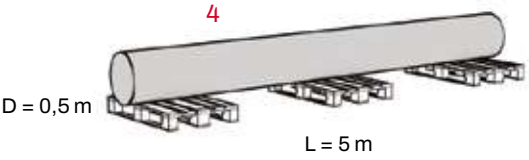
Weight = L x W x H x Unit Weight



If Steel: Unit Weight = 7.85 t/m³
Weight = 5 m x 2 m x 0.1 m x 7.85 t/m³ = 7.85 t
If Aluminum: Unit Weight = 2.64 t/m³
Weight = 5 m x 2 m x 0.1 m x 2.64 t/m³ = 2.64 t
If Concrete: Unit Weight = 2.40 t/m³
weight = 5 m x 2 m x 0.1 m x 2.40 t/m³ = 2.40 t

Example - solid cylinder

$$\text{Weight} = \frac{3.14 \times D^2}{4} \times L \times \text{Unit Weight}$$



If Steel: Unit Weight = 7.85 t/m³
Weight = $\frac{3.14 \times 0.5^2}{4}$ x 5 m x 7.85 t/m³ = 7.70 t
If Concrete: Unit Weight = 2.40 t/m³
Weight = $\frac{3.14 \times 0.5^2}{4}$ x 5 m x 2.40 t/m³ = 2.35 t

Load control
Determining proper WLL of rigging

Know the weight of the load
The weight must include all that is supported

Identify the Centre of Gravity (COG)

Avoid shock loading
Dynamic loading will increase the loading of the rigging gear.
Shock loading will greatly increase the loads and adversely affect the rigging gear.

Module 2 slide 5

NOTES:

Total load = load weight + rigging weight

The load can easily be doubled if load is handled with harsh movements



Module 2 slide 6

How to find the weight

From documentation
- Bills of Ladings
- Reference books
- Drawings and catalogs

Information on the load
- Labels, Tags, Name Plates

Calculate the weight
- Use sections shapes and material density

Weighing the weight
- Scales, Dynamometers, Loadcells



Module 2 slide 7

Consider using loadcells to define the weight of the load.

Calculate weight
Example – steel beam

L = Overall length

Weight = L x Weight Per Unit Length



If I-Beam weight is 32.7 kg/m
Weight = 6 m x 32,7 kg/m = 196,2 kg

Module 2 slide 8

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Calculate weight
Example - steel flats

L = Overall length
W = Overall width
T = Thickness

Weight = W x L x T x Unit Weight



If steel unit weight is 7.849 kg/m^3
Weight = 2 m x 5 m x 0,15 m x 7.849 kg/m^3 = 11.774 kg

Module 2 slide 9

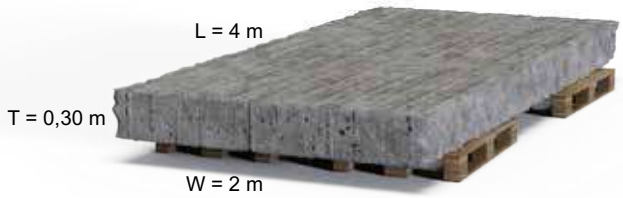
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Calculate weight
Example - concrete slabs

L = Overall length
W = Overall width
T = Thickness

Weight = W x L x T x Unit Weight



If concrete unit weight is 2.403 kg/m^3
Weight = 2 m x 4 m x 0,3 m x 2.403 kg/m^3 = 5.767 kg

Module 2 slide 10

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NOTES:

MATERIAL	WEIGHT IN KILOGRAMS PER CUBIC METRE
Aluminium	2 700
Brass	8 500
Brick	2 100
Coal	1 450
Copper	8 800
Concrete	2 403
Earth	1 600
Iron-steel	7 700
Lead	11 200
Magnesium	1 750
Oil	800
Paper	1 120
Water	1 000
Wood	800

Calculate weight
Example - solid cylinder

Weight = $\frac{3.14 \times D^2}{4}$ x L x Unit Weight



If concrete unit weight is 2.403 kg/m³

Weight = $\frac{3,14 \times (0,50\ m)^2}{4}$ x 20 m x 2.403 kg/m³ = 9.432 kg

Module 2 slide 11

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NOTES:

MATERIAL	WEIGHT IN KILOGRAMS PER CUBIC METRE
Aluminium	2 700
Brass	8 500
Brick	2 100
Coal	1 450
Copper	8 800
Concrete	2 403
Earth	1 600
Iron-steel	7 700
Lead	11 200
Magnesium	1 750
Oil	800
Paper	1 120
Water	1 000
Wood	800

Rig to the Centre of Gravity

Centre of Gravity (COG) is directly below the load hook.



Module 2 slide 12

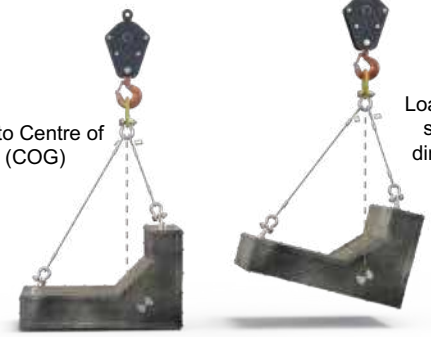
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Good load control starts with rigging to the centre of gravity.

Rigging to the centre of gravity requires that the main load hook be placed over the centre of gravity. The slings must then be connected securely to the load so that they surround and capture the centre of gravity.

Load stability and the Centre of Gravity



Not rigged to Centre of Gravity (COG)

Load is unstable and will shift. COG will move directly below the hook

Module 2 slide 13

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A load properly rigged to its centre of gravity will lift level and will not tip over. If the load is not rigged to its centre of gravity, the load will shift as it is raised. The centre of gravity will move until it is below the load hook.

Centre of Gravity (COG)

With regularly shaped loads, the position of the centre of gravity can be easily judged by measuring out the midpoint in each direction.



Module 2 slide 14

NOTES:

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Centre of Gravity (COG)

For complex loads, it may be necessary to visualize the load in simple sections.

When the weight and centre of gravity of each section is determined, the total weight and the location of the centre of gravity can be found.

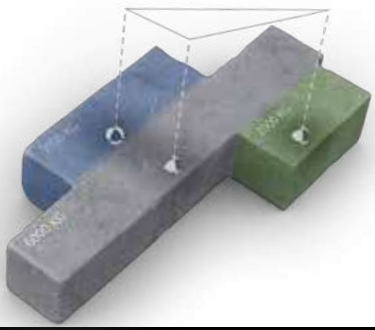


Module 2 slide 15

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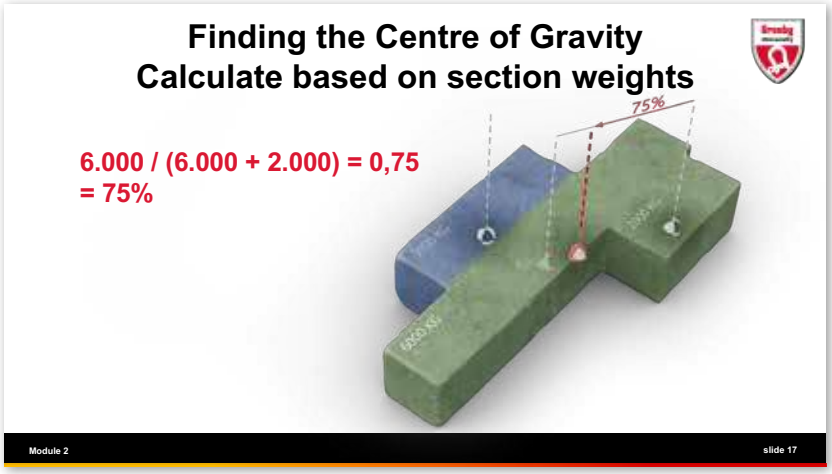
Finding the Centre of Gravity
Calculate based on section weights



Module 2 slide 16

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NOTES:

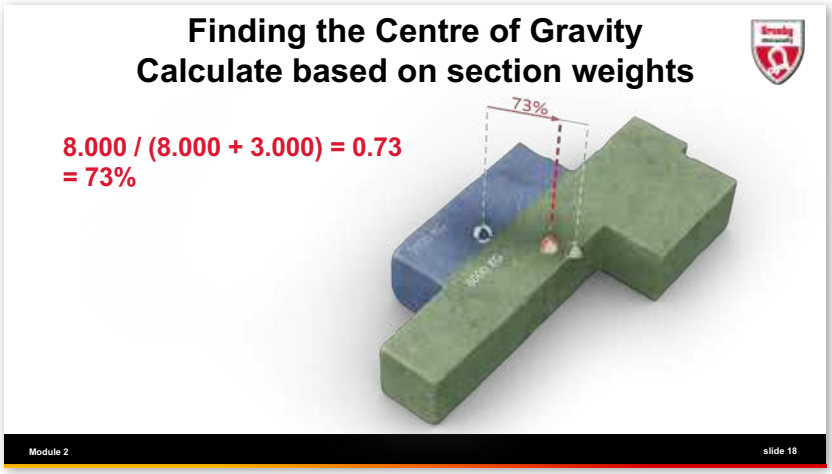
It is possible to calculate the centre of gravity of a complex shape by “breaking” it into simple sections. The weight and centre of gravity (COG) of each section can be determined and used to determine weight and COG of the total load. The COG will be within the area outlined by the lines connecting the centre of gravity of each section.

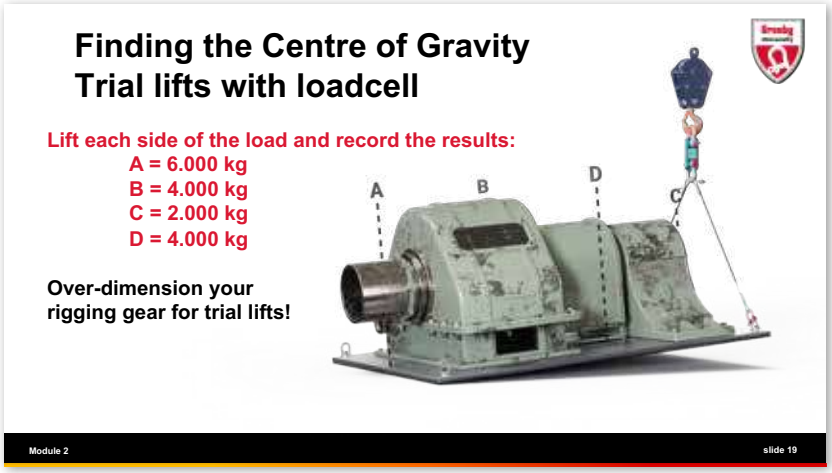
Total weight =
3000 kgs + 6000 kgs + 2000 kgs = 11000 kgs.

Take two of the sections and determine the COG and weight together by adding the weights and placing the COG on a line between each section’s COG.
The COG will be closer to the heavier section, proportional to the section’s weight. The heavy weight is 6000 kgs. the total weight of both sections is 8000 kgs. The COG is 3/4 or 75% of the distance toward COG of heavy end.

Continue this process until all of the sections are added to the load. The heavy weight is 8000 kgs (combined loads). The total weight is 11000 kgs. The COG is 73% of distance toward COG of combined loads.

This technique can be used mathematically with graph paper or marked on the load using chalk.





It is possible to systematically determine the centre of gravity of a complex shape by using a loadcell to weigh each side of the load. The weights are recorded and the results used to calculate the location of the centre of gravity.

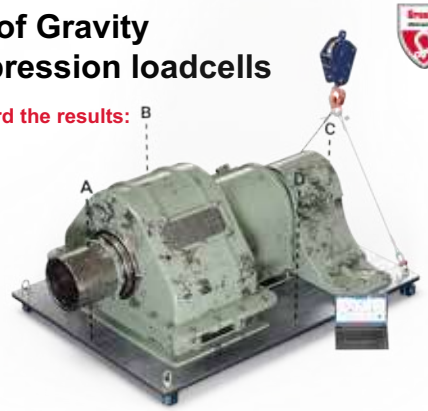
The pivot point (cribbing) of load must be directly under the lifting points.

The total weight of the load is the sum of the weight of two opposing sides. The centre of gravity is located closer to the heavier side, proportional to the side’s weight.

The heavy end “A” is 6 tons. Total weight is 8 tons. The COG is 3/4 or 75% towards “A” end.

Finding the Centre of Gravity
Trial lifts with compression loadcells

Lift each side of load and record the results:
A = 6.000 kg
B = 4.000 kg
C = 2.000 kg
D = 4.000 kg



Module 2 slide 20

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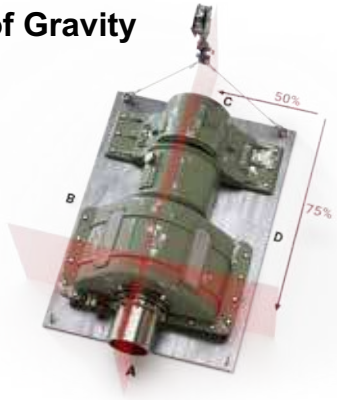
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Finding the Centre of Gravity
Trial lifts

Total weight is
A + C = 6.000 + 2.000 = 8.000 kg
Or
B + D = 4.000 + 4.000 = 8.000 kg

The COG is located
6.000 / 8.000 toward end "A"
or 75%

The COG is located
4.000 / 8.000 toward side "D"
or 50%



Module 2 slide 21

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Finding the Centre of Gravity
Trial lifts

To find weight on each corner, multiply the "end" load times side percent
Load on:
NW = C weight x B weight / total
= 2.000 x 0,5 = 1.000 kg
NE = C weight x D weight / total
= 2.000 x 0,5 = 1.000 kg
SW = A weight x B weight / total
= 6.000 x 0,5 = 3.000 kg
SE = A weight x D weight / total
= 6.000 x 0,5 = 3.000 kg

Total = 1.000 + 1.000 + 3.000 + 3.000 = 8.000 kg
The same as figured earlier.



Module 2 slide 22

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NOTES:

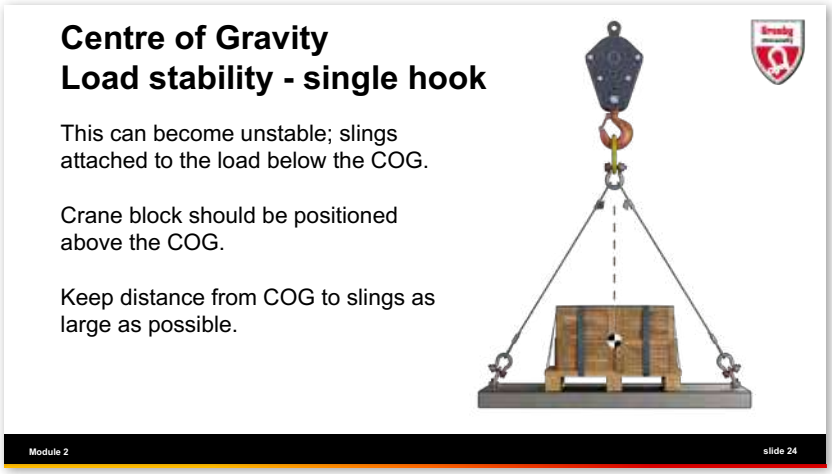
Connected to our wireless centre of gravity software (INSIGHT) the WNI compression loadcell can be used to weigh and verify the centre of gravity of large and heavy objects which may not be evenly proportioned. The system will report weight on each individual loadcell, total weight and COG in an HTML report based on ISO 19901.



NOTES:

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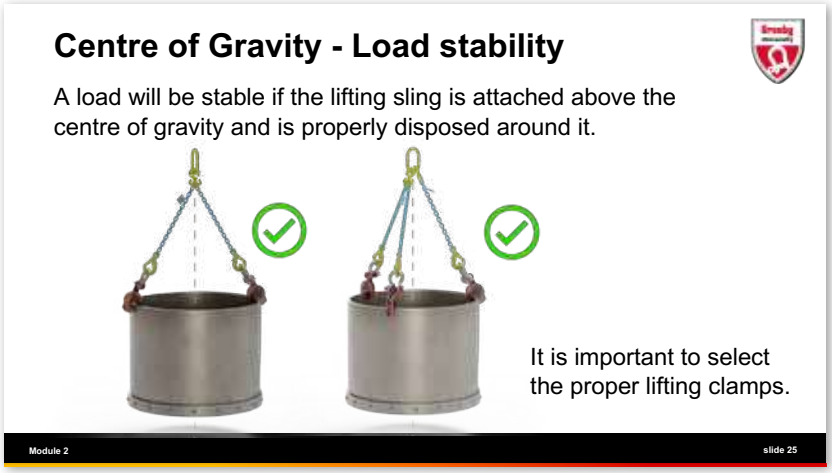
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The rigger needs to make sure that the COG does not get outside the sling legs. If that occurs, it will topple the load.

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It is important to select the proper lifting clamps.

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Centre of Gravity
Load stability

On occasions, particularly when using a single leg, it may be neccessary to lift a load, such as a drum, with the sling positioned a short distance away from the centre of gravity. The load, when lifted, will then take up a tilted position but will be inherently stable.





It is important to select the proper lifting clamps.

Module 2 slide 26

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Is stability a problem?



Module 2 slide 27

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Selecting slings & hitches for improved load control

Select the sling to be used considering:

The hitch to be used,
The load that will be applied,
The rigging environment.



Module 2 slide 28

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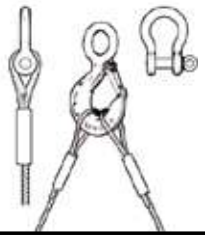
NOTES:

It is important to select the proper lifting clamp. Consider using 2 clamps of type IPVK on a 2-leg sling for improved load control and stability.

WIRE ROPE, CHAIN AND SYNTHETIC SLINGS

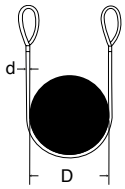
WIRE ROPE SLINGS AND CONNECTIONS TO FITTINGS

Use a thimble to protect sling and to increase D/d ratio. Never place eye over a fitting with a smaller diameter or width than the rope's diameter.

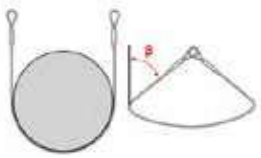


Never place a sling eye over a fitting with a diameter or width greater than one half the length of the eye. 1/3(L) for synthetic slings.





BASKET HITCH

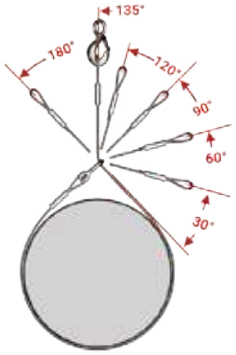


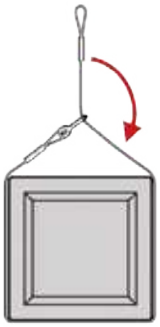
A basket hitch has twice the capacity of a single leg only if the D/d ratio ≥ 25/1 and legs of sling are vertical.
At other angles, see table.

Angle β	Percentage of single leg capacity
0°	200%
30°	170%
45°	140%
60°	100%

CHOKER HITCHES

A choker hitch has a maximum capacity of 80% of the single leg sling only if the angle of choke is 120 degrees or greater.





Angle of choke	Sling rated load percentage of single leg sling capacity
120° - 180°	80%
90° - 119°	65%
60° - 89°	55%
30° - 59°	40%



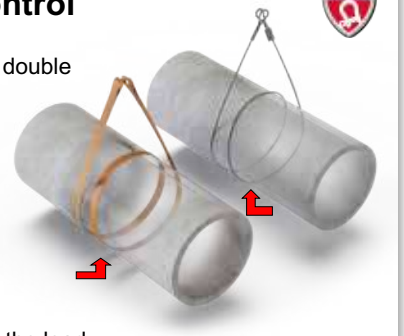
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Basket hitch and load control

For more contact with the load, use a double wrap basket hitch.





Do not overlap slings at the bottom of the load.

Module 2 slide 31

NOTES:

Single wrap basket hitches only provide good load control when the load traps the sling.

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Choker hitch and load control



A single wrap choker hitch does not provide 360 degrees contact with the surface.



A block of wood between hitch and load improves grip and angle of choke.

(BLOCK OF WOOD MUST BE SECURED TO THE LOAD - FALLING OBJECTS)

Module 2 slide 32

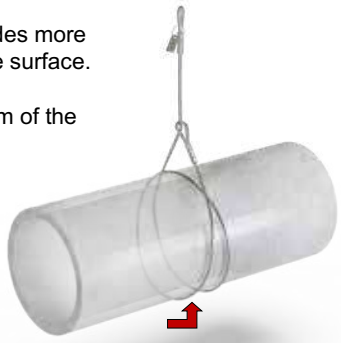
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Double wrap choker hitch and load control

A double wrap choker hitch provides more than 360 degrees contact with the surface.

Do not overlap slings at the bottom of the load.



Module 2 slide 33

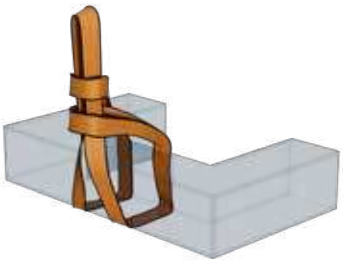
Single wrap choker hitches only provide good load control when the load is short.

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Double wrap choker hitch and load control

A variation of the double wrap choker is formed by placing the belly of the sling through the eyes.



Module 2 slide 34

NOTES:

This type of hitch is used to turn loads. Consider protecting the sling to prevent sling damage.

Two vertical single leg slings and load control

Spreader beams are used to support long and hard to handle loads.

The spreader beam reduces load tipping and bending.



Module 2 slide 35

Two vertical choker hitches and load control

Two choker hitches attached vertically provide good load control over long loads.

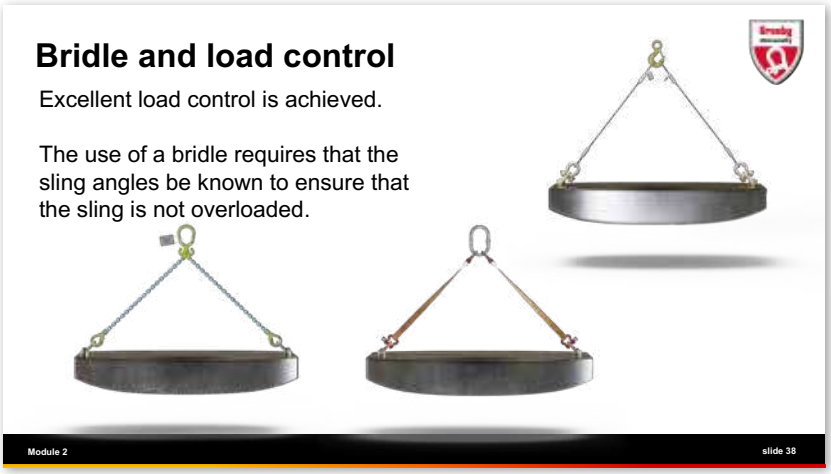


Module 2 slide 36



NOTES:

A double wrap basket hitch increases contact of the slings with the load in this application. Risk for slippage of pipes during movement of the load is reduced with a double wrap basket.





Double leg choker and load control



Chokers alternated | Chokers aligned

The double leg choker has 80% of a bridle at the same sling angle (EN 13414).

Load control is good when vertical sling angle is less than 30 degrees.
On smooth loads, a double wrap is recommended to reduce slippage.

Module 2 slide 40

NOTES:

On smooth loads, a double wrap is recommended to reduce slippage.

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Double leg choker and load control

When choking through the sling eye, alternate to prevent pulling down of the eye.





When using hooks, place hooks with “tips” pointing outward.

On smooth loads, a double wrap is recommended to reduce slippage.

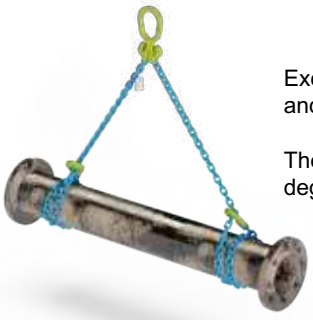
Module 2 slide 41

If both slings are choked the same way, the eyes get pulled down on the load unevenly. By alternating the choke direction between sling legs, the pull on each eye cancels out, keeping everything straighter.

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Double wrap choker and load control



Excellent for handling loose materials and smooth loads.

The hitch has more than a full 360 degrees wrap on the load.

Module 2 slide 42

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Tag Lines



- Place the tagline(s) at points on the load for control during lift-off, traveling and placement.
- The tagline person should never loop the line around his arm or body.
- He should have a clear view of his travel path and the signaler so he can anticipate the load's movement.
- The tagline person will have his/her best control of the load if he/she is trailing the load while traveling with it.

Module 2 slide 43

NOTES:

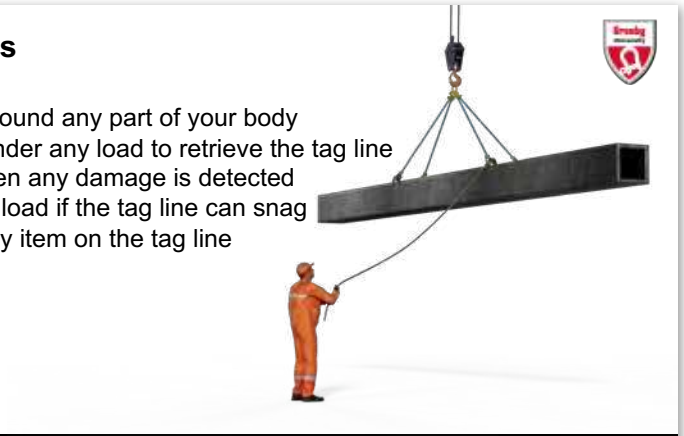
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Tag Lines

Never:

- Wrap around any part of your body
- Move under any load to retrieve the tag line
- Use when any damage is detected
- Raise a load if the tag line can snag
- Land any item on the tag line



Module 2 slide 45

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Discuss load control

1



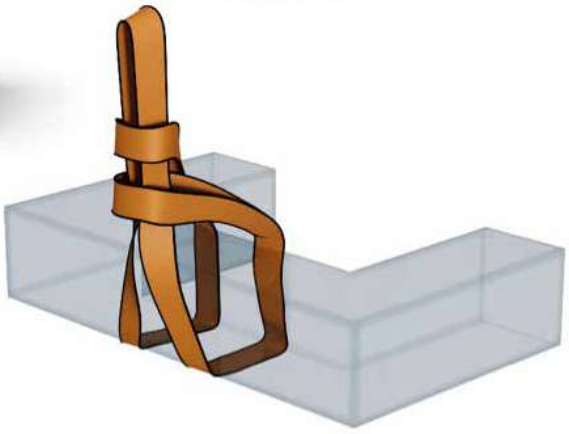
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4



5



6



7



Rigging Principals and Load Control

1. Total load = load weight + _____.
2. _____ will greatly increase the loads and adversely affect the rigging gear.
3. The _____ should be placed directly above the centre of gravity.
4. A tag line may be necessary to assist with _____.
5. Keep distance of centre of gravity to _____ as large as possible.
6. The three basic hitches are vertical, choker and _____.
7. Will the rigging gear be used within _____.
8. Is the load rigged so it will lift level and be _____?
9. Is the location of the _____ known?
10. Do not use a single leg sling to lift loose materials, _____ or any load that can tip.
11. For more contact with the load use a _____ wrap basket or choker hitch.
12. Do not overlap slings at the _____ of the load.

Choose Answer from the Following List

a. double
b. long materials
c. bottom
d. Dynamic loading
e. crane block
f. load control
g. rigging weight
h. slings
i. basket
j. industry standards
k. stable
l. centre of gravity

Welcome to

Loads on rigging & The rigging triangle

3

Based on applicable standards and product application information for

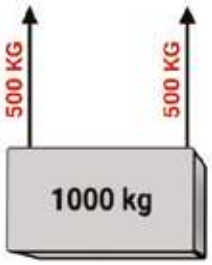
Crosby GUNNEBO Industries

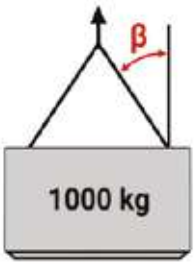
Module 3 slide 1

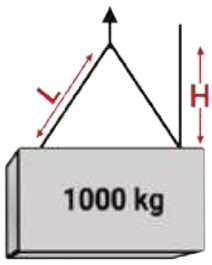
SLING ANGLES

9

Load on each sling = 500 x load angle factor = 500 x L/H



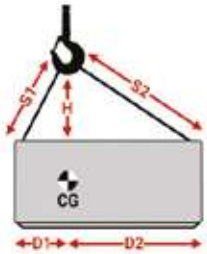




Vertical sling angle β	Load angle factor = L/H
0°	1.00
30°	1.16 (1.2)
45°	1.41 (1.4)
60°	2.00 (2.0)

Load on each sling =
Vertical load x load angle factor

Unequal Sling Leg Length



Sling Load Calculation Formula
Tension 1 = Load x D2 x S1/H (D1+D2)
Tension 2 = Load x D1 x S2/H (D1+D2)

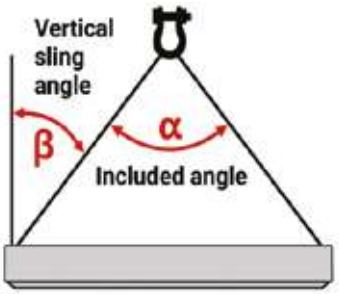
Consider using Crosby SP loadcells for determining sling tension.

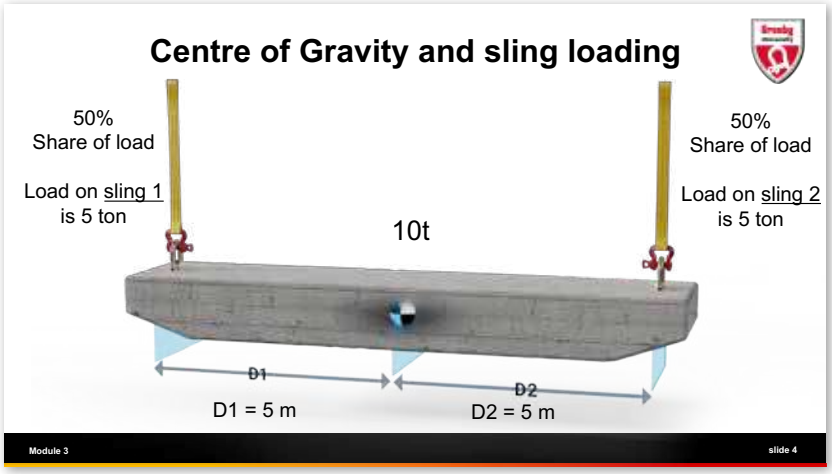
Sling length for desired angle

Vertical angle	Length factor	L/H
60°	1.15	2.00
50°	1.31	1.55
45°	1.41	1.40
40°	1.55	1.30
35°	1.74	1.21
30°	2.00	1.16

Length = D x (length factor)
(D = distance pick-up point –> C.O.G)

Vertical sling angle = 1/2 included angle

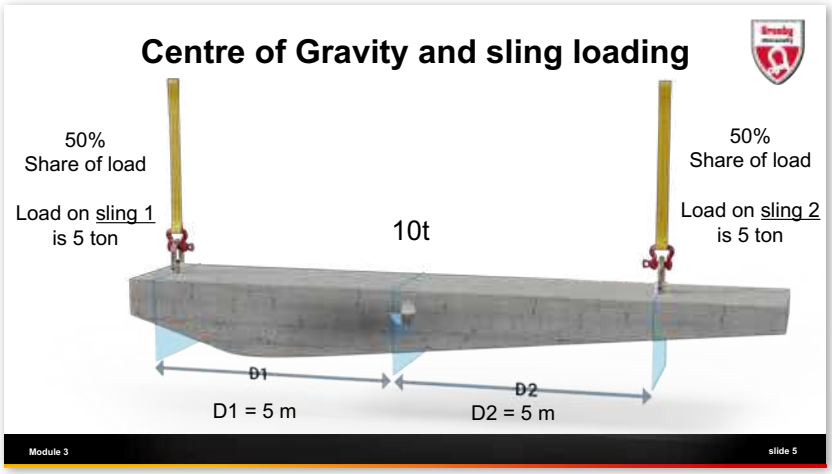




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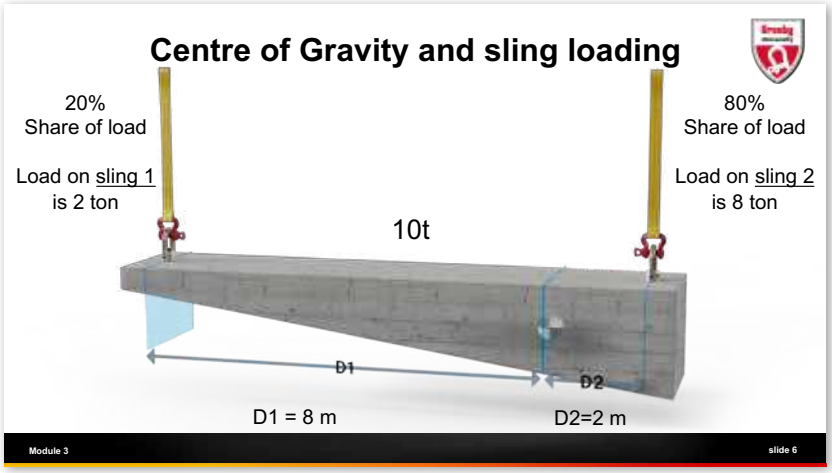
When vertical, the slings will equally share the load if the centre of gravity is spaced equally between the pick points.

If the weight of the load is 10.000 kg, then each sling will have a load of 5.000 kg. Each shackle and hoist ring will also have a load of 5.000 kg.



The location of the centre of gravity relative to the pick points is a very important consideration.

The centre of gravity is still in the middle of both pick points, so each sling will carry 50% of the load.



When the centre of gravity is not equally spaced between the pick points, the slings and fittings will not carry an equal share of the load. The sling connected to the pick point closest to the centre of gravity will carry the greatest share of the load.

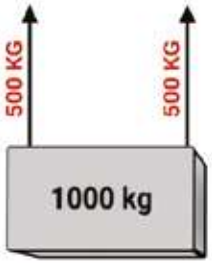
The sling on the right is closest to the COG, it will have the greatest share of load:

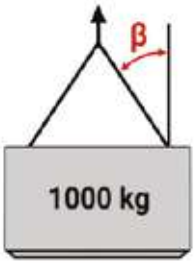
Sling 2 = 10.000 x 8/(8+2) = 8.000 kg

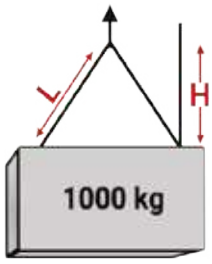
Sling 1 = 10.000 x 2/(8+2) = 2.000 kg

SLING ANGLES

Load on each sling = 500 x load angle factor = 500 x L/H



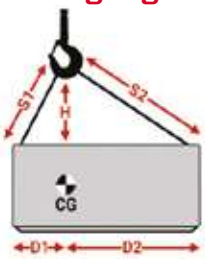




Vertical sling angle β	Load angle factor = L/H
0°	1.00
30°	1.16 (1.2)
45°	1.41 (1.4)
60°	2.00 (2.0)

Load on each sling =
Vertical load x load angle factor

Unequal Sling Leg Length



Sling Load Calculation Formula
Tension 1 = Load x D2 x S1/H (D1+D2)
Tension 2 = Load x D1 x S2/H (D1+D2)

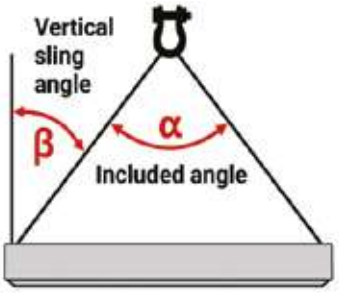
Consider using Crosby SP loadcells for determining sling tension.

Sling length for desired angle

Vertical angle	Length factor	L/H
60°	1.15	2.00
50°	1.31	1.55
45°	1.41	1.40
40°	1.55	1.30
35°	1.74	1.21
30°	2.00	1.16

Length = D x (length factor)
(D = distance pick-up point –> C.O.G)

Vertical sling angle = 1/2 included angle



The rigging triangle
Basic facts

- Angular or side loading can occur at load.
- Sling length affects vertical sling angles.
- 30° vertical angle or smaller is best, 60° is worst choice.
- As the vertical angle becomes bigger, the load is "crushed" and slings work harder.
- The fittings at load connection see the same load as the sling.

Module 3 slide 8

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When the centre of gravity is in the middle of the 2 vertical lifting slings, each sling will take 50% of the load. In this example, the weight of the load is 10t, so each sling will carry 5t.

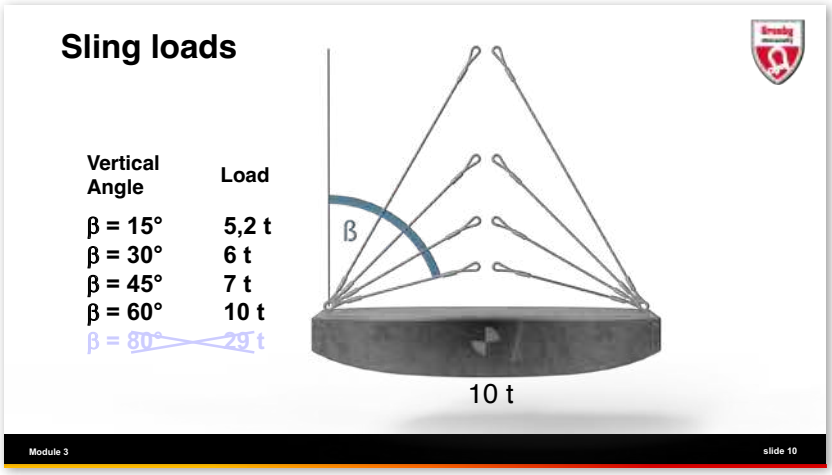
When creating a vertical angle, the slings will need to work harder to lift the same load.

Load on each sling (Resultant Load on sling) = Vertical Load x Load Angle Factor

Vertical Load, also referred to Vertical Share, is the effect of the vertical lifting force.

Load Angle Factor is the effect of the crushing force on the sling due to vertical angle.

Example: With a load weight of 10t and the centre of gravity equally spaced between the pick points, the vertical load on each sling would be 50% of the load weight or 5t on each sling.

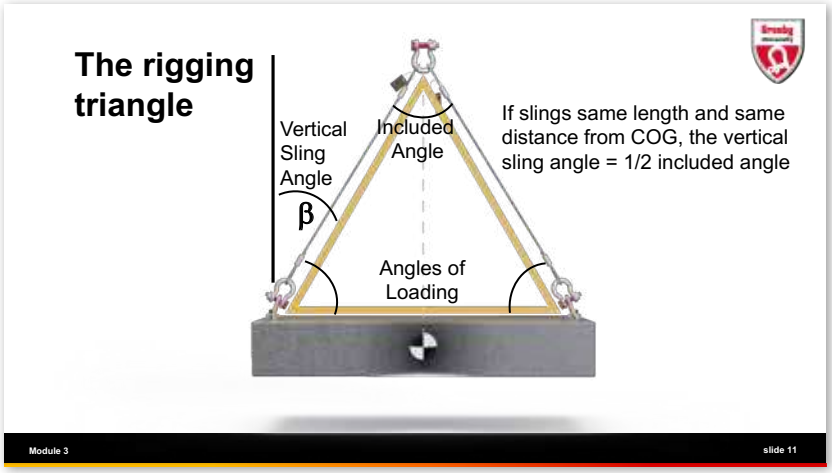


The vertical sling angle is measured between the perpendicular line and the sling leg.

The maximum vertical sling angle allowed is 60 degrees if slings are collected by a shackle or master link.

The maximum vertical sling angle is 45 degrees if slings are placed directly into load hook.

The maximum vertical sling angle is 30 degrees if using choker or basket hitch at the load. 30 degrees or smaller vertical sling angle is always recommended.



1. The included angle at the load hook or collector ring is checked for proper connection.

2. The vertical sling angle is an important factor to help determine the loads placed on each leg of the sling. The vertical sling angles will be equal only if the sling lengths are the same and the centre of gravity is equally spaced between the pick points.

3. The included angle plus the horizontal sling angles will add up to equal 180 degrees.

ASME B30.9 refers to angle of loading for reference.

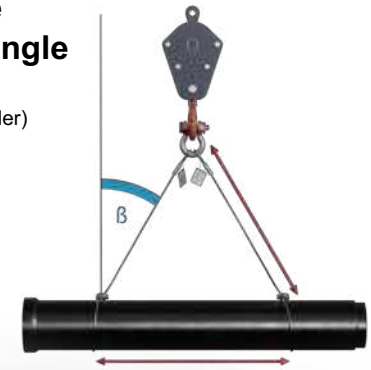
The rigging triangle
30 degree vertical angle

You have a 30 degree (or smaller) vertical sling angle when:

Length of sling

is **equal to** or **longer than**

distance between pick points



Module 3 slide 12

NOTES:

A vertical sling angle of 30 degrees (or smaller) is the preferred choice and is achieved when the sling length is equal to (or greater than) the distance between the pick points.

This rule of thumb only works when the slings are same length and COG is in the middle of two pick points.

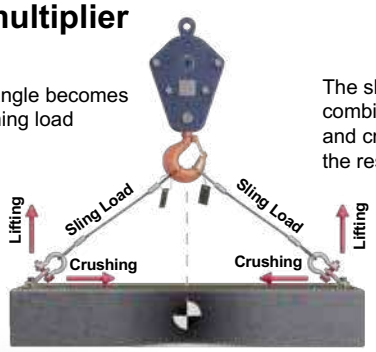
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The load multiplier

As the vertical angle becomes larger, the crushing load increases.

The sling sees the combined effects of lifting and crushing, known as the resultant load.



Module 3 slide 13

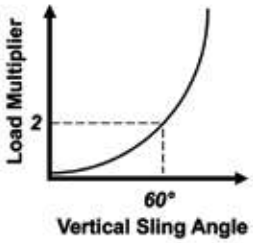
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The load multiplier

Vertical Sling Angle			
30°	45°	60°	80°
Load Multiplier (L/H)			
1,155 (1,2)	1,414 (1,4)	2 (2)	5,789 (6)

Sling load = vertical load x multiplier



As the vertical sling angle approaches 60°, the multiplier increases significantly.

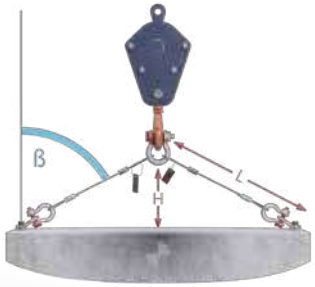
Above 60°, the multiplier increases even more dramatically.

Never allow a vertical sling angle greater than 60°.

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The vertical sling angle L/H and the load multiplier



L/H = load multiplier

Module 3 slide 15

NOTES:

In the rigging triangle, if you take the length of the sling (L), bearing point to bearing point, and divide by the drop (H), you have the load multiplier.

When slings are placed in a shackle or master link, the maximum included angle is 120 degrees.

Measure vertical sling angle by use of L/H



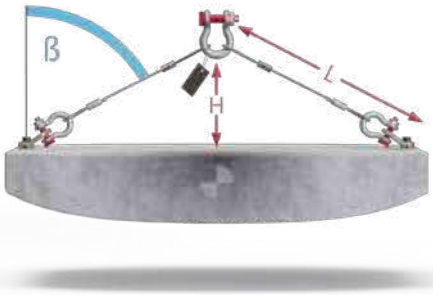
L/H = Load Multiplier

L/H	Angle
1.155 (1.2)	30 Degrees
1.414 (1.4)	45 Degrees
2	60 Degrees

Module 3 slide 16

The use of L/H offers us several tools that can be used in rigging. The most basic tool is that the sling angle can be measured by use of a tape measure.

Calculate the load in each sling leg by use of L/H



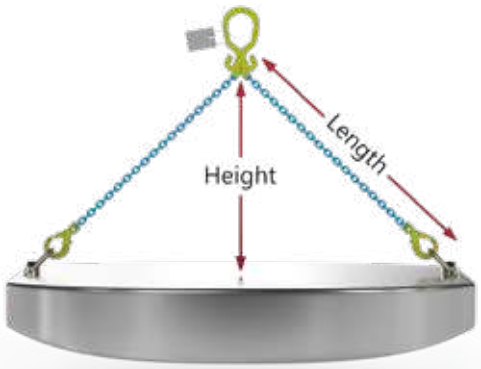
L/H	Load
1.2	1.2 x 5 t = 6 t
1.4	1.4 x 5 t = 7 t
2	2 x 5 t = 10 t

Module 3 slide 17

A powerful tool is the use of L/H to calculate the load in each sling leg and in the fitting at the load connection.

Remember that the load multiplier increases the vertical load (the load if the slings were pulling straight up).

Use L/H to measure sling angle



Use L/H to measure angle and refer to rigging card for sling size

Load weight is 4.000 kg

L	2.0 m	2.0 m	2.0 m
H	1.7 m	1.4 m	1 m
L/H			
Vertical angle			
Sling size **Gr80**			

Crosby

CHAIN SLING CAPACITIES - GRADE 8/80

GUNNEBO Industries

6



CHAIN SIZE mm	VERTICAL (t) (single leg)	TWO LEG SLINGS (t)		THREE AND FOUR LEG SLINGS (t)		CHOKER t
		0°< β ≤ 45°	45°< β ≤ 60°	0°< β ≤ 45°	45°< β ≤ 60°	
6	1.12	1.60	1.12	2.36	1.70	0.90
7	1.50	2.12	1.50	3.15	2.24	1.20
8	2.00	2.80	2.00	4.25	3.00	1.60
10	3.15	4.25	3.15	6.70	4.75	2.50
13	5.30	7.50	5.30	11.20	8.00	4.25
16	8.00	11.20	8.00	17.00	11.80	6.40
19	11.20	16.00	11.20	23.60	17.00	9.00
20	12.50	17.00	12.50	26.50	19.00	10.00
22	15.00	21.20	15.00	31.50	22.40	12.00
26	21.20	30.00	21.20	45.00	31.50	17.00
32	31.50	45.00	31.50	67.00	47.50	25.20

Triple leg slings have 50% more capacity than double leg only if the centre of gravity is in the centre of connection point and the legs are adjusted properly. (Equal share of the load) Quad leg slings offer improved stability but do not provide increased lifting capacity. Always use the individual sling tag to verify the slings capacty. Chart above is for general planning information only. Capacities in accordance with EN818-4.

INSPECTION OF CHAIN LINKS

All slings and attachments shall be visually inspected by the person handling the sling each day they are used. In addition, a periodic inspection shall be performed by a designated person, at least annually, and shall include a record of the inspection.

INSPECTION CRITERIA

Wear
Nicks, cracks, breaks, gouges, stretch, bends
Weld spatter
Excessive temperature
Throat opening of hook

CHAIN LINKS

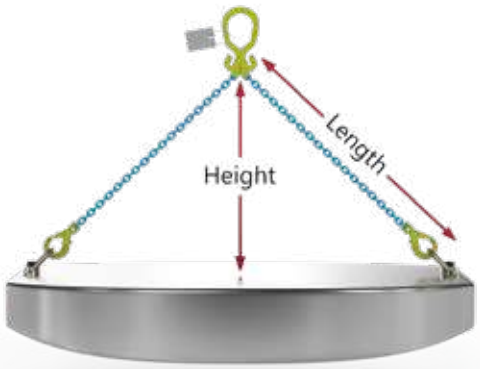
Remove sling from service if links are worn excessively (more than 10% or refer to manufacturer's information), sharp transverse nicks and gouges should be rounded out by grinding (do not exceed wear allowance). Chain links and attachments should hinge freely to adjacent links.

IDENTIFICATION

Chain slings shall have permanently affixed identification stating: size, grade, rated load, vertical sling angle, name of manufacturer and CE (EN818-4)

Use L/H to measure sling angle

Use L/H to measure angle and refer to rigging card for sling size



Load weight is 4.000 kg

L	2.0 m	2.0 m	2.0 m
H	1.7 m	1.4 m	1 m
L/H			
Vertical angle			
Sling size **Gr100**			

Crosby

CHAIN SLING CAPACITIES - GRADE 10/100

GUNNEBO Industries

7



CHAIN SIZE MM	VERTICAL (t) (single leg)	TWO LEG SLINGS (t)		THREE AND FOUR LEG SLINGS (t)		CHOKER t
		0°< β ≤ 45°	45°< β ≤ 60°	0°< β ≤ 45°	45°< β ≤ 60°	
6	1.40	2.00	1.40	3.00	2.12	1.12
7	1.90	2.65	1.90	4.00	2.80	1.60
8	2.50	3.55	2.50	5.30	3.75	2.00
10	4.00	5.60	4.00	8.00	6.00	3.20
13	6.70	9.50	6.70	14.00	10.00	5.35
16	10.00	14.00	10.00	21.20	15.00	8.00
19	14.00	20.00	14.00	30.00	21.20	11.20
20	15.60	21.25	15.60	33.10	23.75	12.50
22	19.00	26.50	19.00	40.00	28.00	15.00
26	26.20	37.50	26.50	56.00	40.00	21.20
32	40.00	56.00	40.00	85.00	60.00	32.50

Triple leg slings have 50% more capacity than double leg only if the centre of gravity is in the centre of connection point and the legs are adjusted properly. (Equal share of the load) Quad leg slings offer improved stability but do not provide increased lifting capacity. Always use the individual sling tag to verify the slings capacty. Chart above is for general planning information only. Capacities based on EN818-4 WLL +25%.

INSPECTION OF CHAIN LINKS

All slings and attachments shall be visually inspected by the person handling the sling each day they are used. In addition, a periodic inspection shall be performed by a designated person, at least annually, and shall include a record of the inspection.

INSPECTION CRITERIA

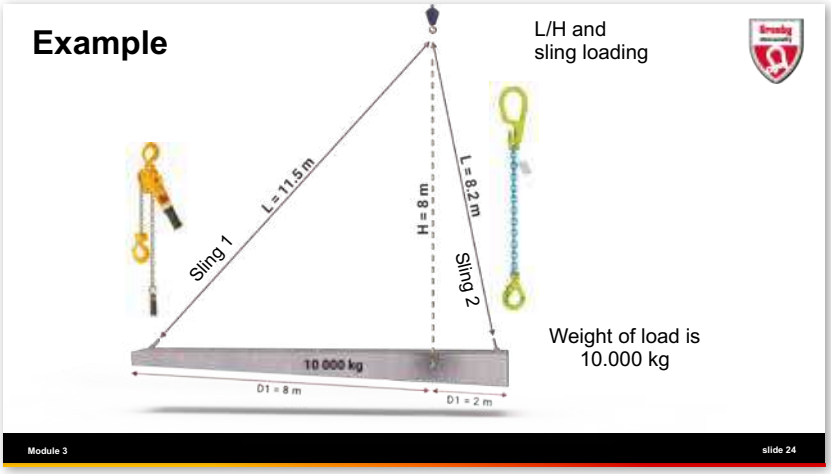
Wear
Nicks, cracks, breaks, gouges, stretch, bends
Weld spatter
Excessive temperature
Throat opening of hook

CHAIN LINKS

Remove sling from service if links are worn excessively (more than 10% or refer to manufacturer's information), sharp transverse nicks and gouges should be rounded out by grinding (do not exceed wear allowance). Chain links and attachments should hinge freely to adjacent links.

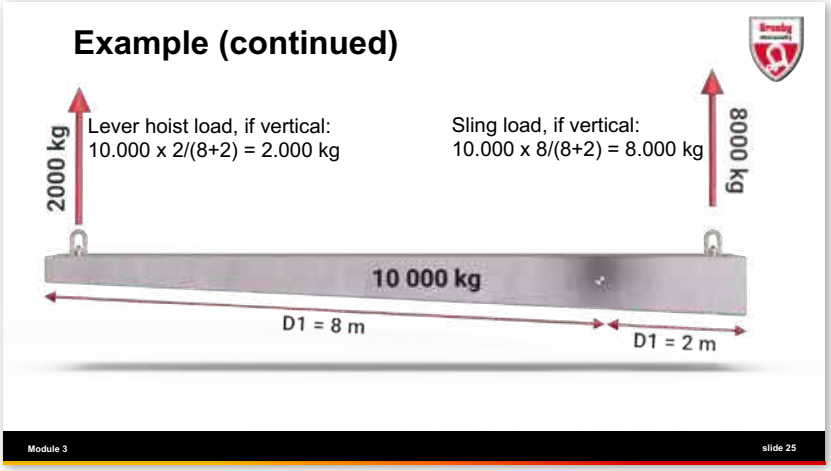
IDENTIFICATION

Chain slings shall have permanently affixed identification stating: size, grade, rated load, vertical sling angle, name of manufacturer and CE (EN818-4)

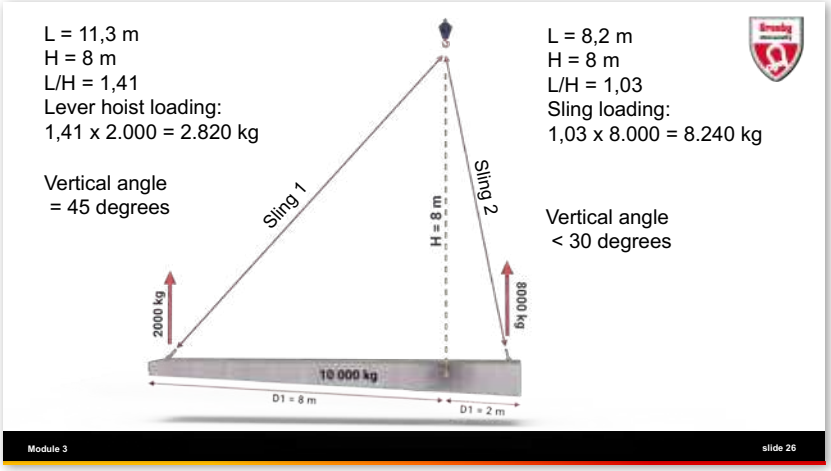


NOTES:

In this example, the COG is not in the middle of the 2 pick points lifting the load. However, the use of the load multiplier L/H is still useful to determine the load on each sling leg.



First, determine the load each leg would carry in vertical position.

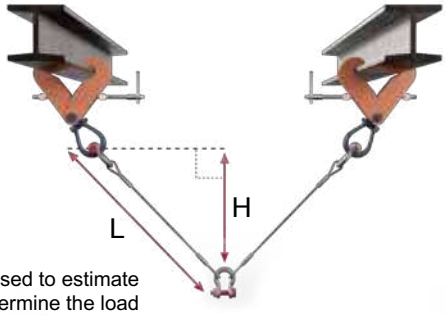


Calculate the load multiplier (L/H) for each side and multiply with the vertical load (the load if the slings were pulling straight up) for each side separately.

Left side vertical load: 2.000 kg
L/H = 11,3/8 = 1,41
Load in Sling 1 = 1,41 x 2.000 kg = 2.820 kg

Right side vertical load: 8.000 kg
L/H = 8,2/8 = 1,03
Load in Sling 2 = 1,03 x 8.000 kg = 8.240 kg

L/H inverted



L/H can also be used to estimate angles and to determine the load multiplier when inverted.

Module 3 slide 27

3 and 4-legged slings

It is wrong to assume that a 3 or 4-leg hitch will have a capacity directly based on the number of legs.



Module 3 slide 28

Rating of multi-leg slings for general service (symmetrically arranged)

The method of rating slings for general service used in the EN-standards removes the need for calculation since **the sling has a fixed WLL for a given range of angles** (0°-45° and 45°-60°)

Since the upper terminal of the sling assembly, e.g. Master link, will have been selected to match the stated WLL of the sling, the sling should not be re-rated by the traditional method for angles smaller than the maximum quoted since the upper terminal will not be strong enough.

Module 3 slide 29

NOTES:

In the inverted rigging triangle, if you take the length of the sling (L), bearing point to bearing point, and divide by the drop (H), you have the load multiplier.

Rating of multi-leg slings for general service (symmetrically arranged)

This method of rating assumes that each leg is at the same angle to vertical, that for three and four leg slings the legs are equally disposed when viewed in plan, and that all legs are in use. **The WLL of a 4 leg sling is calculated assuming that one leg is redundant.**

This method is often referred to as the uniform method.

Module 3 slide 30

NOTES:

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Slings and WLL: uniform method

EN-standards use the uniform method, permitting only:

- One WLL up to a vertical angle of 45°
- A reduced WLL at vertical angles between 45° and 60°

Single leg sling	1 x WLL of a single leg
2-leg sling 0 - 45°	1.4 x WLL of a single leg
2-leg sling 45°- 60°	1 x WLL of a single leg
3 and 4-leg slings 0 - 45°	2.1 x WLL of a single leg
3 and 4- leg slings 45°- 60°	1.5 x WLL of a single leg

FlexiLeg

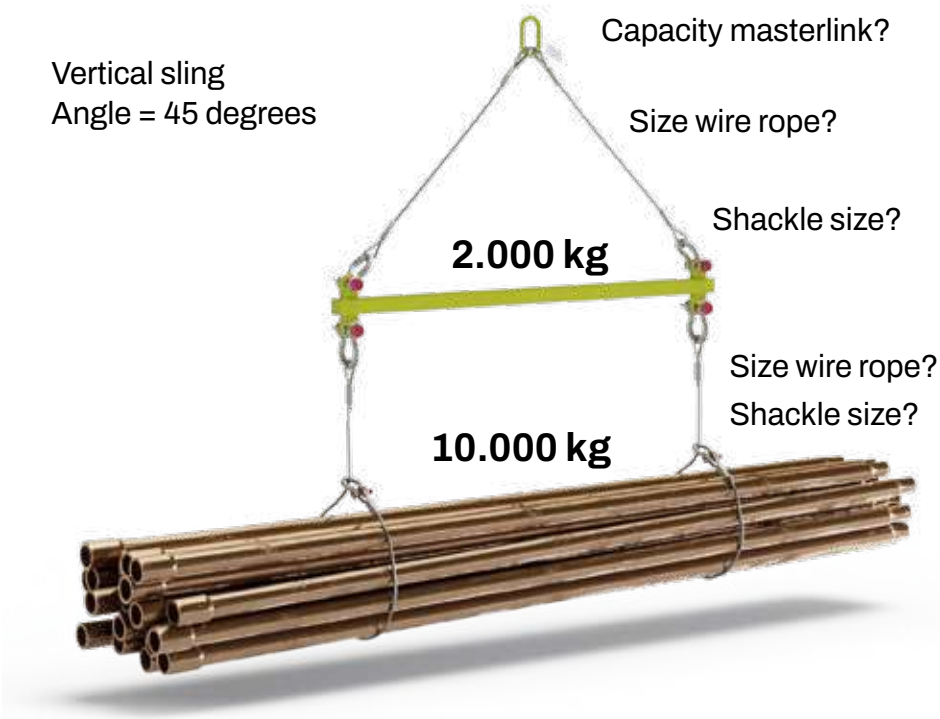


Module 3 slide 31

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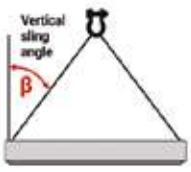
Determine the loads placed on each sling



WIRE ROPE SLING CAPACITIES

5

WORKING LOAD LIMITS FOR SLINGS USING STEEL CORED ROPE OF CLASSES 6X19, 6X36 AND 8X36 AND HAVING FERRULE-SECURED EYE TERMINATIONS - TENSILE STRENGTH 1770 KN/MM² - DESIGN FACTOR 5 / 1

WIRE ROPE SIZE		Crosby Q&T CARBON SHACKLE MIN. SHACKLE SIZE FOR A D/d >1 AT LOAD CONNECTION						
MM	MBL (kN)	SHACKLE SIZE (INCH)	VERTICAL (single leg) t	CHOKER t	TWO LEG SLINGS		THREE AND FOUR LEG SLINGS	
					0°< β ≤ 45° t	45°< β ≤ 60° t	0°< β ≤ 45° t	45°< β ≤ 60° t
8	40.3	3/8	0.75	0.60	1.05	0.75	1.55	1.10
10	63.0	7/16	1.15	0.92	1.60	1.15	2.40	1.70
12	90.7	1/2	1.70	1.36	2.30	1.70	3.55	2.50
13	106	5/8	2.00	1.60	2.80	2.00	4.15	3.00
14	124	5/8	2.25	1.80	3.15	2.25	4.80	3.40
16	161	3/4	3.00	2.40	4.20	3.00	6.30	4.50
18	204	7/8	3.70	2.96	5.20	3.70	7.80	5.65
20	252	7/8	4.60	3.68	6.50	4.60	9.80	6.90
22	305	1	5.65	4.52	7.80	5.65	11.80	8.40
24	363	1-1/8	6.70	5.36	9.40	6.70	14.00	10.00
26	426	1-1/8	7.80	6.24	11.0	7.80	16.50	11.50
28	494	1-1/4	9.00	7.20	12.50	9.00	19.00	13.50
32	645	1-3/8	11.80	9.44	16.50	11.80	25.00	17.50
36	817	1-1/2	15.00	12.00	21.00	15.00	31.50	22.50

Rated capacities (t) based on pin diameter or hook no larger than the natural eye width (1/2 x eye length) or less than the nominal sling diameter. Turnback efficiency: k = 0.9 Flemish eye termination offers a higher efficiency. Refer to EN 13414-1 for full details, vertical sling angles greater than 60° are not recommended! Always use the individual sling tag to verify the slings capacity. Chart above is for general planning information only.

The Rigging Triangle

1. The rigging triangle is formed when _____.
2. The total of all angles inside the rigging triangle is _____.
3. Use a collector ring anytime the included angle exceeds _____.
4. A vertical sling angle greater than 60° is _____.
5. A vertical sling angle of 30° is _____.
6. A vertical sling angle of 45° is _____.
7. As the sling length is increased, the vertical sling angle is _____.
8. L/H is the _____.
9. As the vertical sling angle becomes greater, the slings _____.
10. As the vertical sling angle becomes greater, the _____ increases.
11. The fittings at the load connection see a load _____ to the sling.
12. A vertical sling angle at 30°, the _____ is equal to the distance between the pick points.
13. When the _____ is equally spaced between the pick points, the slings will share equal loads.
14. The sling connected _____ to the centre of gravity will carry a greater share of the load.
15. DO NOT use a _____ as a collector.
16. A 60° vertical share sling angle has a load multiplier of _____.
17. If L/H is > 2, then _____.
18. If L/H = 1.4, the vertical sling angle is _____.

Choose Answer from the Following List

a. preferred
b. not allowed
c. allowed
d. 90°
e. centre of gravity
f. multiple legs are collected
g. decreased
h. 180°
i. load multiplier
j. closest
k. 45°
l. sling length
m. round pin shackle
n. work harder
o. re-rig to smaller vertical
p. crushing load
q. equal
r. 2

Welcome to

Application of hoist hooks, shackles and links

4

Based on applicable standards and product application information for

Crosby GUNNEBO Industries

Module 4 slide 1

Crosby

RIGGING HARDWARE

11

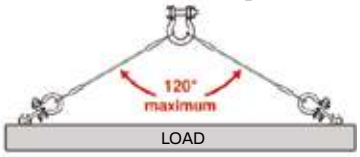
SHACKLES

Fatigue Rated Q&T QUIC-CHECK

HOOKS

G209 G2130 t	G209A G2140* t	CARBON & ALLOY SHACKLES QUENCHED AND TEMPERED				CARBON STEEL WLL		ALLOY STEEL WLL		O THROAT OPENING	A-A INDICATOR*
		D	B	A	C	t	CODE	t	CODE	mm	mm
1	2	9.65	11.20	16.80	36.60	0.75	DC	1.25	DA	22.6	38.1
1.5	2.6	11.20	12.70	19.10	42.90	1.0	FC	1.6	FA	23.1	50.8
2	3.3	12.70	16.00	20.60	47.80	1.6	GC	2.5	GA	25.4	50.8
3.25	5	15.70	19.10	26.90	60.50	2.0	HC	3.2	HA	27.7	50.8
4.75	7	19.10	22.40	31.80	71.50	3.2	IC	5.4	IA	34.5	63.5
6.5	9.5	22.40	25.40	36.60	84.10	5.0	JC	8.0	JA	40.9	76.2
8.5	12.5	25.40	29.50	42.90	95.50	7.5	KC	11.5	KA	53.0	102
9.5	15	29.50	31.80	46.00	108.00	10.0	LC	16.0	LA	57.5	102
12	18	32.80	35.80	51.60	119.00	15.0	NC	22.0	NA	76.5	127
13.5	21	36.10	39.60	57.20	133.00	20.0	OC	31.5	OA	82.5	165
17	30*	38.90	42.20	60.50	146.00	25.0	PC	37.0	PA	76.0	178
25	40*	46.70	51.60	73.20	178.00	30.0	SC	45.0	SA	86.0	203
35	55*	52.60	57.90	82.60	197.00						
55	85*	69.10	70.60	105.00	267.00						

- WLL is based on in-line loading; side loading will reduce the rated working load limit.
- Use a bolt type shackle for permanent installation.
- Use a bolt type shackle anytime the sling or any object may contact the pin causing the pin to rotate.



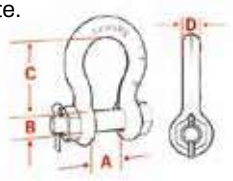
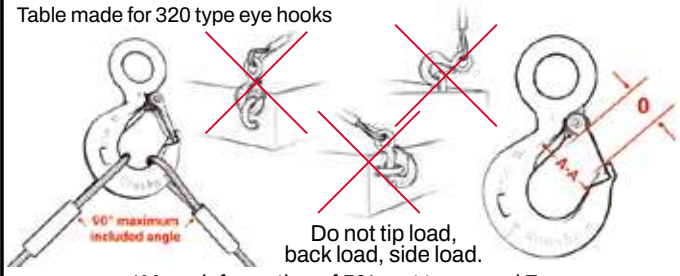


Table made for 320 type eye hooks



Do not tip load, back load, side load.

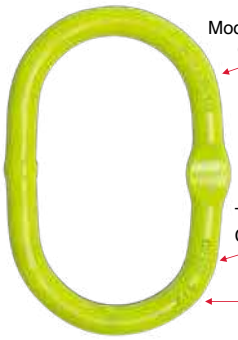
*Max. deformation of 5%, not to exceed 7mm

For additional information refer to the Crosby catalogue

Masterlink identification

Masterlinks

- Must have:
  - Company stamp
  - H32 mark
  - Traceability code
  - Trade size
  - Model name
  - Model size
  - Grade

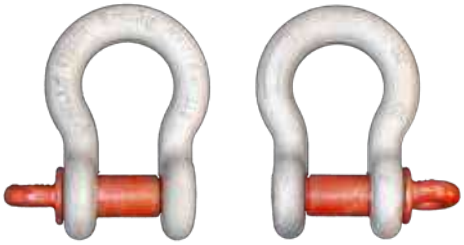


EN 1677

Module 4 slide 9

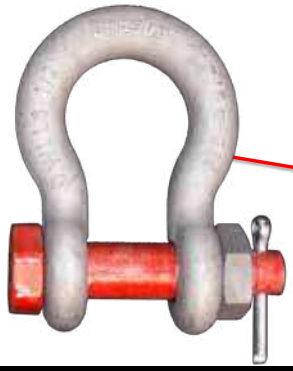
Identification

Crosby’s Product Identification Code (PIC) meets all the requirements of a **Traceability System**



Module 4 slide 5

Identification = Traceability



First character =
Manufacturing plant

Second character =
Year of manufacture

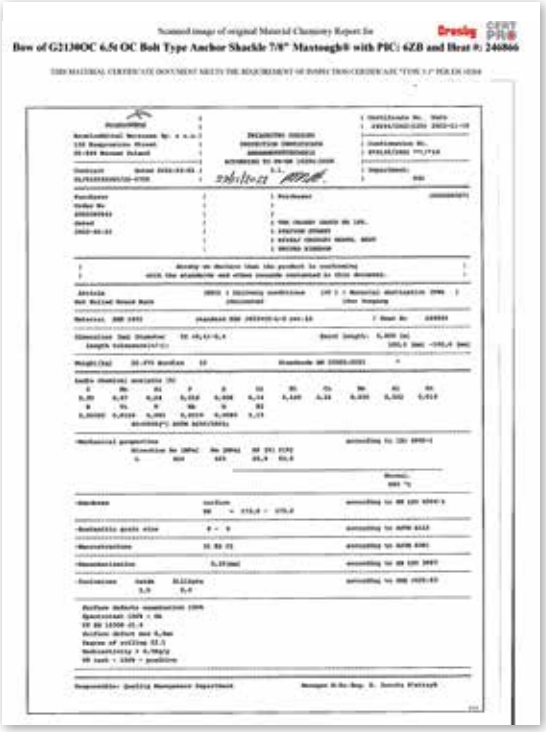
Third character =
Run during that year
(Changes per run and per heat)

EN 13889

Module 4 slide 6

NOTES:

All slings must be protected against edges and abrasive surfaces with materials of sufficient strength and thickness to prevent damage and catastrophic sling failure.



Bow of G2130OC 6.5t OC Bolt Type Anchor Shackle 7/8" Mastough® with PIC: 6ZB and Heat #: 240866

See Crosby Application and Warning Information found in the back of the Kito Crosby catalog for more information.

The sequence of the characters in the Product Identification Code (PIC) can change.

Currently, the year of manufacturing is the first character in the PIC, the manufacturing facility is the second character.

Alloy steel chain slings
Gunnebo chain identification



Description of new markings:

1. Country of origin: “SWE”
2. Manufacturers’ ID: “CG”
3. Grade: “10G”
4. Batch code – year: 1 letter (e.g. “B” for 2020)
5. Batch code – batch: number between 1 and 999 (e.g. 1 for the 1st batch of above stated year)

Markings every 20 links, or at least every meter.

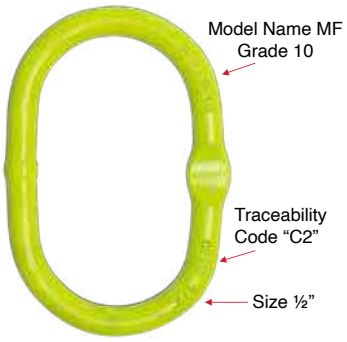
EN 818

Module 4 slide 8

Masterlink identification

Masterlinks

- Must have:
  - Company stamp
  - H32 mark
  - Traceability code
  - Trade size
  - Model name
  - Model size
  - Grade



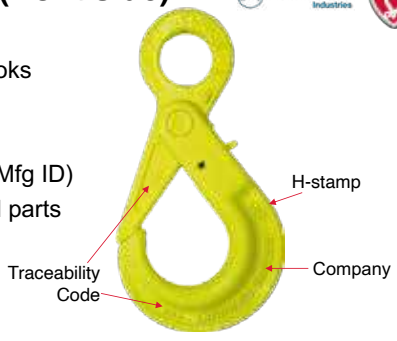
EN 1677

Module 4 slide 9

Hook identification (front side)

Hooks (front side)

- Same on couplers and hooks
- Must have:
  - Company stamp
  - H32 mark (Gunnnebo Mfg ID)
  - Traceability code on all parts (latch and body)
  - Model name
  - Model size
  - Grade



EN 1677

Module 4 slide 10

NOTES:

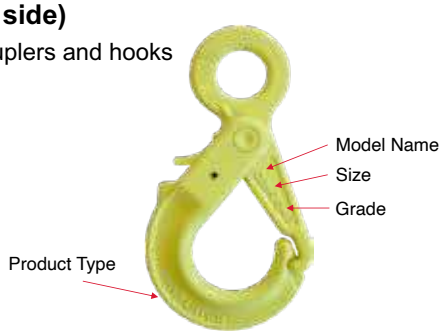
Crosby & Gunnebo use the Product Identification Code (PIC) to maintain material control from the steel mill, to receipt at our plant, to verification, and throughout the manufacturing process.

We can provide certified material analysis for each production lot, traceable by the PIC. Through our own laboratory, we verify the analysis of each heat of steel and only purchase special bar forging quality steel with specific cleanliness requirements and guaranteed harden-ability.

Hook identification (back side)

Hooks (back side)

- Same on couplers and hooks



EN 1677

Module 4 slide 11

NOTES:

Risk management
Crosby product traceability

Crosby PIC

- Manufacturing location
- Year of manufacture
- Set up date of manufacture

Crosby Record Keeping

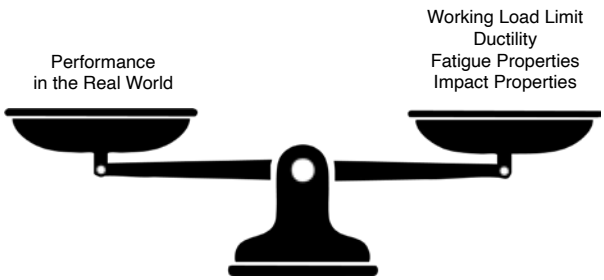
- Heat treatment records
- Testing and field records
- Steel heat and manufacturer

Module 4 slide 12

In 1977, Crosby is the first to use a comprehensive Product Identification Code (PIC) to maintain material control from the steel mill through the manufacturing process.

All load bearing components contain a PIC.

Balanced performance characteristics



Module 4 slide 13

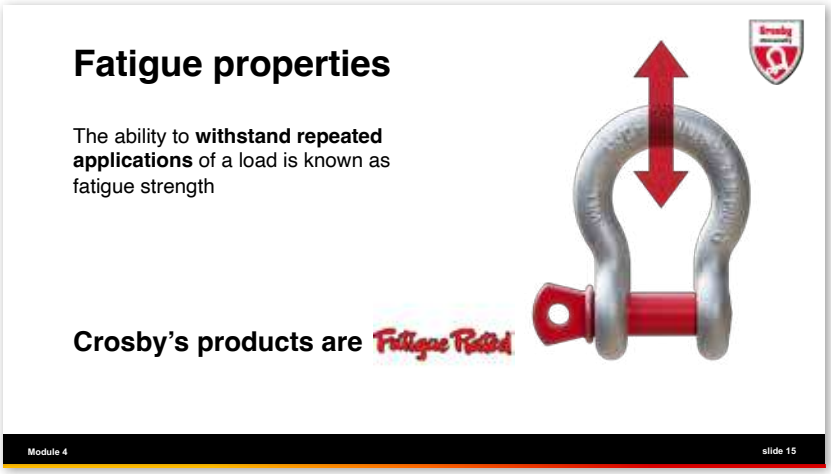
In order to have outstanding performance of lifting & rigging equipment in the real world in different applications and at various environmental conditions, it is critical to have balanced performance characteristics.



NOTES:

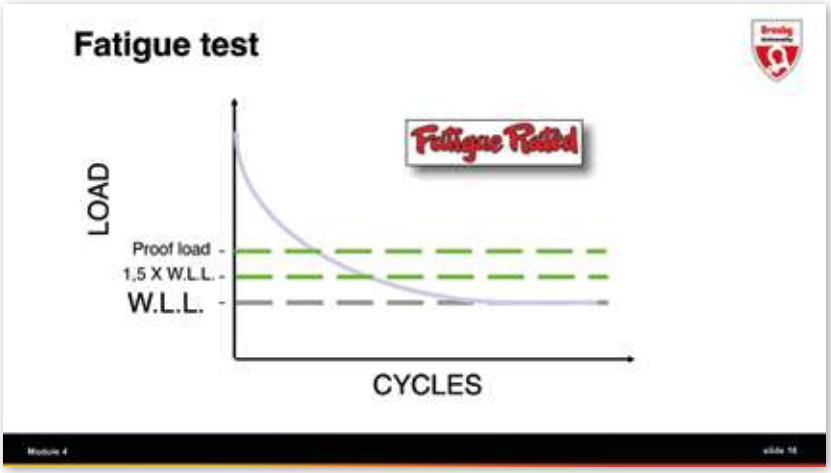
The tensile strength determines the actual allowable working load limit.

Ductility allows the product to deform when overloaded.



Fatigue testing determines the ability of a material to withstand repeated applications of the load. One accepted method of fatigue rating hardware is to test them to 1,5 times the working load limit for 20.000 cycles, without failure. This standard test is accepted as indicating indefinite life when used within the working load limit under normal circumstances (non-pulsating).

Kito Crosby specifies material of specific cleanliness and guaranteed harden-ability. This effort enhances the fatigue properties.

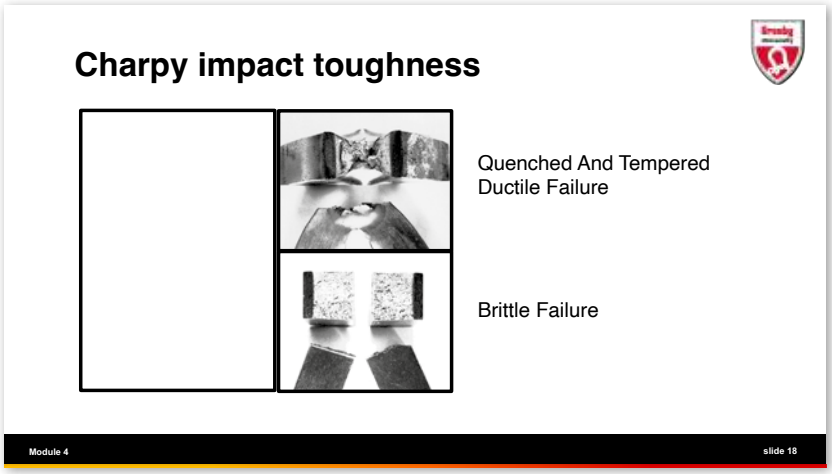




NOTES:

The properties of steel when a load is rapidly applied (shock) is known as its impact strength or toughness. The charpy v-notch impact test is the accepted method of performing the testing and measurement of toughness.

Crosby's quenched and tempered hardware has better resistance to crack initiation and crack growth at all temperatures.

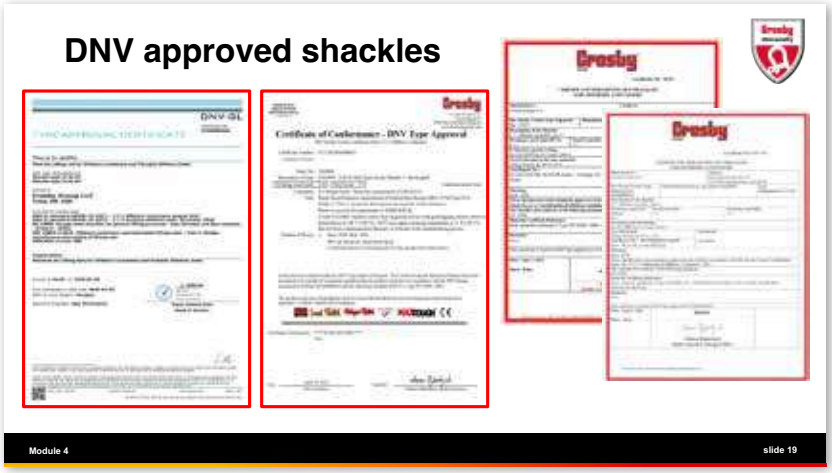


Crosby's quenched and tempered products have excellent performance at all operating temperatures.

Quenching and tempering of the proper steels has been found to be the best heat treatment to fully develop these properties. The quenched and tempered product will deform before ultimate failure, thus giving warning.

The quenching process is a rapid cooling in water or oil, after heating, to form a strong but ductile structure.

The tempering process is the reheating of the product for a predetermined time. The product obtains the desired strength while increasing the ductility.



DNV 2.7-1 standard covers lifting sets for offshore containers. Hardware must meet impact requirements of 42 joules at -20° C.

Type approval requires:

1. A Type Approval certificate that verifies that the product design complies with the referenced standard(s) and,

2. A manufacturing survey (MSA) that verifies that the manufacturing location has been verified as capable of making the product.

3. A product certificate must be made available that verifies that the product shipped meets the requirements of the Type Approval and MSA. This product certificate must reference a serial number or PIC and is issued for each product produced.

Storage and work environment

- Store in an area where it will not be subjected to damage, corrosive action, or extreme heat
- The strength can be affected by chemically active environments such as caustic or acid substances or fumes
- Consult the manufacturer before using in chemically active environments

ASME B30.26

Module 4 slide 21

Elevated temperature service Crosby hardware

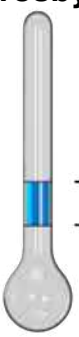


No loss of strength while used between -40° C and 204° C

No permanent loss of strength after used at or below 260° C

Module 4 slide 22

Cold temperature service Crosby hardware



At temperatures below -18° C, required good rigging practices include:

- Lifting at slow steady rate
- Increased lubrication schedule
- Visual inspection before each lift
- Removal of all nicks, gouges
- Removal from service if welded or modified in field (after leaving the factory)
- Periodic inspection by dye penetrant or magna-flux if user determines it is necessary

Module 4 slide 24

NOTES:

Elevated Temperature Service
Crosby forged and cast steel products can be used in general service conditions up to temperatures of 400° F (204° C). The following should be considered when operating up to temperatures of 400 ° F (204° C).

1. Products that contain non-ferrous materials, and lubricants, plastics, etc. may be adversely affected by high temperatures, and typically should not exceed 200° F (93° C).

2. Galvanized, plated or painted fittings may suffer some or total degradation of the surface finish.

3. Extended exposure to elevated temperatures can cause severe surface scaling and significant permanent reduction of properties.

4. Repeated heating and cooling to room temperatures can result in temper embrittlement.

For other operating temperatures or products, contact Crosby Engineering.

Low Temperature Service
Crosby forged and cast steel products can be used in general service conditions down to temperatures of -40° F (-40° C). McKissick blocks can be used in general service conditions down to temperatures of -4° F (-20° C).
At temperatures from 0° F to -40° F (-18° C to -40° C), good rigging practice requires special attention in the following areas:

1. Lifting should be performed at a steady rate. Shock loading should be avoided.

2. Equipment containing bearings should have increased inspection and maintenance schedule, and may require special lubrication.

3. All lifting equipment should be given a thorough visual inspection before each lift.

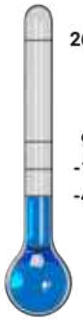
4. Remove nicks, gouges, or cracks by grinding (5% maximum material removal).

5. Do not use fittings that have been welded or modified after leaving the factory.

6. If determined to be necessary by the user, lifting equipment should undergo periodic inspection by dye penetrant or magnetic particle inspection.

For operation at temperatures below -40° F (-40° C), consider “Cold Tuff” products or contact Crosby Engineering.

Cold temperature service
Crosby hardware



- Load ratings on Crosby equipment are valid for general service conditions down to temperatures of -40° F (-40° C)
- Follow specific recommended rigging practices when using below 0° F (-18° C)
- Consult Crosby engineering for temperatures below -40° F (-40° C)

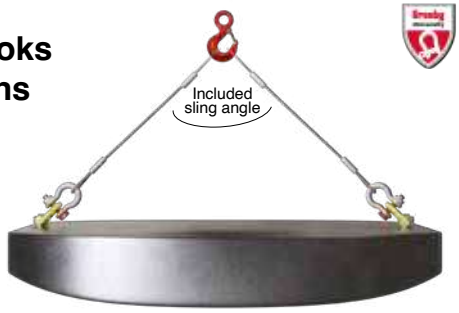
Module 4 slide 25

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Application of hooks
Key considerations

Latch
Seating
Included angle
Hook size
Hook material



Module 4 slide 26

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Typical hoist hooks



Module 4 slide 27

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NOTES:

Crosby also provides ROV hooks.



L-562A ROV shank hook



L-320R ROV eye hook

Rigging practices
Hooks in direct pull

- Loading shall be centered in the base of hook to prevent point loading of the hook
- Hooks shall not be used in such a manner as to a side load or back load on the hook



ASME B30.10

Module 4 slide 28

NOTES:

Hooks
Improper loading



DO NOT
tip load, side load or back load hoist hooks

Module 4 slide 29

ASME B30.10 provides several basic operating (rigging) practices that personnel using hooks shall be aware of:

1. The weight of the load to be lifted does not exceed the load rating of the hook or the load rating of the equipment of which the hook is a part.

2. Shock loading should be avoided.

3. The load shall be centred in the base (bowl/ saddle) of the hook to prevent point loading of the hook.

4. Hooks shall not be used in such a manner as to apply side load or back load on the hook.

5. Hands, fingers, and body shall be kept from between hook and load.

Rigging practices
Hooks in direct pull

Duplex hooks shall be equally loaded on both sides

If duplex hook loaded at pin hole, the load applied shall not exceed the rated load



ASME B30.10

Module 4 slide 30

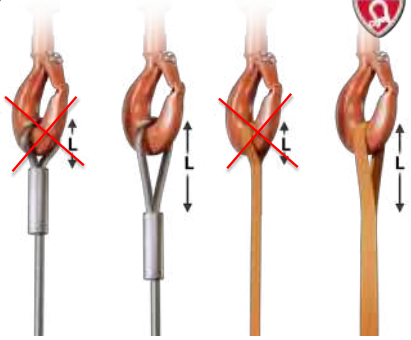
6. Duplex (sister) hooks shall be loaded equally on both sides unless the hook is specifically designed for single loading. When using an articulated duplex (sister) hook, care should be taken because articulation of the hook may cause instability in the sling load.

7. If the duplex (sister) hook is loaded at the pin hole instead of at the two saddles, the load applied shall not exceed the rated load that would normally be shared by the two saddles or the rated load of the supporting equipment.

Connection of slings to hooks

Do not open sling eye greater than 50% of eye length

Thickness of hook must be less than 1/2 L



Note: Per WSTDA & ASME B30.9 synthetic sling eyes: thickness of hook must be less than 1/3 L

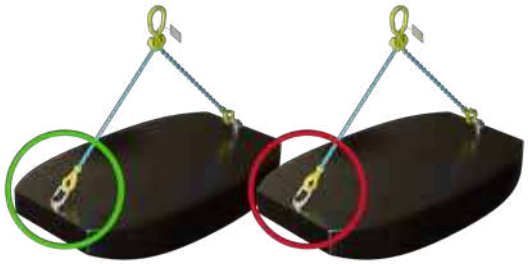
Module 4 slide 31

NOTES:

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Orientation of hooks at load



Place hooks with tips pointing outward

Module 4 slide 32

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Orientation of hooks at load



Place hooks with tips pointing outward

Module 4 slide 33

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Crosby QUIC-CHECK®
Hoist hooks



Angle indicators indicate the maximum included angle which is allowed between two (2) sling legs in the hook.

Angle indicators

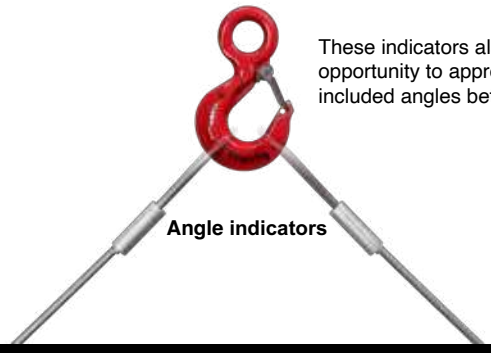
Module 4 slide 34

NOTES:

Crosby's Quic-Check angle indicators indicate the maximum included angle which is allowed between two sling legs in the hook.

For angles greater than 90 degrees, or more than two legs, a collector ring should be used to attach the legs of the sling to the hook.

Crosby QUIC-CHECK®
Hoist hooks



These indicators also provide the opportunity to approximate other included angles between two sling legs.

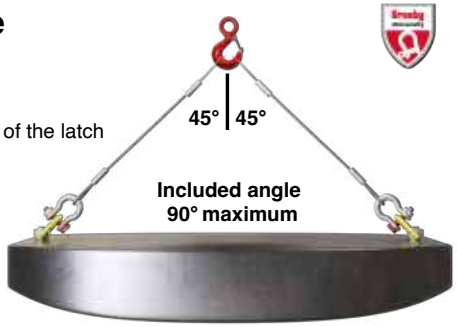
Angle indicators

Module 4 slide 35

The included angle
Hoist hooks

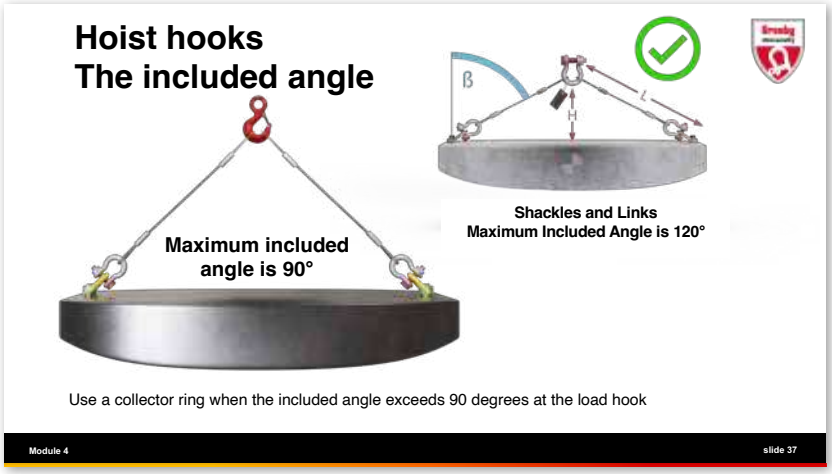
The slings must sit in the base of the hook and clear of the latch

The Working Load Limit is valid for a single leg or multiple legs as long as the included angle does not exceed 90 degrees



Module 4 slide 36

When placing 2 slings directly in a hook, the maximum allowed included angle is 90° (45° from vertical).

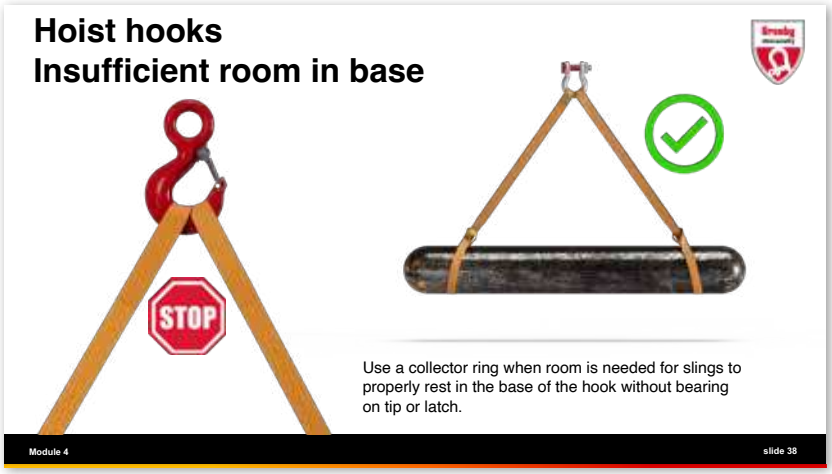


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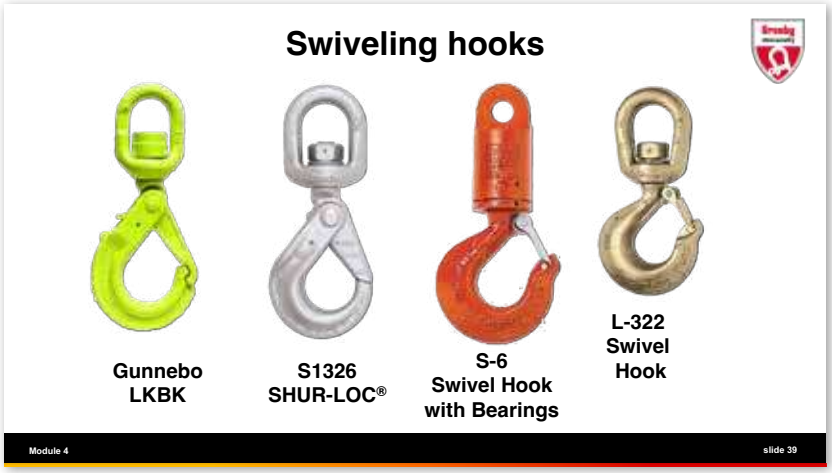
With an included angle greater than 90 degrees, use an intermediate link such as a master link or bolt-type shackle to collect the legs of the slings.

The intermediate link can be placed over the hook to provide an in-line load on the hook. This approach must also be used when using slings with three or more legs.

The maximum vertical sling angle is 45 degrees if slings are placed directly into load hook.



Slings should not overlap as they could damage each other due to the weight of the load.



Swivel hoist hooks
Types

Positioning hooks **(washers only, no bearing)** are intended to swivel before the load is applied

Hooks with **ball bearings** can rotate under full load

Hooks with **roller bearings** can rotate under full load

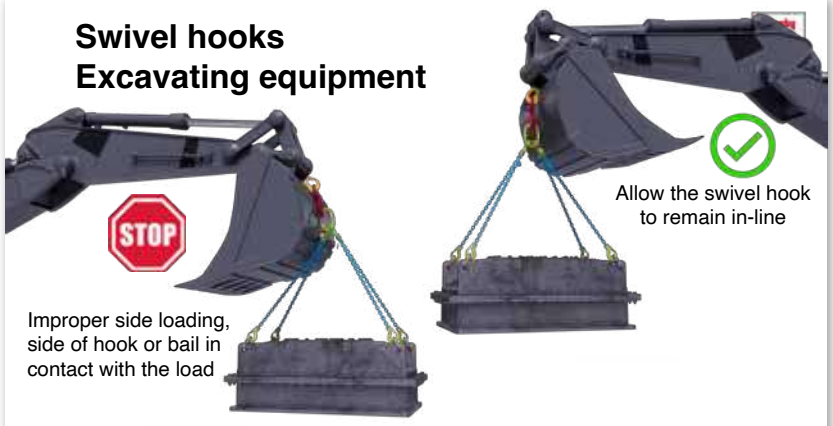
Module 4 slide 40

NOTES:

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Swivel hooks
Excavating equipment



Module 4 slide 41

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Latch purpose

"Where required, a latch shall be provided"

The requirement is indicated by the type of hoist equipment being used.

The purpose of a latch is to bridge the throat opening of the hook, for the purpose of retaining slings or other devices under slack rigging conditions only.

The latch is not intended to support the load.



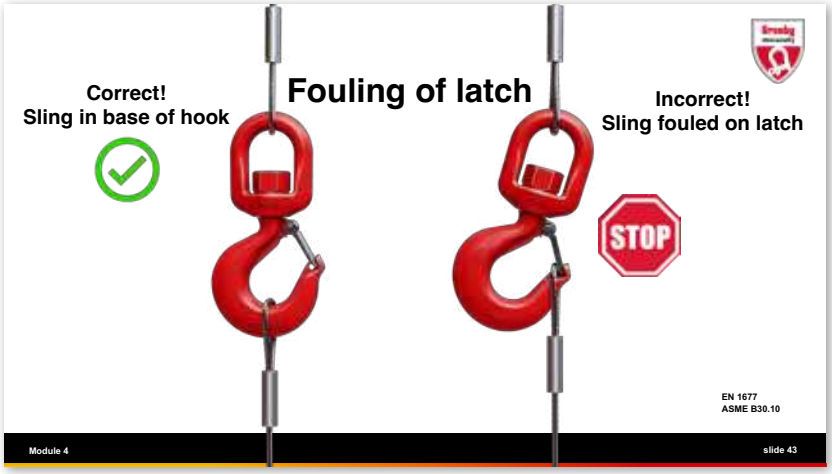
EN 1677
ASME B30.10

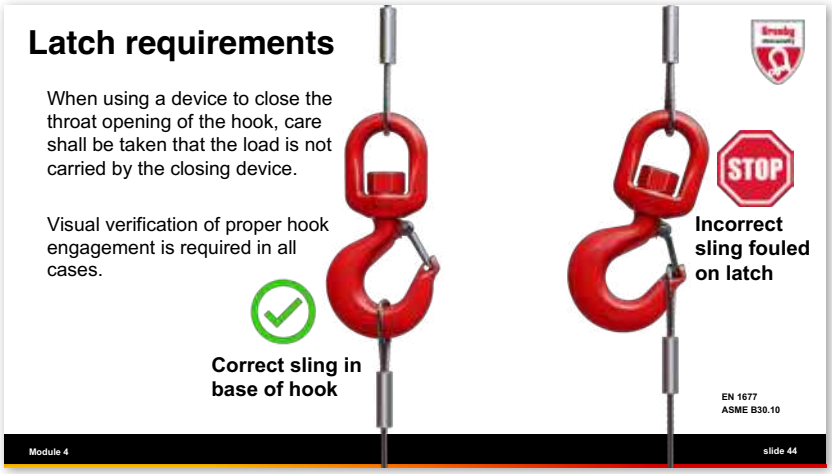
Module 4 slide 42

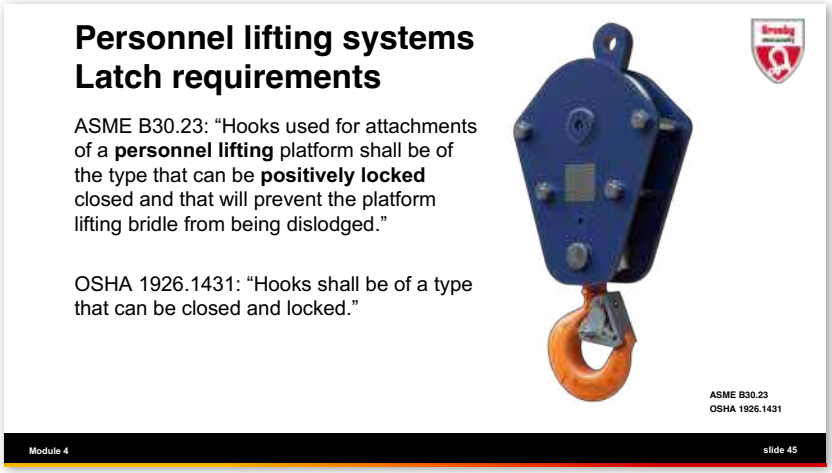
For most hooks, replacement latches and trigger kits (for self-locking hooks) are available.

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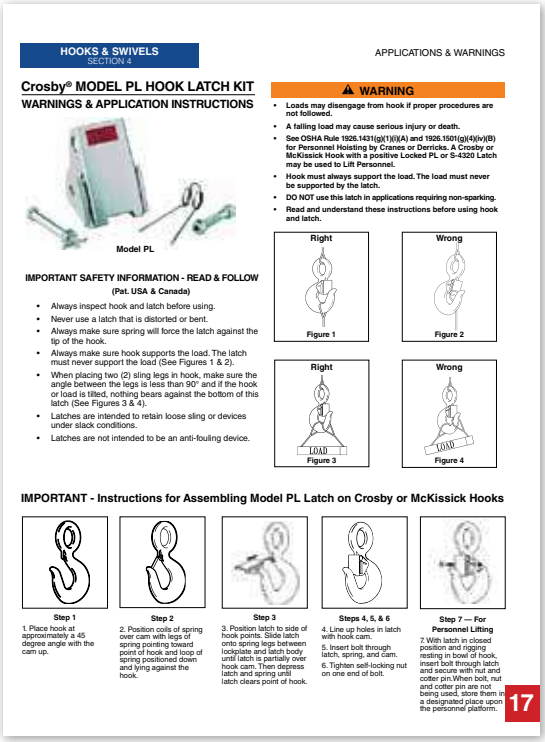
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NOTES:



HOOKS & SWIVELS
SECTION 4

APPLICATIONS & WARNINGS

Crosby® MODEL PL HOOK LATCH KIT
WARNINGS & APPLICATION INSTRUCTIONS

Model PL

IMPORTANT SAFETY INFORMATION - READ & FOLLOW
(Pat. USA & Canada)

- Always inspect hook and latch before using.
- Never use a latch that is distorted or bent.
- Always make sure spring will force the latch against the tip of the hook.
- Always make sure hook supports the load. The latch must never support the load (See Figures 1 & 2).
- When placing two (2) sling legs in hook, make sure the angle between the legs is less than 90° and if the hook or load is tilted, nothing bears against the bottom of this latch (See Figures 3 & 4).
- Latches are intended to retain loose sling or devices under slack conditions.
- Latches are not intended to be an anti-fouling device.

⚠ WARNING

- **Loads may disengage from hook if proper procedures are not followed.**
- **A falling load may cause serious injury or death.**
- **See OSHA Rule 1926.1431(g)(1)(i)(A) and 1926.1501(g)(4)(iv)(B) for Personnel Hoisting by Cranes or Derricks. A Crosby or McKissick Hook with a positive Locked PL or S-4320 Latch may be used to Lift Personnel.**
- **Hook must always support the load. The load must never be supported by the latch.**
- **DO NOT use this latch in applications requiring non-sparking.**
- **Read and understand these instructions before using hook and latch.**

Right — Figure 1
Wrong — Figure 2
Right — Figure 3
Wrong — Figure 4

IMPORTANT - Instructions for Assembling Model PL Latch on Crosby or McKissick Hooks

Step 1
1. Place hook at approximately a 45 degree angle with the cam up.

Step 2
2. Position coils of spring over cam with legs of spring pointing toward point of hook and loop of spring positioned down and lying against the hook.

Step 3
3. Position latch to side of hook points. Slide latch onto spring legs between lockplate and latch body until latch is partially over hook cam. Then depress latch and spring until latch clears point of hook.

Steps 4, 5, & 6
4. Line up holes in latch with hook cam.
5. Insert bolt through latch, spring, and cam.
6. Tighten self-locking nut on one end of bolt.

Step 7 — For Personnel Lifting
7. With latch in closed position and rigging resting in bowl of hook, insert bolt through latch and secure with nut and cotter pin. When bolt, nut and cotter pin are not being used, store them in a designated place upon the personnel platform.

17

See Crosby Application and Warning Information found in the back of the Kito Crosby catalog for more information.

EN Standards: latch requirements

- Each hook shall have a **spring loaded latch** to ensure that the load cannot become accidently unhooked.
- The latch shall engage in the point of the hook to form a **complete closure** of mating surfaces.
- With the hook in any orientation the spring shall ensure that the latch is held positively in the closed position.
- Latches operated soley by gravity shall not be used.
- The spring shall be constructed from **corrosion protected** material and shall be able to withstand at least **10.000 complete openings of the latch without fracture.**

EN 1677-2, 5.6

Module 4 slide 46

NOTES:

Crosby sorting hooks



Do not concentrate load on last 5 cm of hook.

Tip loading caused by a vertical sling angle smaller than 45 degrees results in a W.L.L. of 1,8 ton when hook fully engaged.

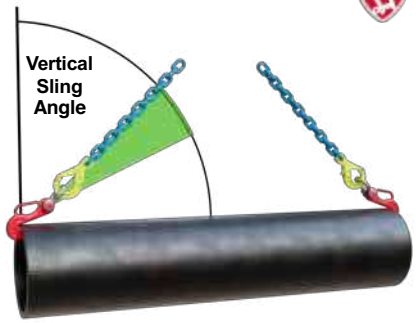
W.L.L. at bottom of hook is 6,8 ton (per piece) when fully engaged and the vertical sling angle is greater than 45 degrees.

Module 4 slide 47

Crosby sorting hooks Vertical sling angles

The vertical sling angle should be 45 to 60 degrees.

A vertical sling angle smaller than 45 degrees may provide inadequate engagement forces and create tip loading.



Module 4 slide 48

Consider using CrosbyIP lifting clamps with pre-tension to lift steel pipes.

Other type of pipe hooks, with replaceable nylon inserts to minimize thread and pipe damage, are available.



IPPH Pipe Hook with insert

Weld-on hook



Designed for attachment to mobile equipment as a pick point for sling attachment.



Always make sure the hook supports the load

The load must be applied in the **135-degree** zone shown

Module 4 slide 49

NOTES:



Make sure load on the weld-on hook is applied within the 135° zone of the hook. Lifting hardware fitted in the weld-on hook should hang freely without touching or lying on the excavator grab.

Weld-on hook Application notes



The latch must not
- Support the Load
- Never Tip Load
- Never Side Load

Never attach more than one sling directly in hook; use shackle, masterlink, or other proper hardware to collect multiple slings.

Do not use weld-on hook for personnel lifting.

Module 4 slide 50

Fulfills requirements of EN 474-1.

Weld-on hook Welding notes

The strength of the weld-on hook depends upon the method of attachment and the choice of support

Crosby & Gunnebo provide welding guidance with each hook:
- Minimum plate thickness
- Minimum fillet size
- Preheat temperature
- Inspection requirements

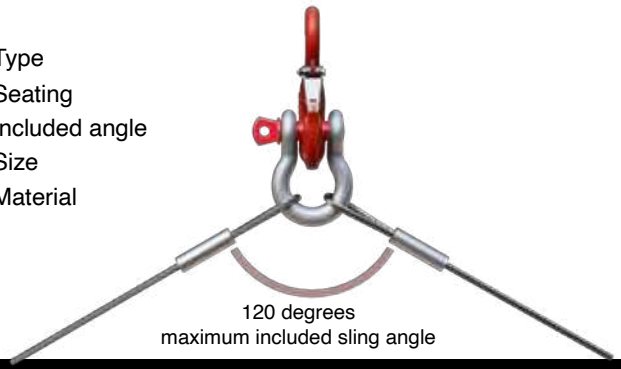


Module 4 slide 51

Welding should only be performed by a trained & competent welder.

Application of shackles key considerations

Type
Seating
Included angle
Size
Material



120 degrees
maximum included sling angle

Module 4 slide 52

NOTES:

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Shackles



SCREW PIN

Use when picking and placing a load, tighten pin prior to each lift.



BOLT TYPE

Use in permanent or long-term installations. Always use nut and cotter!

Module 4 slide 53

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Special shackles



Synthetic sling saver shackles



Wide body shackles

Improved D/d ratio



Module 4 slide 54

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Special shackles have been developed to be used with large capacity wire rope slings, high performance synthetic slings and wide web slings. These protect the sling and allow the use of the full capacity of the slings.

Crosby & Gunnebo also fabricate ROV shackles.

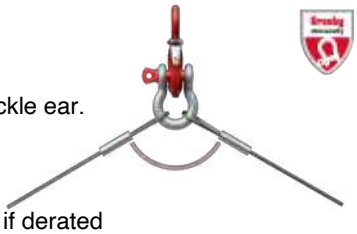


Gunnebo 861
Retrieve ROV shackle



Crosby G-2100
Release & Retrieve ROV shackle

Application of shackles
Key considerations



Tighten shoulder of pin against shackle ear.
WLL is based on in-line loading.

Side loading:
- Screw pin and bolt type shackles if derated
- Never side load round pin shackles

Orientation of screw pin:
- Never allow to be rotated

Permanent overhead installations:
- Use only bolt type shackles with nut & cotter pin

Module 4 slide 57

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Application of shackles
Key considerations

When a shackle is used to connect two slings to hook of a lifting machine, it should be a bow type shackle assembled with the slings in the shackle body and the hook engaged with the shackle pin.
The included angle between the slings should not exceed 120°.



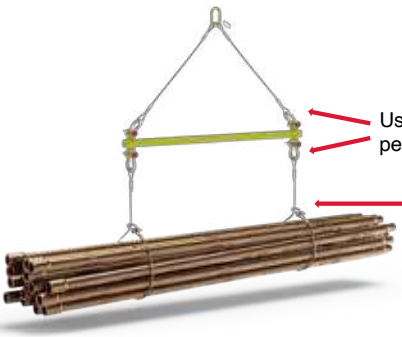
EN 13889

Module 4 slide 58

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Bolt type shackles





Use bolt type shackles when a permanent or long-term connection

Use screw pin shackles when it will be a temporary connection



Module 4 slide 59

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NOTES:

Rigging practices – Shackles

- The screw pin shall not be rigged in a manner that would cause the pin to unscrew.
- For long term installations, bolt-type should be used, if screw pin type used, the pin shall be secured.
- Multiple slings shall not exceed 120° included angle in bow.
- The pin shall be connected to the choking eye of sling when used in a choker hitch.
- Screw pin threads shall be fully engaged and tight, and the shoulder should be in contact with the shackle body.
- If designed for a cotter pin, it shall be used and maintained.
- Applied load should be centred in the bow to prevent side loading.
- Multiple sling legs should not be applied to the pin.
- If side loaded, the rated load shall be reduced according to manufacturer.

Shackles symmetrically loaded with two leg slings having a maximum included angle of 120° can be utilized to full working load limit.

For shackles larger than 125 metric tons, the maximum included angle is 90 degrees for full working load limit.

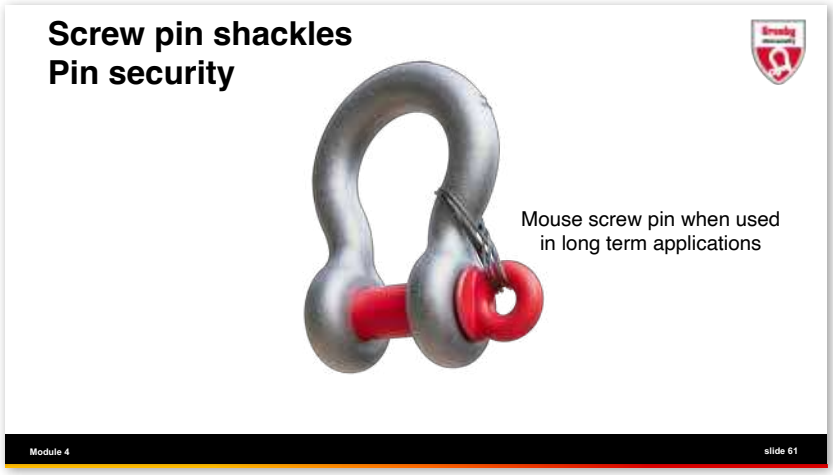
Contact Crosby engineering if included angle is greater than 90 degrees for shackles > 125 metric tons.

NOTES:


Screw pin shackles
Pin security
STOP
The load is unstable and if the load shifts the sling might unscrew the shackle pin.
Module 4
slide 60

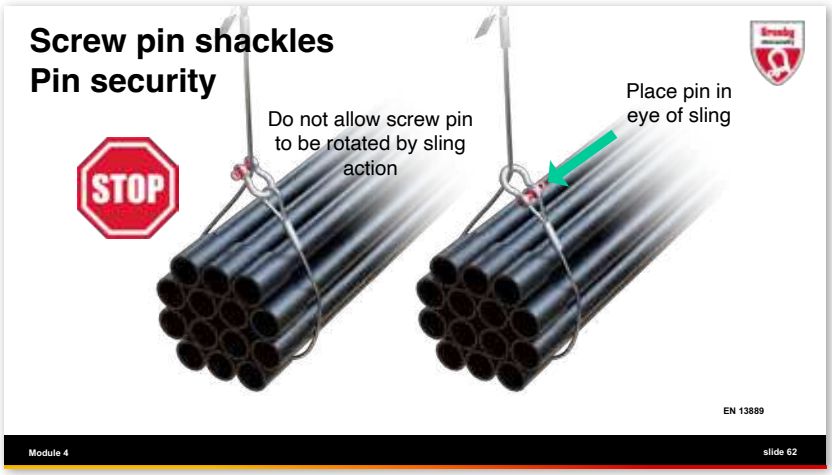
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Screw pin shackles
Pin security
Mouse screw pin when used in long term applications
Module 4
slide 61

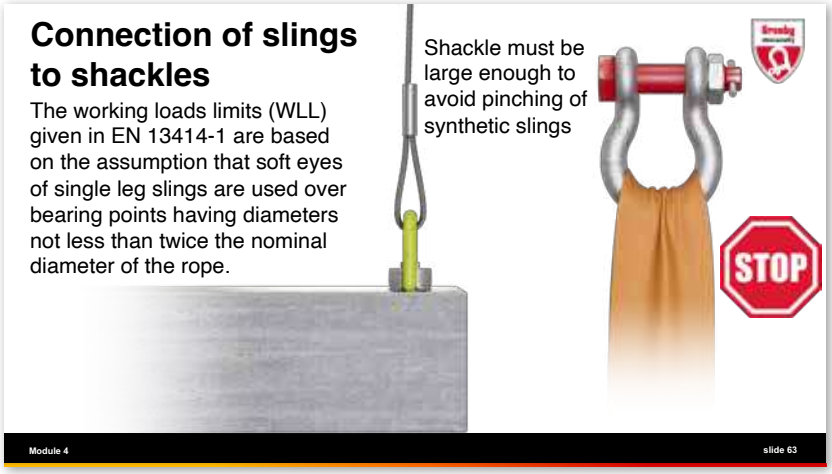
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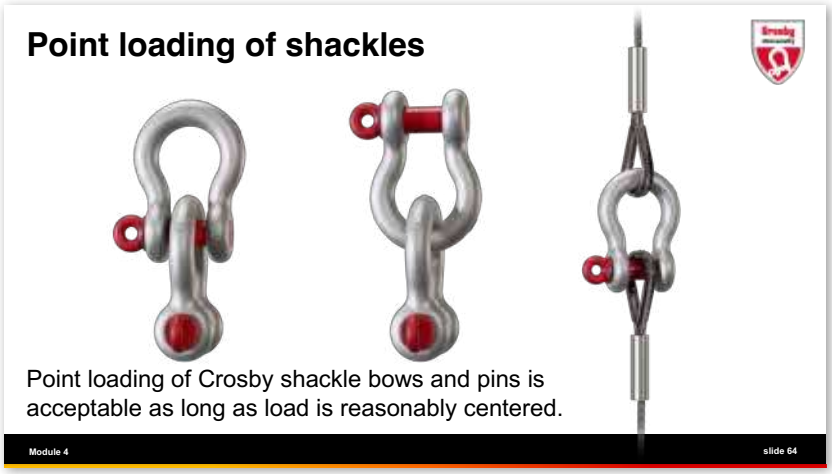
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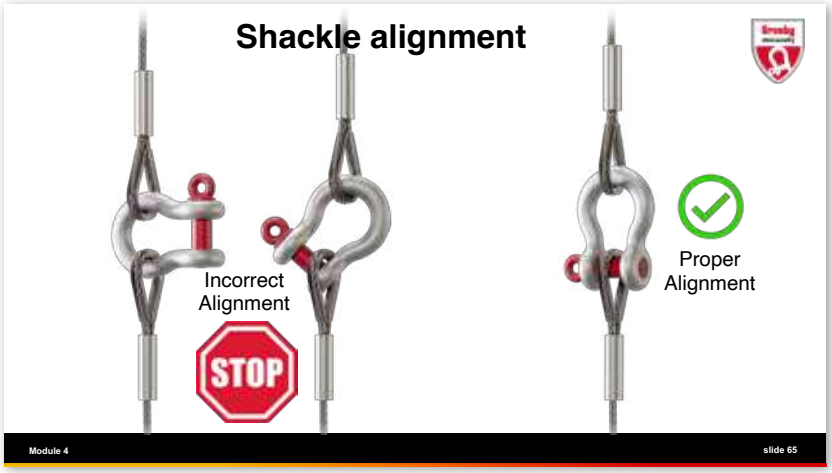

Screw pin shackles
Pin security
STOP
Do not allow screw pin to be rotated by sling action
Place pin in eye of sling
EN 13889
Module 4
slide 62

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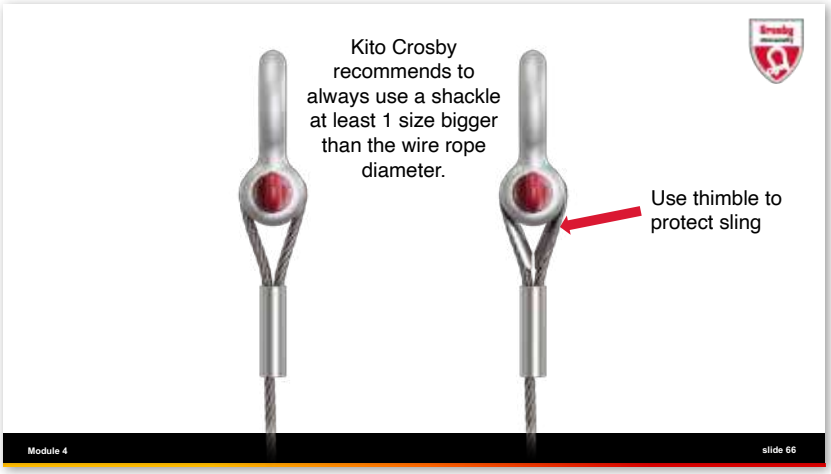
NOTES:

Inadequate pin diameters and the folding, bunching or pinching of synthetic web or round slings will reduce the rated load significantly. Consider using Crosby sling saver fittings for applications with synthetic slings.
The recommended curve width of shackle to web sling. Effective Width = 0.75 x W.



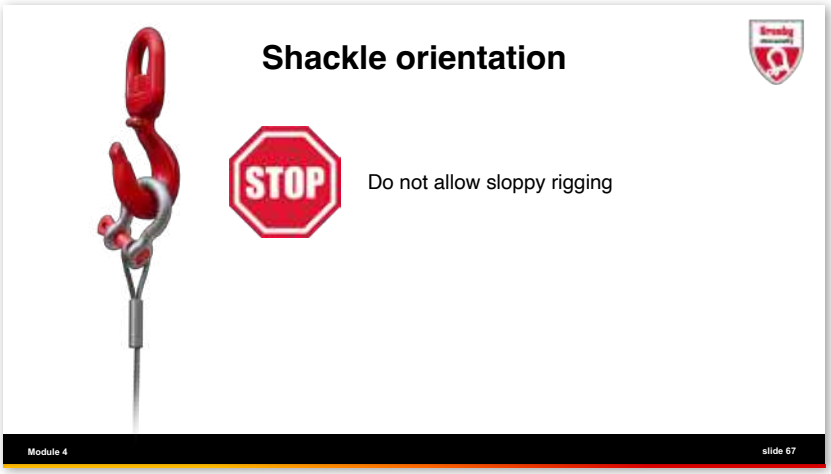
S-253 Screw Pin Sling Shackle

It has been determined that all Crosby & Gunnebo shackles can be point-to-point loaded to the working load limit without bending of the pin/bolt. This loading can be bow-to-bow or bow-to-pin.



NOTES:

The use of thimbles does not increase the capacity (WLL) of the wire rope sling. It just gives additional protection to the sling eye.





There may be other factors to consider in the pad eye design, which Crosby is not aware of.

Side loading of shackles





Angle of side load	Loss of W.L.L.
None, In line	None
45 degree	30% Loss
90 degree	50% Loss

Never side load a round pin shackle!

Module 4 slide 69

Side loading of screw pin and bolt type shackles



Side loaded shackles or not?

Module 4 slide 70

Shackle orientation

When a single sling leg is placed in a shackle, orientate the shackle to best align the rigging.



Module 4 slide 71

NOTES:

Side loaded rating reduction table for 3/16” to 3” (120t) shackles.

Angle from In-Line (Degrees)	Reduction in WLL
0 to 10	0%
11 to 20	15%
21 to 30	25%
31 to 45	30%
46 to 55	40%
56 to 70	45%
71 to 90	50%

Crosby tests indicate that in order to maintain design factor, the working load limit should be reduced as shown for loads applied at various angles.

Do not side load G/S-213 or G/S-215 round pin shackles.

For shackles greater than 3” (120t), where the angle of the side load is greater than 5 degrees, contact Crosby engineering.

Angle indicators are forged into the shackle bow at 45 degree angles from vertical.

These are utilized on screw pin and bolt type shackles to quickly check the approximate angle of a two-legged hitch, or quickly check the angle of a single leg hitch when the shackle pin is secured and the pull of the load is off vertical (side loaded), thus requiring a reduction in the working load limit of the shackle.

When one sling is placed into a shackle, the shackle can be placed pin up or bow up. Pin up allows self alignment. Bow up allows shackle to be placed over a larger hook.

When 2 slings are placed into a shackle, the pin must be up in order to have the 2 slings in the bow.

Shackles placed on hooks



Shackle “hung up” on hook.



Shackle pin resting in base of hook.



Module 4 slide 72

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Shackle as a collector ring

3/16" to 3" (120 metric tons)

Use only screw pin and bolt type shackles as collector.

Orientate shackle so pin is up and bow is down.





Included angle
120° maximum

Module 4 slide 73

For shackles larger than 3” or 120 metric tons, the maximum included angle is 90 degrees for full working load limit.

Contact Crosby engineering if included angle is greater than 90 degrees.

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Shackle as a collector ring







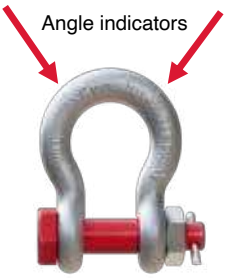
Shackle pin up when collecting multiple leg slings.

Module 4 slide 74

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Crosby QUIC-CHECK Shackles



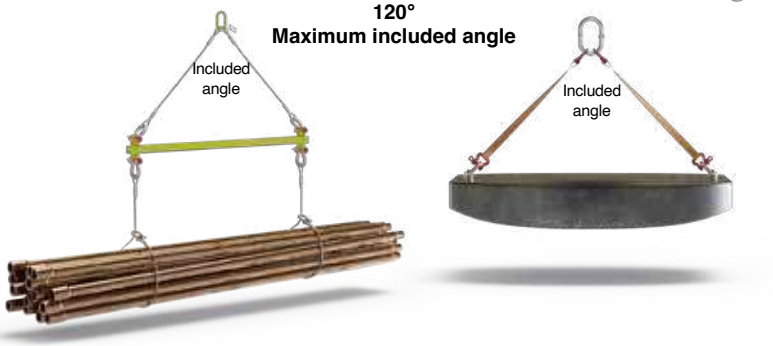
Angle indicators are forged into the shackle bow at 45° angles from vertical.

These are utilized **to quickly check the approximate angle of a two-legged hitch** or quickly check the angle of a single leg hitch when the shackle pin is secured and the pull of the load is off vertical or side loaded.

Module 4 slide 75

Masterlinks and rings

120°
Maximum included angle



Module 4 slide 76

Rigging practice
Links and rings

Link or ring shall be of the proper shape and size to ensure that it seats properly in the hook or lifting device.

Multiple slings or rigging hardware gathered in a link or ring shall not exceed a 120 degrees included angle.



Module 4 slide 77

NOTES:

Masterlink and masterlink assemblies



Never attach **more than 2 slings** to **a single masterlink.**

For 3 & 4-leg slings, a masterlink assembly (with sub-links) to be used.

It is best practice to fit upper and lower eyes with a **thimble** in case connected to an upper or lower fitting (masterlink, hook,...).

Module 4 slide 78

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Masterlinks







As collector ring for wire rope and synthetic slings

As collector ring for chain slings

Module 4 slide 79

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Pear shape links

Multiple leg slings





Single leg slings

Place link to best fit hook

Module 4 slide 80

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NOTES:

Master links are also used to gather multiple leg wire rope slings or synthetic slings. The slings are often fabricated (swaged or sewn) permanently onto the master links. The master link is sized based on total load that the master link will see and a 5/1 design factor.

Pear shape links

Pear shape links shall not be used as lower terminals.
(lower end fittings)



EN 818-4, 5.2.2.1

Module 4 slide 81

Hinge points chain slings



A masterlink with sub-links is required for 3 and 4-leg slings.

Single masterlink is required for single and two leg chain slings.

Module 4 slide 82

Hinge points





Best practice with multiple hinge points

Improved practice over placing slings directly in hook

Module 4 slide 83

NOTES:

Master links are used for single and multiple leg chain slings. The master link is sized based upon chain sling capacity (4/1 design factor).

The Gunnebo Industries GrabiQ and FlexiLeg chain system offers solutions that increase the flexibility in lifting operations even further. Our FlexiLeg solution allows you to have an instant leg change on site.

With one single master link in combination with five Flexi-legs, we offer a solution that replaces four complete traditional slings, a total of ten legs. In addition, FlexiLeg also gives you the opportunity to modify the chain sling to different lifting operations, whenever and wherever it is needed.

DNV approval links







Module 4 slide 84

NOTES:

Crosby masterlink and masterlink assemblies: proof test

Crosby master links and master link assemblies are proof tested with special fixtures in accordance with ASTM A952. While other specifications such as en 1677-4 and AWRF recommended guideline for proof test procedures for slings related to master link and master link assemblies also allow for the use of special fixtures when proof testing, Crosby follows the guidelines set forth in ASTM A952. The purpose of the special fixture is to prevent localized point loading during the proof test. Point loading at the proof test load may result in permanent deformation. **The proof test fixture PER ASTM A952 allows for a maximum fixture width (w) of 60% of the inside width (b) of the master link.** A sketch showing an example of the special fixture is shown in figure 1. Note that the corner of the fixture should be contoured so that a sharp edge does not make contact with the master link during the loaded condition.

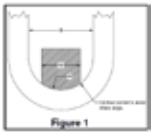


Figure 1

Note:
EN 1677-4, 6.2.1 specifies a test fixture not greater than 70% of the internal width of the link

EN 1677-4, 6.2.1
ASTM A952

Module 4 slide 85

Discuss the use of hooks and shackles

1



2



3



4



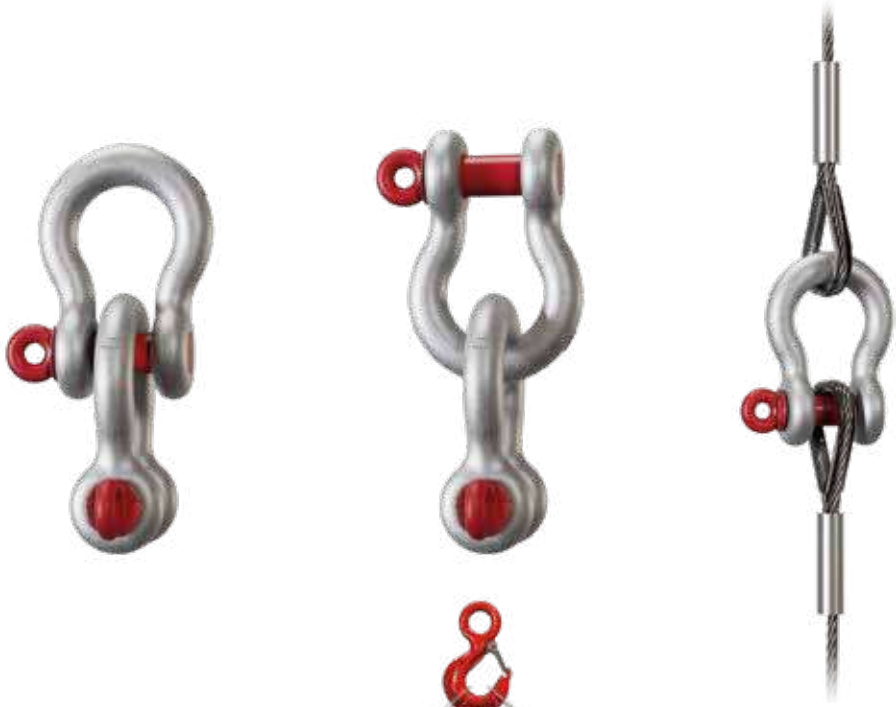
5



6



7



8



9



Application of Hoist Hooks, Shackles and Links

1. Do not back load, side load or _____ a hoist hook.
2. Screw pin shackles must have their screw pin _____ prior to each lift.
3. When placing synthetic slings on load hooks, make sure the hooks width is _____ one-third the length of the sling's eye.
4. DO NOT _____ a synthetic sling when connecting to a shackle or hook.
5. If a screw pin shackle is used for suspending a load for a long period of time, it must be _____.
6. Never place a screw pin shackle where its screw pin can be _____ in use.
7. When placing slings into a load hook, ensure that the _____ _is not fouled.
8. Do not allow an included angle greater than _____ for hooks.
9. The maximum vertical sling angle is _____ if slings are placed directly into a load hook.
10. Where required, a latch _____ provided.
11. Multiple slings or rigging hardware gathered in a link or ring shall not exceed a _____ included angle.
12. Do not side load a _____ shackle.

Choose Answer from the Following List

a. tightened
b. 45°
c. less than
d. tip load
e. shall be
f. 120°
g. round pin
h. bunch or pinch
i. rotated
j. latch
k. "moused"
l. 90°

Welcome to

Application of eye bolts, Hoist rings, and turnbuckles

5

Based on applicable standards and product application information for

Crosby GUNNEBO Industries

Module 5 slide 1

Crosby

RIGGING HARDWARE

13

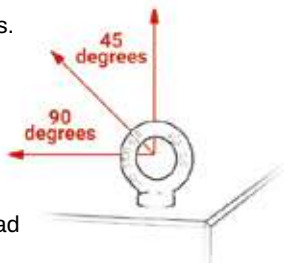
EYE BOLTS

Fatigue Rated Q&T QUIC-CHECK

SWIVEL HOIST RINGS

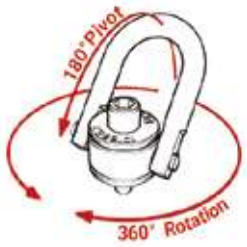
SHANK DIMENSIONS	WLL IN - LINE PULL	WLL 0°< β ≤ 45°	WLL 45°< β ≤ 90
mm	t	t	t
M6 x 13	0.20	0.06	0.05
M8 x 13	0.40	0.12	0.10
M10 x 17	0.64	0.19	0.16
M12 x 20.5	1.00	0.30	0.25
M16 x 27	1.80	0.54	0.45
M20 x 30	2.50	0.75	0.62
M24 x 36	4.00	1.20	1.00
M27 x 69.8	5.00	1.50	1.25
M30 x 45	6.00	1.80	1.50
M36 x 54	8.50	2.55	2.12

- Never exceed Working Load Limits.
- Always use shoulder nut eye bolts for angular lifts.
- Always screw eye bolt down completely for proper seating.
- Always tighten nuts securely against the load.
- For angular lifts, adjust working load as shown above.
- Always apply load to the eye bolt in the plane of the eye.

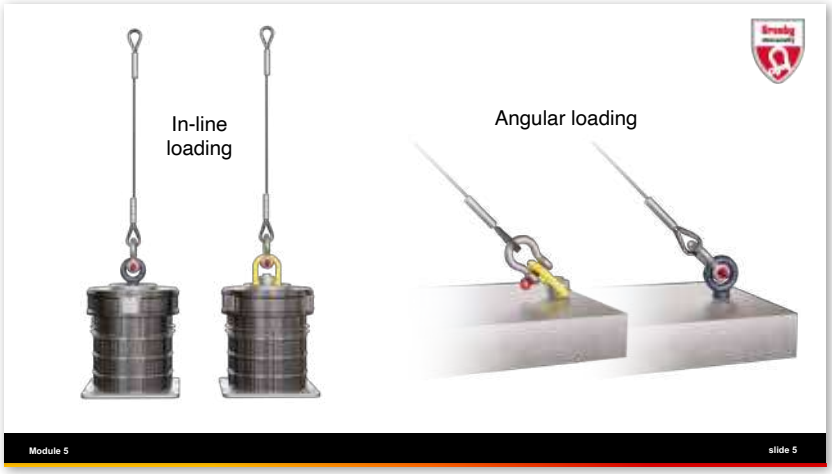


THREAD SHANK SIZE & EFF. THREAD PROJECTION		WLL D.F. 5/1	WLL D.F. 4/1	TORQUE
mm	mm	t	t	Nm
M8 x 40	16.9	0.40	0.50	10
M10 x 40	16.9	0.45	0.55	16
M12 x 50	16.9	1.05	1.30	38
M16 x 60	26.9	1.90	2.40	81
M20 x 65	31.9	2.15	2.70	136
M20 x 75	27.8	3.00	3.75	136
M24 x 80	32.8	4.20	5.25	312
M30 x 120	61.7	7.00	8.75	637
M36 x 150	54.0	11.00	13.75	1005
M42 x 160	64.0	12.50	15.60	1005
M48 x 160	74.0	13.50	16.90	1350

- The swivel hoist ring maintains 100% of its WLL at angular loading. It is subjected to the same load as the sling.
- Apply proper torque during installation.
- Never use spacers between bushing flange and mounting surface.
- Always ensure free movement of bail. There should be no interference between load and hoist ring bail.



For additional information refer to the Crosby catalogue



NOTES:

Always be sure threads on shank and receiving holes are clean.

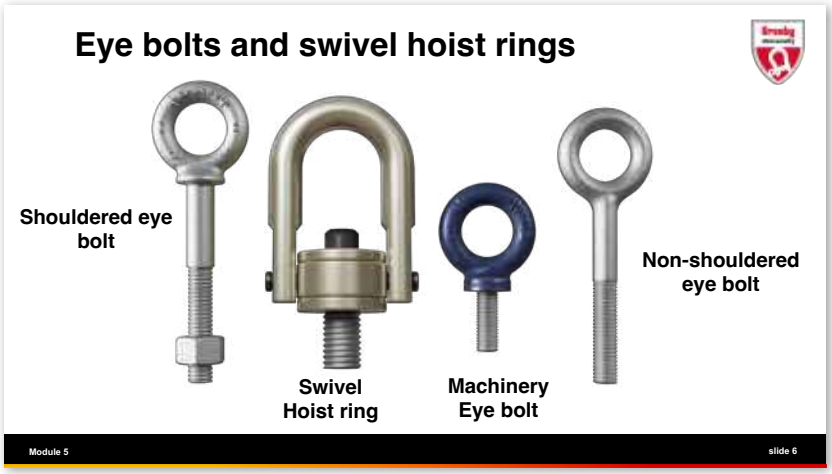
Never machine, grind, or cut eye bolt.

Never exceed working load limits.

Never use regular nut eye bolts for angular lifts.

Always use shoulder nut eye bolts (or machinery eye bolts) for angular lifts.

Never undercut eye bolt to seat shoulder against the load.



Always countersink receiving hole or use washer with sufficient I.D. to seat shoulder. Do not use additional washers due to improper thread depth.

Always screw eye bolt down completely for proper seating.

Always tighten nuts securely against the load.



Application and assembly Eye bolts

- Always countersink receiving hole.
- Always screw eye bolts down completely for proper seating.
- Always tighten nuts securely against the load.



Module 5 slide 8

NOTES:

Do not use additional washers due to improper thread depth.

Machinery eye bolt installation



Minimum tap depth is basic shank length plus one-half the nominal eye bolt diameter.

Module 5 slide 9

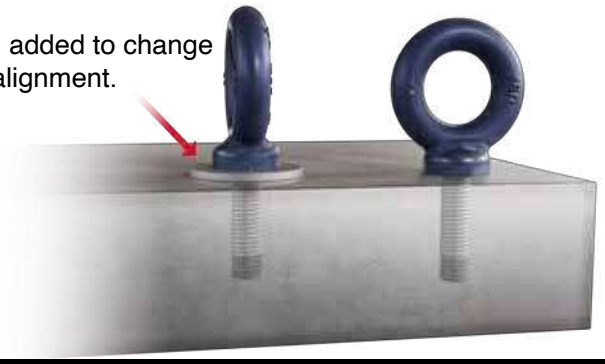
Drill and tap the load to the correct sizes to a minimum depth of one-half the eye bolt size beyond the shank length of the machinery eye bolt.

Thread the eye bolt into the load until the shoulder is flush and securely tightened against the load.

If the plane of the machinery eye bolt is not aligned with the sling line, estimate the amount of unthreading rotation necessary to align the plane of the eye properly. Remove the machinery eye bolt from the load and add shims (washers) of proper thickness to adjust the angle of the plane of the eye to match the sling line.

Machinery eye bolt installation

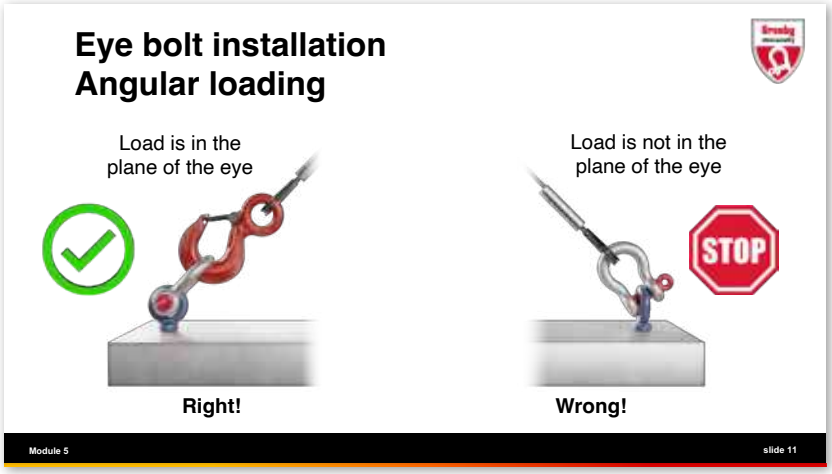
Shim added to change eye alignment.



Module 5 slide 10

Table 3

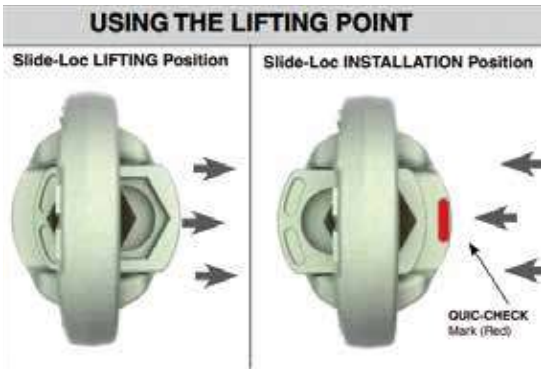
Eye Bolt Size (mm)	Shim Thickness Required to change Rotation 90° (mm)	Eye Bolt Size (in)	Shim Thickness Required to Change Rotation 90° (in)
M6	.25	1/4	.0125
M8	.31	5/16	.0139
M10	.38	3/8	.0156
M12	.44	1/2	.0192
M16	.50	5/8	.0227
M20	.62	3/4	.0250
M24	.75	7/8	.0278
M27	.75	1	.0312
M30	.88	1-1/8	.0357
M36	1.00	1-1/4	.0357
M42	1.13	1-1/2	.0417
M48	1.25	1-3/4	.0500
M64	1.50	2	.0556
—	—	2-1/2	.0625



NOTES:

Never exceed the working load limit of the eye bolt or hoist ring.







Stainless Steel swivel hoist rings types SS-125UNC and SS-125M are available in the standard offering. All components are 316 stainless steel, except bolt retainers, which are made from 15-7 PH (UNS 15700) magnetic stainless steel.

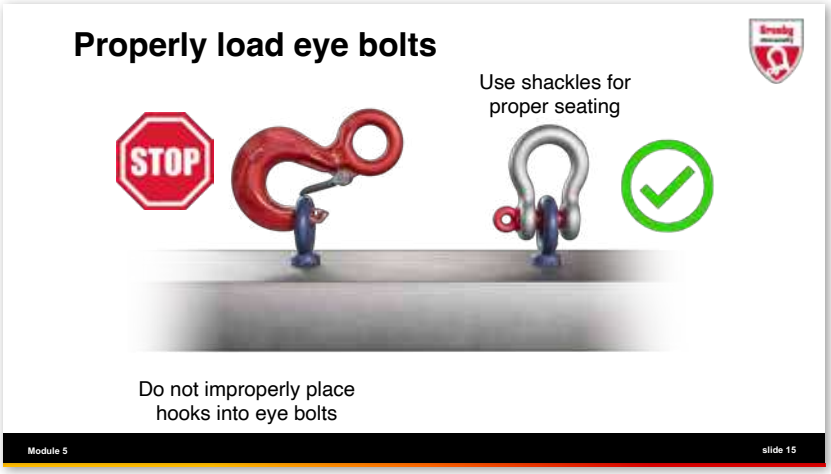


SS-125

For offshore applications, HR1000CT (Cold Tuff) swivel hoist rings (UNC & Metric) are available in accordance with DNV Offshore Standard DNV-OS-E101, Drilling Plant, Standard for Certification DNVGL-ST-0378, Lifting Appliances, and DNVGL-SI-0166.

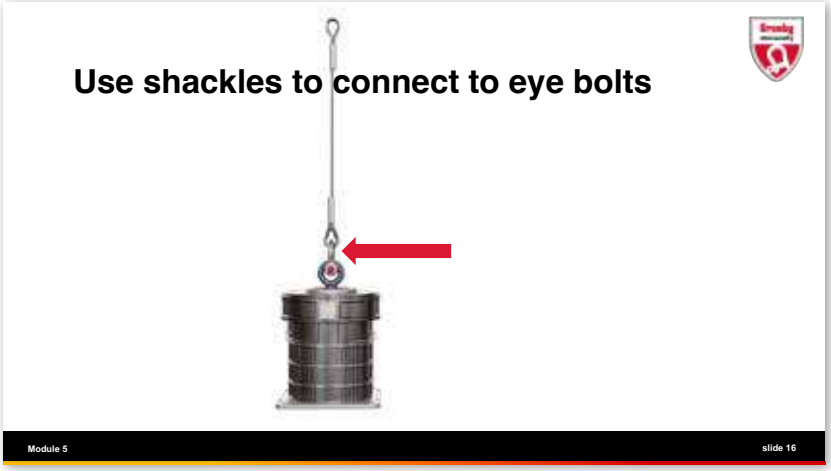


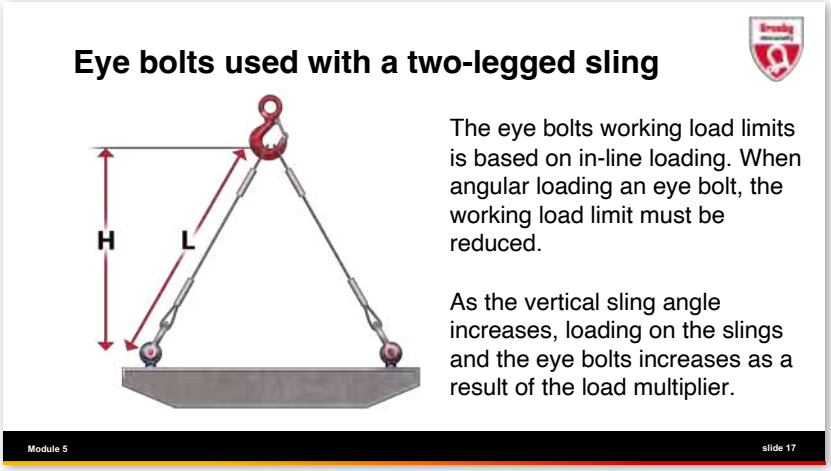
HR1000CT



NOTES:

When the eye bolt is too small for a hook or lifting sling to connect properly, consider using a shackle.





Never reeve slings through eye bolts



Reeving will greatly increase the loads and affects the effective sling angle

Module 5 slide 18

NOTES:

In addition to improper reeving through, both eye bolts are positioned 90° wrong. The load is not in plane with the eye.

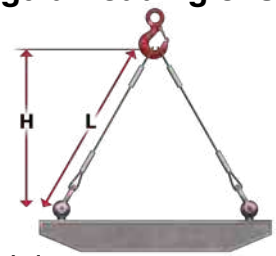
Application and assembly of eye bolts

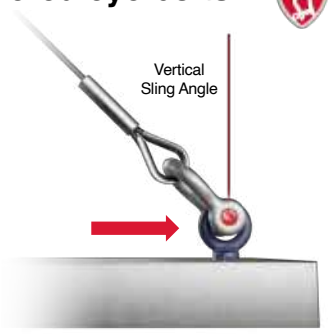
Always use shoulder eye bolts (or machinery eye bolts) for angular lifts.



Module 5 slide 19

Angular loading of shouldered eye bolts





Eye bolts:
- Must have a shoulder
- Must be tight against the load
- Must be in the plane of the eye

Module 5 slide 20

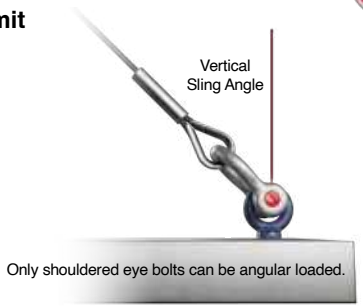
Only shouldered eye bolts can be angular loaded. Always properly connect to the eye bolt and keep properly aligned.

When eye bolts are used with a sling bridle, the load on the sling legs and eye bolts increase as the vertical angle increases. At the same time that the load increases, the working load limit of the eye bolts are reduced as a result of the angular loading.

Angular loading of eye bolts

Reduction of Working Load Limit

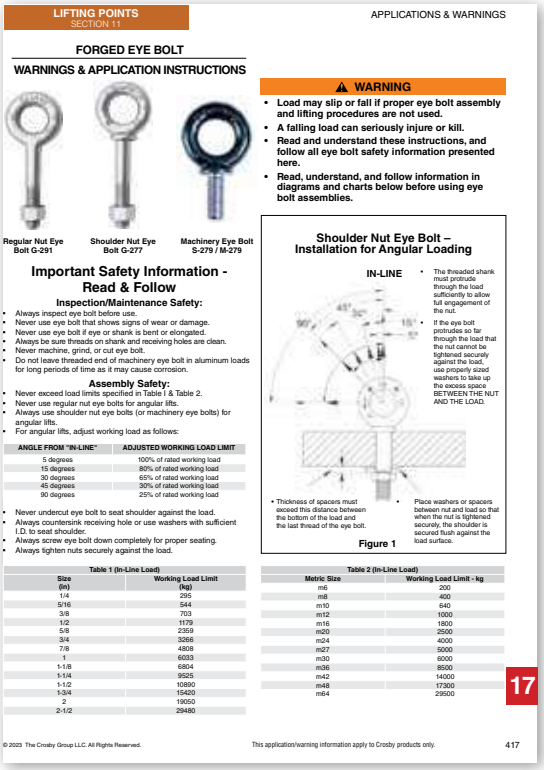
Vertical Sling Angle	Loss of Strength	Adjusted Working Load limit
0	0%	100% of in line
30	35%	65% of in line
45	70%	30% of in line
60	75%	25 % of in line



Only shouldered eye bolts can be angular loaded.

Module 5 slide 21

NOTES:



LIFTING POINTS
SECTION 11

APPLICATIONS & WARNINGS

FORGED EYE BOLT

WARNINGS & APPLICATION INSTRUCTIONS

Regular Nut Eye Bolt G-291 | Shoulder Nut Eye Bolt G-277 | Machinery Eye Bolt S-279 / M-279

Important Safety Information - Read & Follow

Inspection/Maintenance Safety:

- Always inspect eye bolt before use.
- Never use eye bolt that shows signs of wear or damage.
- Never use eye bolt if eye or shank is bent or elongated.
- Always be sure threads on shank and receiving holes are clean.
- Never machine, grind, or cut eye bolt.
- Do not leave threaded end of machinery eye bolt in aluminum loads for long periods of time as it may cause corrosion.

Assembly Safety:

- Never exceed load limits specified in Table I & Table 2.
- Never use regular nut eye bolts for angular lifts.
- Always use shoulder nut eye bolts (or machinery eye bolts) for angular lifts.
- For angular lifts, adjust working load as follows:

ANGLE FROM "IN-LINE"	ADJUSTED WORKING LOAD LIMIT
5 degrees	100% of rated working load
15 degrees	80% of rated working load
30 degrees	65% of rated working load
45 degrees	30% of rated working load
90 degrees	25% of rated working load

- Never undercut eye bolt to seat shoulder against the load.
- Always countersink receiving hole or use washers with sufficient I.D. to seat shoulder.
- Always screw eye bolt down completely for proper seating.
- Always tighten nuts securely against the load.

WARNING

- Load may slip or fall if proper eye bolt assembly and lifting procedures are not used.
- A falling load can seriously injure or kill.
- Read and understand these instructions, and follow all eye bolt safety information presented here.
- Read, understand, and follow information in diagrams and charts below before using eye bolt assemblies.

Shoulder Nut Eye Bolt – Installation for Angular Loading

IN-LINE

- The threaded shank must protrude through the load sufficiently to allow full engagement of the nut.
- If the eye bolt protrudes so far through the load that the nut cannot be tightened securely against the load, use properly sized washers to take up the excess space BETWEEN THE NUT AND THE LOAD.
- Thickness of spacers must exceed this distance between the bottom of the load and the last thread of the eye bolt.
- Place washers or spacers between nut and load so that when the nut is tightened securely, the shoulder is secured flush against the load surface.

Figure 1

Table 1 (In-Line Load)

Size (in)	Working Load Limit (kg)
1/4	295
5/16	544
3/8	703
1/2	1179
5/8	2359
3/4	3266
7/8	4808
1	6033
1-1/8	6804
1-1/4	9525
1-1/2	10890
1-3/4	15420
2	19050
2-1/2	29480

Table 2 (In-Line Load)

Metric Size	Working Load Limit - kg
m6	200
m8	400
m10	640
m12	1000
m16	1800
m20	2500
m24	4000
m27	5000
m30	6000
m36	8500
m42	14000
m48	17300
m64	29500

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This application/warning information apply to Crosby products only.

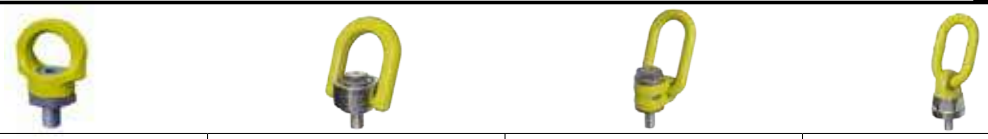
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See Crosby Application and Warning Information found in the back of the Kito Crosby catalog for more information.

GUNNEBO Industries

LIFTING POINTS

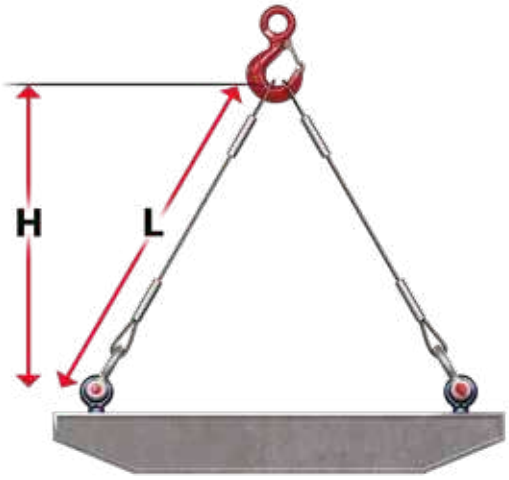
14



	LPE	RLP	DLP	BLP
Tight space	✓		✓	✓
Limited height (effective length)	✓	✓		
Vertical lift	✓	✓		✓
Angular lift		✓	✓	✓
Vertical rotation under load				✓
Tilting under load		✓	✓	✓
Sensitive load surface				✓
Single part lift	✓	✓		✓
Multiple part lift		✓	✓	✓

This chart is intended to give guidance in choosing the right lifting point for your operation and is not rules for usage.
For more advice, contact your closest authorized distributor or the responsible Kito Crosby area manager.

Selection of eye bolt



Load weight is 2.000 kg

L	2.0 m	2.0 m	2.0 m
H	1.7 m	1.4 m	1 m
L/H			
Vertical angle			
Load in each leg			
Size eyebolt			

Crosby

RIGGING HARDWARE

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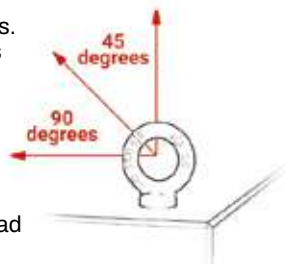
EYE BOLTS

Fatigue Rated QT QUIC-CHECK

SWIVEL HOIST RINGS

SHANK DIMENSIONS	WLL IN - LINE PULL	WLL 0°< β ≤ 45°	WLL 45°< β ≤ 90
mm	t	t	t
M6 x 13	0.20	0.06	0.05
M8 x 13	0.40	0.12	0.10
M10 x 17	0.64	0.19	0.16
M12 x 20.5	1.00	0.30	0.25
M16 x 27	1.80	0.54	0.45
M20 x 30	2.50	0.75	0.62
M24 x 36	4.00	1.20	1.00
M27 x 69.8	5.00	1.50	1.25
M30 x 45	6.00	1.80	1.50
M36 x 54	8.50	2.55	2.12

- Never exceed Working Load Limits.
- Always use shoulder nut eye bolts for angular lifts.
- Always screw eye bolt down completely for proper seating.
- Always tighten nuts securely against the load.
- For angular lifts, adjust working load as shown above.
- Always apply load to the eye bolt in the plane of the eye.



THREAD SHANK SIZE & EFF. THREAD PROJECTION		WLL D.F. 5/1	WLL D.F. 4/1	TORQUE
mm	mm	t	t	Nm
M8 x 40	16.9	0.40	0.50	10
M10 x 40	16.9	0.45	0.55	16
M12 x 50	16.9	1.05	1.30	38
M16 x 60	26.9	1.90	2.40	81
M20 x 65	31.9	2.15	2.70	136
M20 x 75	27.8	3.00	3.75	136
M24 x 80	32.8	4.20	5.25	312
M30 x 120	61.7	7.00	8.75	637
M36 x 150	54.0	11.00	13.75	1005
M42 x 160	64.0	12.50	15.60	1005
M48 x 160	74.0	13.50	16.90	1350

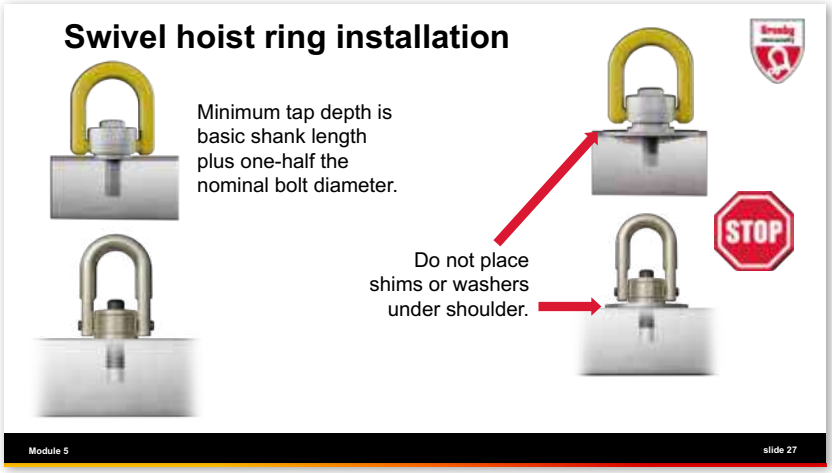
- The swivel hoist ring maintains 100% of its WLL at angular loading. It is subjected to the same load as the sling.
- Apply proper torque during installation.
- Never use spacers between bushing flange and mounting surface.
- Always ensure free movement of bail. There should be no interference between load and hoist ring bail.



For additional information refer to the Crosby catalogue







NOTES:

Never exceed the WLL indicated on the swivel hoist ring.

Use swivel hoist ring only with ferrous (steel and iron) or nonferrous (i.e. aluminum) loads.

Drill and tap work piece to the correct size to a minimum of depth of one-half the eye bolt size beyond the shank length. See rated load limit and bolt torque requirements imprinted on top of the swivel trunnion. If torque value not visible on the hoist ring, check the application information in the catalogue.

Install hoist ring to recommended torque with a torque wrench making sure the bushing flange meets the load (work piece) surface.

Never use spacers between bushing flange and mounting surface.

Always select proper load rated lifting device for use with swivel hoist ring.

Attach lifting device ensuring free fit to hoist ring bail (lifting ring).

Apply partial load and check proper rotation and alignment. There should be no interference between load (work piece) and hoist ring bail.

Special note: when a hoist ring is installed with a retention nut, the nut must have a full thread engagement and must meet one of the following standards to develop the working load limit (WLL).

UNC nuts:
- ASTM A-563
  - (a) Grade D Hex Thick
  - (b) Grade DH Standard Hex
  - (c) Grade DH3
- ASTM A-194
  - (a) Grade 2H
  - (b) Grade 4
  - (c) Grade 7
- SAE J995 (Grade 8 – standard hex)
- FNL (Grade 9)

Metric nuts:
- ASTM A-563M (Class 10S)
- ISO 898-2 (EN 20898-2 / DIN 267-4)
  - (a) Class 10
  - (b) Class 12

Various Crosby & Gunnebo swivel hoist rings can be supplied with longer bolts upon special request.

Swivel hoist ring installation

Use swivel hoist ring with ferrous metal or aluminum work pieces.

Do not leave threaded end of hoist ring in aluminum for long periods (due to corrosion).



Module 5 slide 28

Hoist rings must align with slings



Module 5 slide 29

Swivel hoist ring application - alignment

Hoist ring must swivel freely, and the hoist ring must be able to align with sling without interference.



Module 5 slide 30

NOTES:

Swivel hoist rings are often a better choice for bridle lifts (multiple leg slings). When properly installed, the hoist ring will swivel and pivot freely to align itself with the attached sling. The required working load limit is determined by the actual load seen by the sling leg. The working load limit of swivel hoist rings are not affected by angular loading. There is no need to derate them.

Side pull swivel hoist rings

Use various Crosby shackles to connect to side pull hoist rings. Check for proper rotation and alignment.



Do not allow interference between load and shackle.







Do not allow interference between side pull hoist ring and shackle.

Module 5 slide 31

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Side pull swivel hoist rings

Use various Crosby shackles to connect to side pull hoist rings

Crosby screw pin & bolt type

Crosby S281 web sling shackles



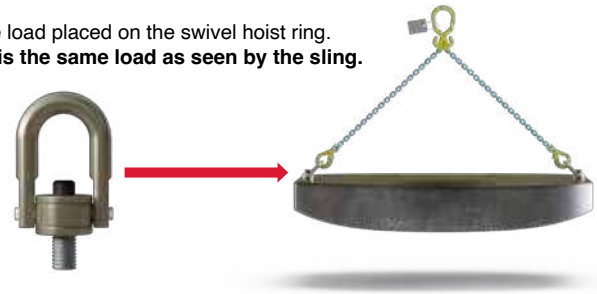
Module 5 slide 32

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Swivel hoist rings - The load multiplier

Determine load placed on the swivel hoist ring.
The load is the same load as seen by the sling.



The load increases as the vertical sling angle increases.

Module 5 slide 33

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NOTES:

Swivel hoist ring application – connection

Do not reeve slings
from one hoist ring to another.

This will alter the load
and angle of loading on
the hoist ring.



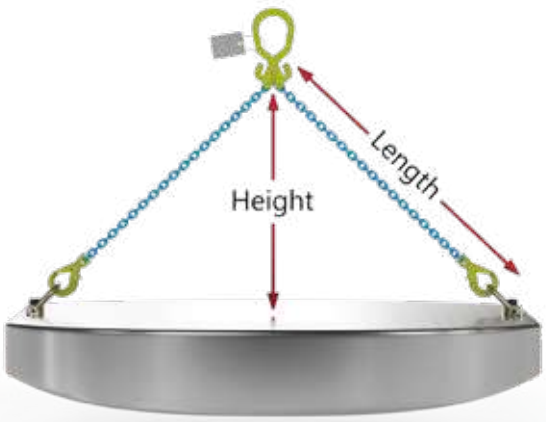
Module 5 slide 34

NOTES:

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Selection of hoist rings (safety factor 5/1)



Load weight is 2.000 kg

L	2.0 m	2.0 m	2.0 m
H	1.7 m	1.4 m	1 m
L/H			
Vertical angle			
Load in each leg			
Size hoist ring			

Crosby

RIGGING HARDWARE

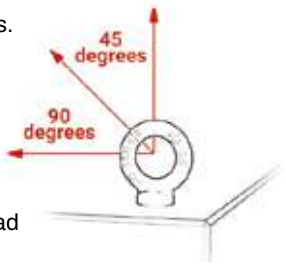
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EYE BOLTS

Fatigue Rated QT QUIC-CHECK

SHANK DIMENSIONS	WLL IN - LINE PULL	WLL 0°< β ≤ 45°	WLL 45°< β ≤ 90
mm	t	t	t
M6 x 13	0.20	0.06	0.05
M8 x 13	0.40	0.12	0.10
M10 x 17	0.64	0.19	0.16
M12 x 20.5	1.00	0.30	0.25
M16 x 27	1.80	0.54	0.45
M20 x 30	2.50	0.75	0.62
M24 x 36	4.00	1.20	1.00
M27 x 69.8	5.00	1.50	1.25
M30 x 45	6.00	1.80	1.50
M36 x 54	8.50	2.55	2.12

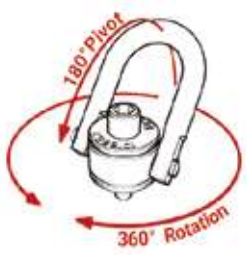
- Never exceed Working Load Limits.
- Always use shoulder nut eye bolts for angular lifts.
- Always screw eye bolt down completely for proper seating.
- Always tighten nuts securely against the load.
- For angular lifts, adjust working load as shown above.
- Always apply load to the eye bolt in the plane of the eye.



SWIVEL HOIST RINGS

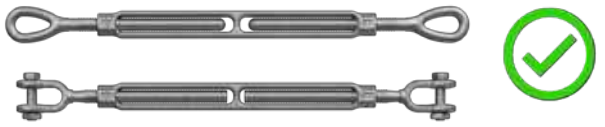
THREAD SHANK SIZE & EFF. THREAD PROJECTION		WLL D.F. 5/1	WLL D.F. 4/1	TORQUE
mm	mm	t	t	Nm
M8 x 40	16.9	0.40	0.50	10
M10 x 40	16.9	0.45	0.55	16
M12 x 50	16.9	1.05	1.30	38
M16 x 60	26.9	1.90	2.40	81
M20 x 65	31.9	2.15	2.70	136
M20 x 75	27.8	3.00	3.75	136
M24 x 80	32.8	4.20	5.25	312
M30 x 120	61.7	7.00	8.75	637
M36 x 150	54.0	11.00	13.75	1005
M42 x 160	64.0	12.50	15.60	1005
M48 x 160	74.0	13.50	16.90	1350

- The swivel hoist ring maintains 100% of its WLL at angular loading. It is subjected to the same load as the sling.
- Apply proper torque during installation.
- Never use spacers between bushing flange and mounting surface.
- Always ensure free movement of bail. There should be no interference between load and hoist ring bail.



For additional information refer to the Crosby catalogue

Crosby turnbuckles



Eye and Jaw turnbuckles are suitable for overhead lifting.



Hook turnbuckles are not suitable for overhead lifting and to be used in non-lifting applications only.

Module 5 slide 38

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NOTES:

Rigging practices – Turnbuckles

- Load applied should be in-line and in-tension turnbuckles should not be side loaded.
- Should be rigged or secured to prevent unscrewing during the lift.
- For long-term installations, secure to prevent unscrewing.
- Should be adjusted with a properly sized wrench, used on the wrench flats of the turnbuckle body.
- End fitting threads shall be fully engaged, verify before loading.
- Components, including pins, bolts, nuts, or cotter pins used with jaw ends, shall be in good working condition.
  Locking nuts shall be compatible with the threads of the turnbuckle end.
- Avoid contact with obstructions that could damage or bend the turnbuckle.
- Hook type turnbuckles have a working load limit significantly lower than the eye or jaw type.
- Hook type turnbuckles do not have a provision for a latch.
- Do not use hook type turnbuckles in lifting applications.

Crosby

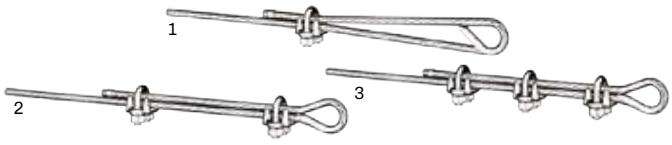
RIGGING HARDWARE

15

WIRE ROPE CLIPS

SIZE		EFFICIENCY	NUMBER OF CLIPS	TURNBACK LENGTH	TORQUE
INCH	mm			mm	Nm
1/8	3 - 4	80%	2	85	6.1
3/16	5	80%	2	95	10.2
1/4	6 - 7	80%	2	120	20.3
5/16	8	80%	3	133	40.7
3/8	9 - 10	80%	3	165	61
7/16	11	80%	3	178	88
1/2	12 - 13	80%	3	292	88
9/16	14 - 15	80%	3	305	129
5/8	16	80%	3	305	129
3/4	18 - 20	80%	4	460	176
7/8	22	80%	4	480	305
1	24 - 26	90%	5	660	305

- Apply u-bolt over dead end of the wire rope, live end of the rope rests in the saddle; never saddle a dead horse!
- Use the recommended number of clips and apply the recommended torque as specified in the table.
- A termination is only finished when it has been loaded to the required WLL and the nuts have been retorqued a second time.



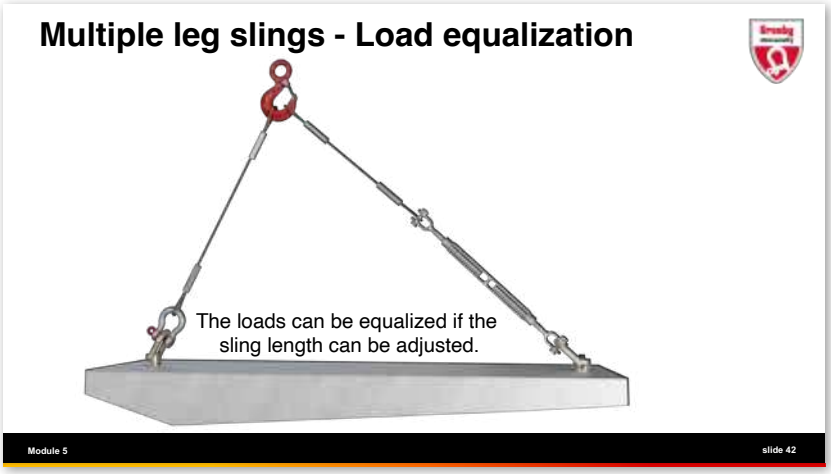
TURNBUCKLES

SIZE		WLL (t) JAW AND EYE D.F. 5/1	WLL (t) HOOK END FITTING D.F. 5/1
INCH	mm		
1/4	6.3	0.23	0.18
5/16	8	0.36	0.32
3/8	9.5	0.54	0.45
1/2	13	1.00	0.68
5/8	16	1.59	1.02
3/4	19	2.36	1.36
7/8	22	3.27	1.81
1	25	4.54	2.27
1-1/4	32	6.89	-
1-1/2	38	9.71	-
1-3/4	45	12.70	-
2	51	16.80	-
2-1/2	57	27.20	-
2-3/4	70	34.00	-

The use of locknuts or mousing is an effective method of preventing turnbuckles from rotating.



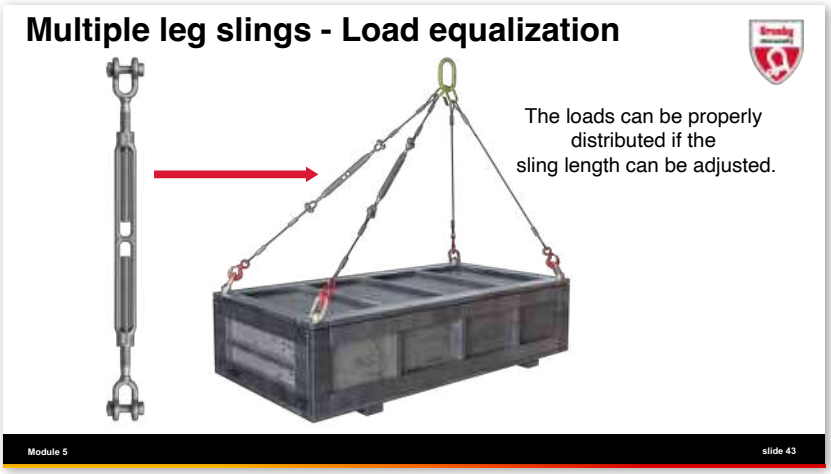
For additional information refer to the Crosby catalogue



NOTES:

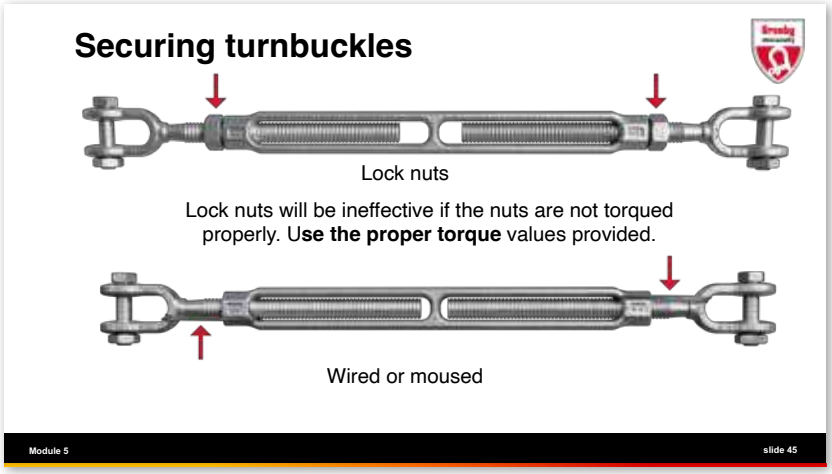
Do not use lashing turnbuckles or other non-lifting grade turnbuckles for lifting.

Crosby turnbuckles are rated for lifting applications.



Turnbuckles may be adjusted under load.

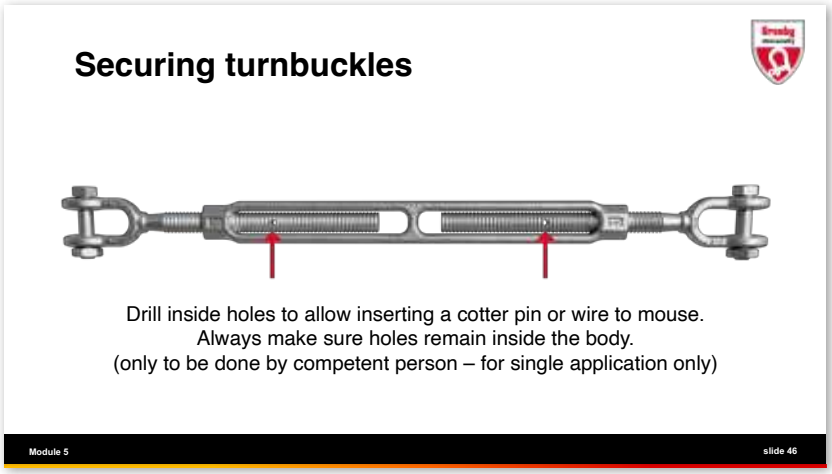




NOTES:

Unintended rotation and backing out of the end fitting can be prevented by proper use of locknuts or by wire “mousing”.

Turnbuckle end to allow inserting a cotter pin or wire to mouse.



Diameter of hole should be less than 25% of turnbuckle diameter.

Eye/Jaw Turnbuckle Size	Torque Locknut (Ft-Lbs)
1/4	3.1
5/16	6.3
3/8	11.3
1/2	27.5
5/8	54.7
3/4	97.5
7/8	157.5
1	250
1 1/4	475
1 1/2	802.5
1 3/4	1225
2	1850
2 1/2	3750
2 3/4	5156

Discuss the use of the hardware

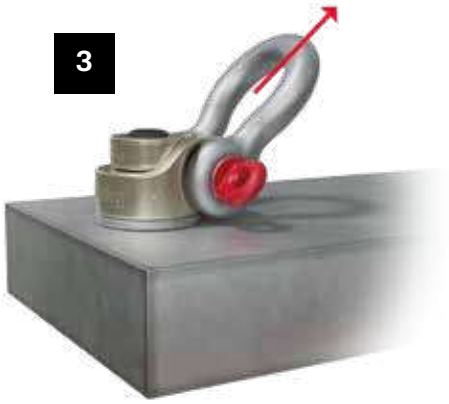
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2



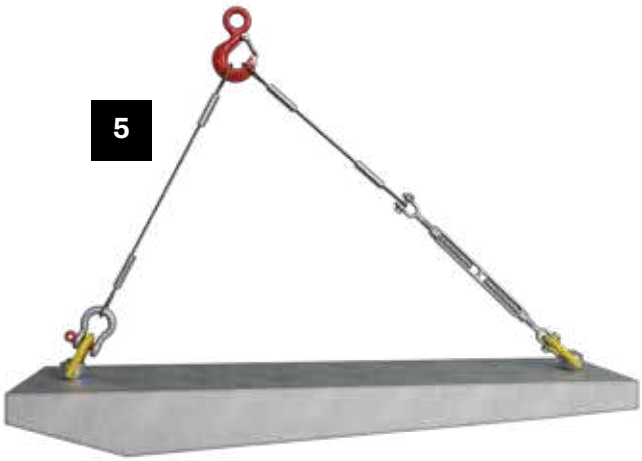
3



4



5



6



7



Application of Eye Bolts, Hoist Rings, and Turnbuckles

1. Only angular load an eye bolt if it has a _____ that is tight against the load.
2. Angular loading of an eye bolt will result in a reduction of the _____.
3. Never _____ slings through eye bolts or hoist rings.
4. Hoist rings must be installed using a _____.
5. Turnbuckles should be rigged or secured to prevent _____.
6. The load applied to a turnbuckle should be _____.
7. Hoist rings must be able to _____ with the sling without interference.
8. _____ turnbuckles are not suitable for overhead lifting.
9. Never use _____ between hoist ring and the load surface.
10. When angular loading an eye bolt, the load must be in the _____ of the eye.
11. Always screw eye bolts down _____ for proper seating.
12. Never _____ eye bolts to seat the shoulder against the load.

Choose Answer from the Following List

a. reeve
b. spacers
c. shoulder
d. undercut
e. align
f. completely
g. working load limit
h. torque wrench
i. Hook
j. in-line
k. unscrewing
l. plane

Welcome to

Application of wire rope terminations

6

Based on applicable standards and product application information for

Crosby

Module 6

slide 1

Crosby

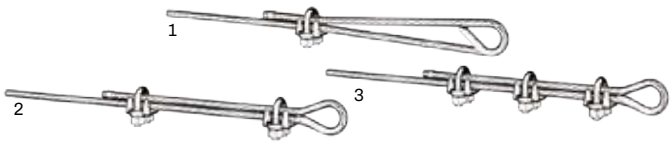
RIGGING HARDWARE

15

WIRE ROPE CLIPS

SIZE		EFFICIENCY	NUMBER OF CLIPS	TURNBACK LENGTH	TORQUE
INCH	mm			mm	Nm
1/8	3 - 4	80%	2	85	6.1
3/16	5	80%	2	95	10.2
1/4	6 - 7	80%	2	120	20.3
5/16	8	80%	3	133	40.7
3/8	9 - 10	80%	3	165	61
7/16	11	80%	3	178	88
1/2	12 - 13	80%	3	292	88
9/16	14 - 15	80%	3	305	129
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3/4	18 - 20	80%	4	460	176
7/8	22	80%	4	480	305
1	24 - 26	90%	5	660	305

- Apply u-bolt over dead end of the wire rope, live end of the rope rests in the saddle; never saddle a dead horse!
- Use the recommended number of clips and apply the recommended torque as specified in the table.
- A termination is only finished when it has been loaded to the required WLL and the nuts have been retorqued a second time.



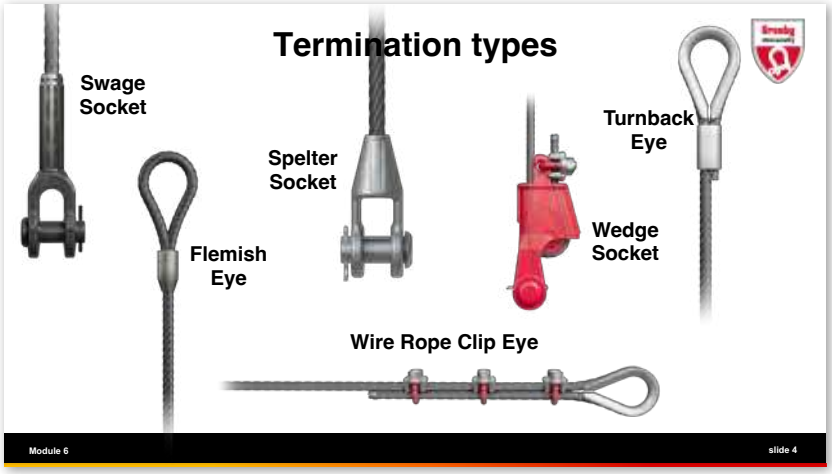
TURNBUCKLES

SIZE		WLL (t) JAW AND EYE D.F. 5/1	WLL (t) HOOK END FITTING D.F. 5/1
INCH	mm		
1/4	6.3	0.23	0.18
5/16	8	0.36	0.32
3/8	9.5	0.54	0.45
1/2	13	1.00	0.68
5/8	16	1.59	1.02
3/4	19	2.36	1.36
7/8	22	3.27	1.81
1	25	4.54	2.27
1-1/4	32	6.89	-
1-1/2	38	9.71	-
1-3/4	45	12.70	-
2	51	16.80	-
2-1/2	57	27.20	-
2-3/4	70	34.00	-

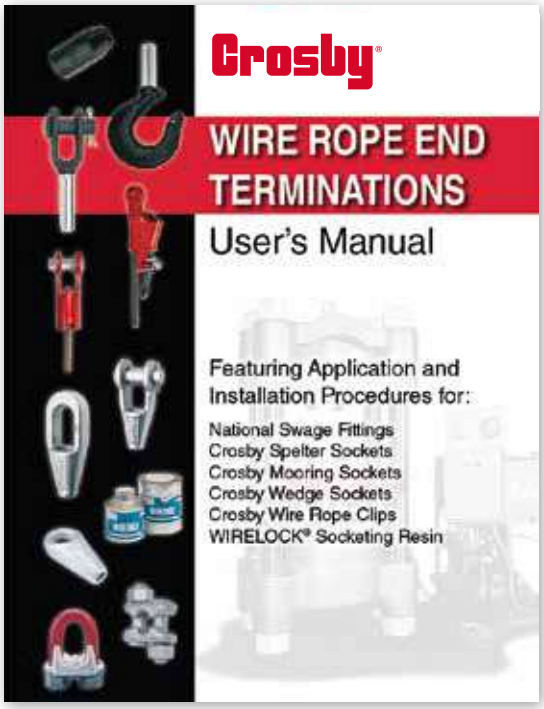
The use of locknuts or mousing is an effective method of preventing turnbuckles from rotating.

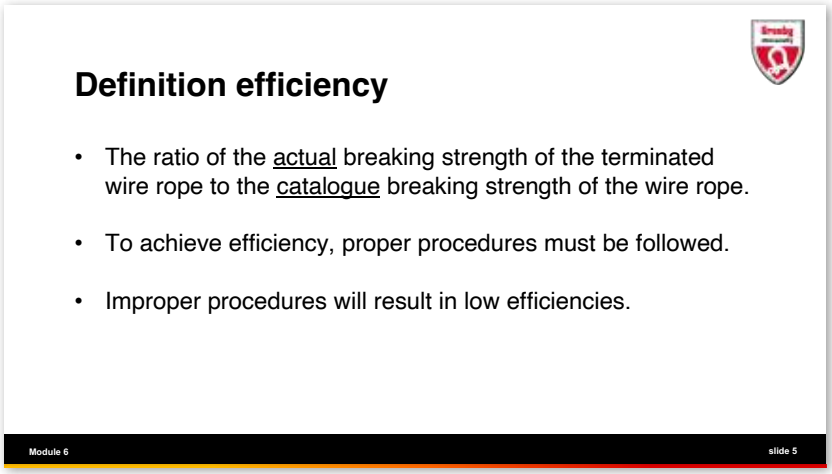


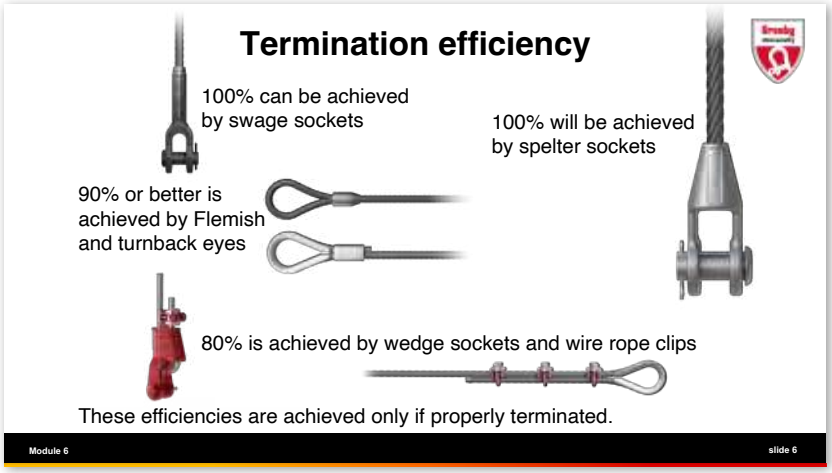
For additional information refer to the Crosby catalogue


Termination types
Swage Socket
Flemish Eye
Spelter Socket
Wedge Socket
Turnback Eye
Wire Rope Clip Eye
Module 6
slide 4

NOTES:


Crosby
WIRE ROPE END TERMINATIONS
User's Manual
Featuring Application and Installation Procedures for:
National Swage Fittings
Crosby Spelter Sockets
Crosby Mooring Sockets
Crosby Wedge Sockets
Crosby Wire Rope Clips
WIRELOCK® Socketing Resin


Definition efficiency
• The ratio of the actual breaking strength of the terminated wire rope to the catalogue breaking strength of the wire rope.
• To achieve efficiency, proper procedures must be followed.
• Improper procedures will result in low efficiencies.
Module 6
slide 5


Termination efficiency
100% can be achieved by swage sockets
100% will be achieved by spelter sockets
90% or better is achieved by Flemish and turnback eyes
80% is achieved by wedge sockets and wire rope clips
These efficiencies are achieved only if properly terminated.
Module 6
slide 6

Fabricated slings termination efficiency (as per standards)

Hand splice 80%



Turnback 90%



Flemish eye 90% or higher



EN 13411 – Terminations for steel wire ropes
EN 13414 – Steel wire rope slings

Module 6 slide 7

Wire rope clip types - Critical applications

Fist Grip



Forged U-Bolt



Malleable





Wire rope clips shall be drop-forged steel of single saddle (U-bolt) or double saddle clip. Malleable cast iron clips shall not be used.

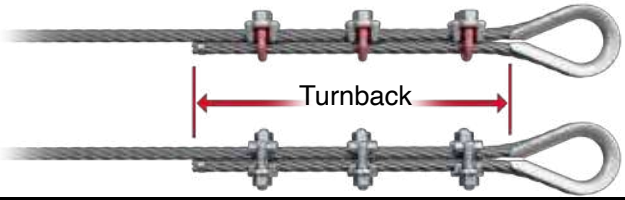
ASME B30.26

Module 6 slide 8

Wire rope clips

Basic requirements for proper termination

- Select proper size clips and turnback
- Place clips on in proper sequence
- Torque all clips evenly
- Apply first load and retorque



Module 6 slide 11

NOTES:

Rigging practices – Wire rope clips

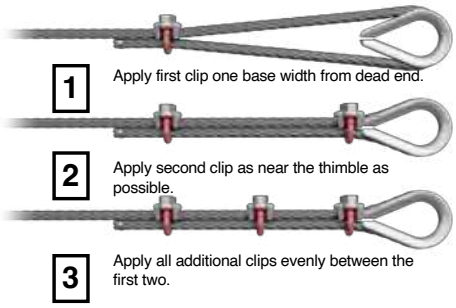
- Applies to wire rope clips, U-Bolt and double saddle, saddles shall be forged steel.
- Wire rope clip materials shall be of sufficient strength such that failure of the wire rope will occur before failure of the wire rope clips.
- Before installing a wire rope clip on plastic coated or plastic impregnated wire rope, consult the manufacturer.
- The use of wire rope clips to fabricate slings is generally prohibited, see EN 13414 & ASME B30.9.
- The saddle shall be placed on the live end of the wire rope, with the U-Bolt on the dead end.
- Use at least the minimum number, spacing and turnback of clips as recommended by the manufacturer.
- Wire rope clip shall be tightened to the torque recommended by the manufacturer.
- After assembly, the connection shall be loaded to at least the expected working load, the clips shall be retightened to the recommended torque.

Table 1

Rope Size (in)	Rope Size (mm)	Minimum No. of Clips	Amount of Rope to Turn Back in mm	*Torque in Nm
1/8	3-4	2	85	6.1
3/16	5	2	95	10.2
1/4	6-7	2	120	20.3
5/16	8	2	133	40.7
3/8	9-10	2	165	61.0
7/16	11-12	2	178	88
1/2	13	3	292	88
9/16	14-15	3	305	129
5/8	16	3	305	129
3/4	18-20	4	460	176
7/8	22	4	480	305
1	24-25	5	660	305
1-1/8	28-30	6	860	305
1-1/4	33-34	7	1120	488
1-3/8	36	7	1120	488
1-1/2	38-40	8	1370	488
1-5/8	41-42	8	1470	583
1-3/4	44-46	8	1550	800
2	48-52	8	1800	1017
2-1/4	56-58	8	1850	1017
2-1/2	62-65	9	2130	1017
2-3/4	68-72	10	2540	1017
3	75-78	10	2690	1627
3-1/2	85-90	12	3780	1627

OSHA 1910.184 and ASME B30.9 requires all slings exposed to temperatures over 538° C (1000° F) to be removed from service.
* Crosby does not recommend the use of Alloy Chain at temperatures above 427° C (800° F).
** When chain is used at room temperature after being heated to temperatures shown in the first column.

Application of wire rope clips



1 Apply first clip one base width from dead end.

2 Apply second clip as near the thimble as possible.

3 Apply all additional clips evenly between the first two.



Module 6 slide 12

Wire rope splicing

Interlocking turnback eyes with thimbles is the preferred method of splicing with wire rope clips.



Or an alternative

Place rope ends parallel to each other with the clips placed as shown, note the number and orientation of clips.

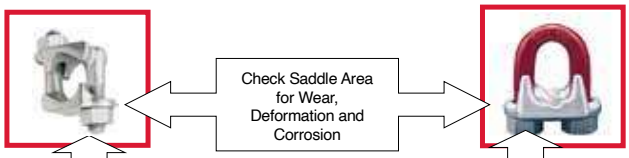
Overlap = 2 x Turnback for One Eye

# of Clips = 2 x That Required for One Eye



Module 6 slide 13

Wire rope clips re-use in field



Crosby clips can be reused after careful inspection of threads and saddle area.
Proper torque values must be attained whenever Crosby clips are reused.

Module 6 slide 14

NOTES:

Always use thimbles when forming eyes with wire rope clips. Wire rope thimbles are designed to provide the wire rope with protection against wear. They are not considered a primary load carrying member and are not rated by a load carrying capacity.

1. Apply first clip one base width from dead end, use torque wrench to tighten nuts evenly, alternating from one nut to the other until reaching the recommended torque.

2. Apply second clip as near the thimble as possible, use torque wrench to tighten nuts evenly, alternating from one nut to the other until reaching the recommended torque.

3. Apply third and additional clips evenly between the first two, use torque wrench to tighten nuts evenly, alternating from one nut to the other until reaching the recommended torque

4. Apply first load of equal or greater weight than the loads expected in use, next check and use torque wrench to retighten to recommended torque.

The U-Bolt must fit into the base without requiring a forceful change in U-Bolt spread.

The clip assembly must be properly installed capable of being torqued to its full recommended value.

The roddles in the clip base must be undamaged.

The clip assembly must be re-torqued after the initial load application.

Never saddle a “dead horse”

Never place “U-bolt” over the live line



Incorrect; all three U-Bolts are on the live line.



Incorrect; U-Bolts are staggered, one U-Bolt is on the live line.



Incorrect splicing of two wire ropes; not enough clips. U-Bolts not aligned properly.

Module 6 slide 15

Application of bundle clips

G460 soft eye bundle clip



G461 thimble eye bundle clip



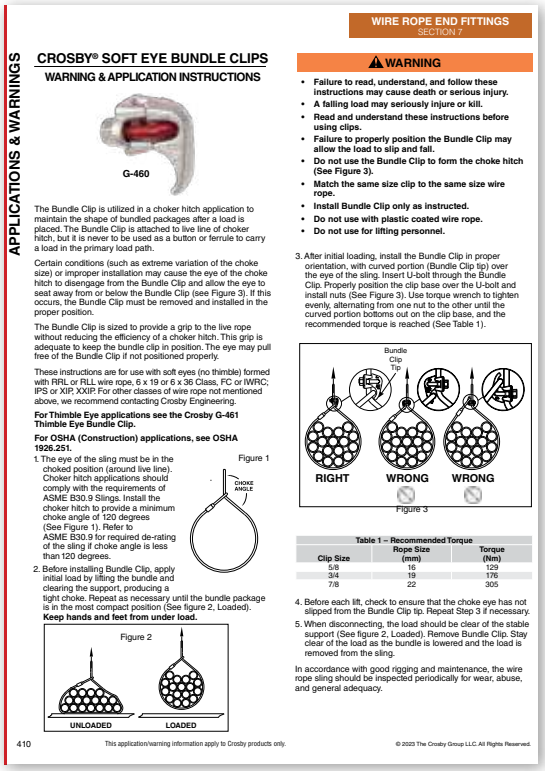
Module 6 slide 16

Application of bundle clips

- For transporting bundles of pipe and other cylindrical items.
- Specific design allows the choker hitch of the sling to maintain its position, even after tension of the load is released.
- Allows for quick and easy crane attachment and transfer of load.

Module 6 slide 17

NOTES:



APPLICATIONS & WARNINGS

WIRE ROPE END FITTINGS
SECTION 7

CROSBY® SOFT EYE BUNDLE CLIPS
WARNING & APPLICATION INSTRUCTIONS

G-460

The Bundle Clip is utilized in a choker hitch application to maintain the shape of bundled packages after a load is placed. The Bundle Clip is attached to live line of choker hitch, but it is never to be used as a button or ferrule to carry a load in the primary load path.

Certain conditions (such as extreme variation of the choke size) or improper installation may cause the eye of the choke hitch to disengage from the Bundle Clip and allow the eye to seat away from or below the Bundle Clip (see Figure 3). If this occurs, the Bundle Clip must be removed and installed in the proper position.

The Bundle Clip is sized to provide a grip to the live rope without reducing the efficiency of a choker hitch. This grip is adequate to keep the bundle clip in position. The eye may pull free of the Bundle Clip if not positioned properly.

These instructions are for use with soft eyes (no thimble) formed with RRL or RLL wire rope, 6 x 19 or 6 x 36 Class, FC or IWRC; IPS or XIP, XXIP. For other classes of wire rope not mentioned above, we recommend contacting Crosby Engineering.

For Thimble Eye applications see the Crosby G-461 Thimble Eye Bundle Clip.

For OSHA (Construction) applications, see OSHA 1926.251.

1. The eye of the sling must be in the choked position (around live line). Choker hitch applications should comply with the requirements of ASME B30.9 Slings. Install the choker hitch to provide a minimum choke angle of 120 degrees (See Figure 1). Refer to ASME B30.9 for required de-rating of the sling if choke angle is less than 120 degrees.

Figure 1

CHOKE ANGLE

2. Before installing Bundle Clip, apply initial load by lifting the bundle and clearing the support, producing a tight choke. Repeat as necessary until the bundle package is in the most compact position (See figure 2, Loaded). **Keep hands and feet from under load.**

Figure 2

UNLOADED LOADED

⚠ WARNING

- **Failure to read, understand, and follow these instructions may cause death or serious injury.**
- **A falling load may seriously injure or kill.**
- **Read and understand these instructions before using clips.**
- **Failure to properly position the Bundle Clip may allow the load to slip and fall.**
- **Do not use the Bundle Clip to form the choke hitch (See Figure 3).**
- **Match the same size clip to the same size wire rope.**
- **Install Bundle Clip only as instructed.**
- **Do not use with plastic coated wire rope.**
- **Do not use for lifting personnel.**

3. After initial loading, install the Bundle Clip in proper orientation, with curved portion (Bundle Clip tip) over the eye of the sling. Insert U-bolt through the Bundle Clip. Properly position the clip base over the U-bolt and install nuts (See Figure 3). Use torque wrench to tighten evenly, alternating from one nut to the other until the curved portion bottoms out on the clip base, and the recommended torque is reached (See Table 1).

Bundle Clip Tip

RIGHT WRONG WRONG

Figure 3

Table 1 – Recommended Torque

Clip Size	Rope Size (mm)	Torque (Nm)
5/8	16	129
3/4	19	176
7/8	22	305

4. Before each lift, check to ensure that the choke eye has not slipped from the Bundle Clip tip. Repeat Step 3 if necessary.
5. When disconnecting, the load should be clear of the stable support (See figure 2, Loaded). Remove Bundle Clip. Stay clear of the load as the bundle is lowered and the load is removed from the sling.

In accordance with good rigging and maintenance, the wire rope sling should be inspected periodically for wear, abuse, and general adequacy.

410

This application/warning information apply to Crosby products only.

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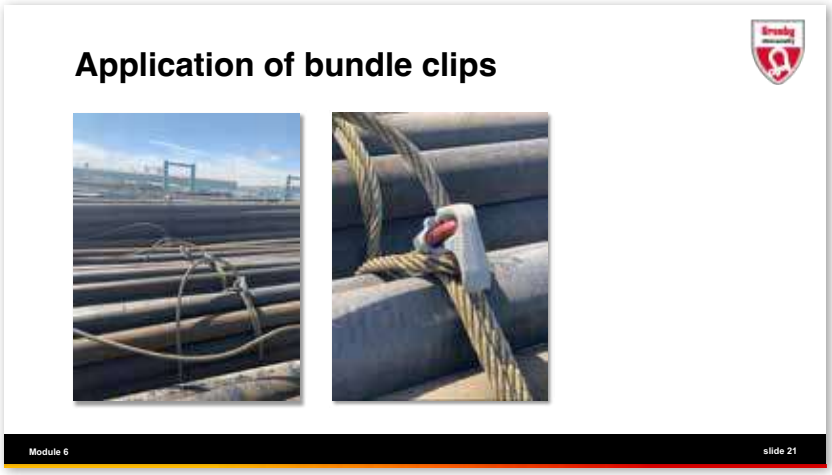
See Crosby Application and Warning Information found in the back of the Kito Crosby catalog for more information.



NOTES:

Do not lift directly on the bundle clip!

These clips are designed to allow the choker hitch of the sling to maintain position, even after tension of the load is released.





NOTES:

Rigging practices – Wedge sockets

- Wedge socket materials shall be of sufficient strength such that failure of the wire rope will occur before failure of the wedge socket.
- Before installing a wedge socket on plastic coated or plastic impregnated wire rope, consult the manufacturer.
- The wedge socket shall be assembled as recommended by the manufacturer.
- The live line of wire rope shall be aligned with socket pin
- The proper wedge shall be matched with the socket
- Wedges shall not be interchanged between different manufacturers' sockets or models
- The dead-end tail of the wire rope extending beyond wedge shall be secured as recommended by the manufacture.
- The dead-end of the wire rope shall not be attached to the live line such that it restricts the movement of the live end.
- After assembly, the connection shall be loaded to fully seat the wedge before use.
- Wedge sockets should not be side loaded, shock loading and impacts should be avoided.

D/d RATIO - BLOCKS & SHEAVES

Crosby

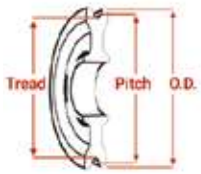
WEDGE SOCKETS QUIC-CHECK

17



D = SHEAVE PITCH DIAMETER

d = WIRE ROPE DIAMETER



	EFFICIENCY ROPE REDUCES ITS BENDING STRENGTH	FATIGUE LIFE REPEATED BENDING AND STRAIGHTENING OF WIRE ROPE CAUSES "FATIGUING"
D/d	STRENGTH EFFICIENCY COMPARED TO CATALOG STRENGTH IN %	RELATIVE FATIGUED BENDING LIFE
40	95%	
30	93%	10
25	92%	6.6
20	91%	3.8
18	90%	2.9
16	89%	2.1
14	88%	1.5
12	87%	1.1
10	86%	
8	83%	
6	79%	
4	75%	
2	65%	
1	50%	

Figure 1

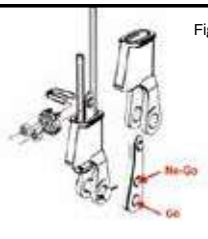


Figure 2



ASSEMBLY SAFETY

- Use only with standard 6 to 8 strand wire rope of designated size. For intermediate size rope, use next larger size socket. Tail length of dead end as per figure 1.
- Align live end of rope with centre of pin. (see figure 1)
- Secure dead end section of rope. (see figure 1)
- Do not attach dead end to live end. (see figure 2)
- Use a hammer to seat wedge and rope as deep into socket as possible before applying first load.
- Refer to figure 1 for assembly of Crosby terminator wedge socket.
- Dead end should be seized, brazed or welded before inserting into socket. Method used depends on type or wire rope. Refer to wire rope manufacturer for instructions. Seizing is normally the preferred method. Welding on the tail of standard wire rope is not recommended.

OPERATING SAFETY

- Apply first load to fully seat the wedge and wire rope in the socket. This load should be of equal or greater weight than loads expected in use. Tighten nuts on clip to recommended torque.
- Efficiency rating of the wedge socket termination is based upon the catalogue breaking strength of wire rope. The efficiency of a properly assembled wedge socket is 80%. (80% only with use of EEIP steel wire rope)

For additional information refer to the Crosby catalogue

Wedge socket

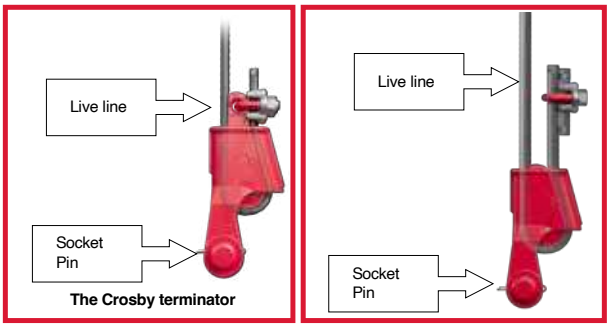
Basic requirements for proper termination

- Live line in line with pin
- Proper tail length for 6 to 8 strand wire rope: At least 6 diameters, not less than 150 mm
- Proper tail length for rotation resistant wire rope: At least 20 diameters, not less than 150 mm
- Secure tail, do not “clip” to live line
- Apply first load to seat wedge



Module 6 slide 27

Wedge socket
Live line in-line with pin



Module 6 slide 28

Wedge socket - Seat wedge

- Use a hammer to seat wedge and rope as deep into socket as possible before applying first load
- Apply first load to fully seat the wedge and wire rope in the socket
- First load should be of equal or greater weight than the loads expected in service



Module 6 slide 29

NOTES:

ASME B30.5 requires that “wire rope clips used in conjunction with wedge sockets shall be attached to the unloaded dead end of the rope only”.

Seize ends of all wire rope. Welding of the tail of the dead end is not recommended when using standard 6 to 8 strand wire ropes.

When using rotation resistant wire rope, based on wire rope manufacturer, ensure that the dead end is seized, welded or brazed before inserting into wedge socket to prevent core slippage.

Use a hammer to seat wedge and rope as deep into socket as possible before applying first load.

Apply first load to fully seat the wedge and wire rope in the socket.

First load should be of equal or greater weight than the loads expected in service.

During use, do not strike the dead end section with any other elements of the rigging, this is called “two blocking.”

Do not side load the wedge.

S-423T Super Terminator

The 423T wedge socket terminations have a minimum efficiency rating on most high-performance, high-strength, compacted-strand, rotation-resistant wire ropes of 80% based on the catalog breaking strength of the various ropes.

The design eliminates the difficulty of properly seating the wedge with high performance wire rope into a wedge socket termination.



S-423T

The Crosby Terminator - Secure tail

Properly match socket, wedge and clip.



Module 6 slide 30

Wedge sockets - Secure tail



Torque wire rope clip to same value as for a wire rope clip termination

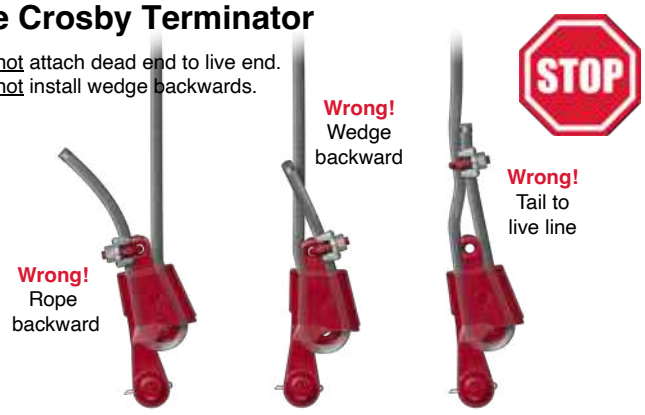
TABLE 1								
Rope Size (mm)	9-10	11-13	14-16	18-19	20-22	24-26	28	32
Clip Size (in)	3/8	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4
* Torque NM	61	88	129	176	305	305	305	488

* The tightening torque values shown are based upon the threads being clean, dry, and free of lubrication.

Module 6 slide 31

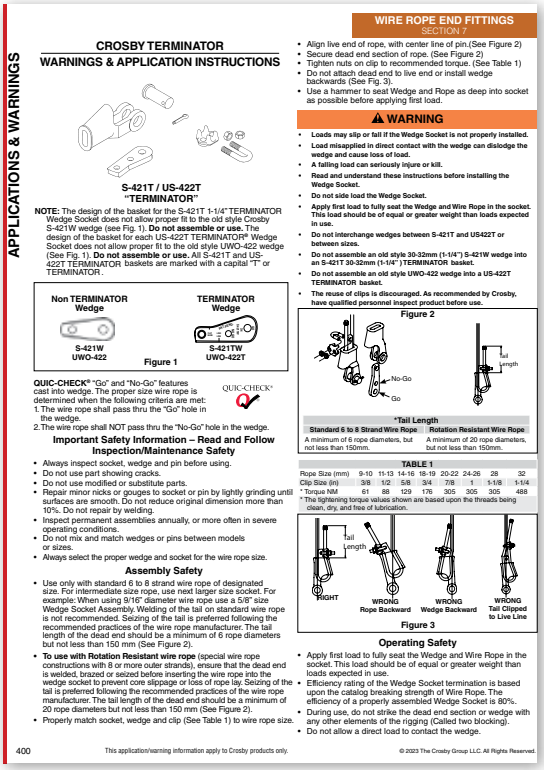
The Crosby Terminator

Do not attach dead end to live end.
Do not install wedge backwards.



Module 6 slide 32

NOTES:



APPLICATIONS & WARNINGS

WIRE ROPE END FITTINGS
SECTION 7

CROSBY TERMINATOR
WARNINGS & APPLICATION INSTRUCTIONS

S-421T / US-422T
"TERMINATOR"

NOTE: The design of the basket for the S-421T 1-1/4" TERMINATOR Wedge Socket does not allow proper fit to the old style Crosby S-421W wedge (see Fig. 1). **Do not assemble or use.** The design of the basket for each US-422T TERMINATOR® Wedge Socket does not allow proper fit to the old style UWO-422 wedge (See Fig. 1). **Do not assemble or use.** All S-421T and US-422T TERMINATOR baskets are marked with a capital "T" or TERMINATOR.

Non TERMINATOR Wedge — S-421W UWO-422
TERMINATOR Wedge — S-421TW UWO-422T
Figure 1

QUIC-CHECK® "Go" and "No-Go" features cast into wedge. The proper size wire rope is determined when the following criteria are met:
1. The wire rope shall pass thru the "Go" hole in the wedge.
2. The wire rope shall NOT pass thru the "No-Go" hole in the wedge.

Important Safety Information – Read and Follow Inspection/Maintenance Safety

- Always inspect socket, wedge and pin before using.
- Do not use part showing cracks.
- Do not use modified or substitute parts.
- Repair minor nicks or gouges to socket or pin by lightly grinding until surfaces are smooth. Do not reduce original dimension more than 10%. Do not repair by welding.
- Inspect permanent assemblies annually, or more often in severe operating conditions.
- Do not mix and match wedges or pins between models or sizes.
- Always select the proper wedge and socket for the wire rope size.

Assembly Safety

- Use only with standard 6 to 8 strand wire rope of designated size. For intermediate size rope, use next larger size socket. For example: When using 9/16" diameter wire rope use a 5/8" size Wedge Socket Assembly. Welding of the tail on standard wire rope is not recommended. Seizing of the tail is preferred following the recommended practices of the wire rope manufacturer. The tail length of the dead end should be a minimum of 6 rope diameters but not less than 150 mm (See Figure 2).
- **To use with Rotation Resistant wire rope** (special wire rope constructions with 8 or more outer strands), ensure that the dead end is welded, brazed or seized before inserting the wire rope into the wedge socket to prevent core slippage or loss of rope lay. Seizing of the tail is preferred following the recommended practices of the wire rope manufacturer. The tail length of the dead end should be a minimum of 20 rope diameters but not less than 150 mm (See Figure 2).
- Properly match socket, wedge and clip (See Table 1) to wire rope size.

- Align live end of rope, with center line of pin.(See Figure 2)
- Secure dead end section of rope. (See Figure 2)
- Tighten nuts on clip to recommended torque. (See Table 1)
- Do not attach dead end to live end or install wedge backwards (See Fig. 3).
- Use a hammer to seat Wedge and Rope as deep into socket as possible before applying first load.

⚠ WARNING

- **Loads may slip or fail if the Wedge Socket is not properly installed.**
- **Load misapplied in direct contact with the wedge can dislodge the wedge and cause loss of load.**
- **A falling load can seriously injure or kill.**
- **Read and understand these instructions before installing the Wedge Socket.**
- **Do not side load the Wedge Socket.**
- **Apply first load to fully seat the Wedge and Wire Rope in the socket. This load should be of equal or greater weight than loads expected in use.**
- **Do not interchange wedges between S-421T and US422T or between sizes.**
- **Do not assemble an old style 30-32mm (1-1/4") S-421W wedge into an S-421T 30-32mm (1-1/4") TERMINATOR basket.**
- **Do not assemble an old style UWO-422 wedge into a US-422T TERMINATOR basket.**
- **The reuse of clips is discouraged. As recommended by Crosby, have qualified personnel inspect product before use.**

Figure 2

*Tail Length

Standard 6 to 8 Strand Wire Rope	Rotation Resistant Wire Rope
A minimum of 6 rope diameters, but not less than 150mm.	A minimum of 20 rope diameters, but not less than 150mm.

TABLE 1

Rope Size (mm)	9-10	11-13	14-16	18-19	20-22	24-26	28	32
Clip Size (in)	3/8	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4
* Torque NM	61	88	129	176	305	305	305	488

* The tightening torque values shown are based upon the threads being clean, dry, and free of lubrication.

RIGHT — WRONG Rope Backward — WRONG Wedge Backward — WRONG Tail Clipped to Live Line
Figure 3

Operating Safety

- Apply first load to fully seat the Wedge and Wire Rope in the socket. This load should be of equal or greater weight than loads expected in use.
- Efficiency rating of the Wedge Socket termination is based upon the catalog breaking strength of Wire Rope. The efficiency of a properly assembled Wedge Socket is 80%.
- During use, do not strike the dead end section or wedge with any other elements of the rigging (Called two blocking).
- Do not allow a direct load to contact the wedge.

400 This application/warning information apply to Crosby products only. © 2023 The Crosby Group LLC. All Rights Reserved.

See Crosby Application and Warning Information found in the back of the Kito Crosby catalog for more information.

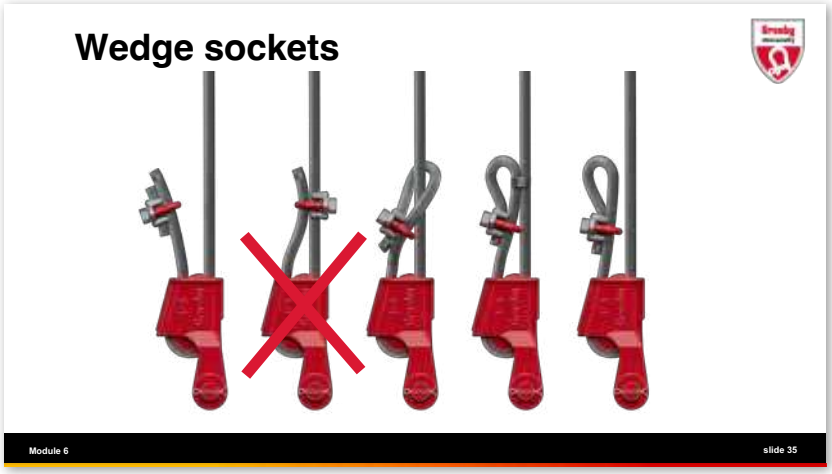
Select wedge socket to match wire rope size. For intermediate rope sizes, use next larger size socket (example: use 5/8" wedge socket assembly for 9/16" diameter wire rope).

Crosby wedge sockets have Quic-Check "go" and "no-go" holes to check wire rope size. Never substitute wedges, only use proper size wedge and matching socket.

As stated in our general catalog, wedge sockets have an efficiency rating of 80% based on the catalog strength of the wire rope.



Never attach the dead-end of the rope directly to the live line with the wire rope clip.



NOTES:

With old style short wedges, there are various options to fix the dead end of the rope. However, it is not allowed to fix the dead end to the live line with the wire rope clip.

Be aware that a wire rope clip always needs to clamp 2 pieces of wire rope of the same size which is indicated on both the wedge socket and clip base.

When only 1 piece of rope is clamped by the wire rope clip, the dead end could slip through at some point.

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01



02



Improper installation of a wedge socket. Never fix the dead end of the wire rope to the live line with the wire rope clip.

03





04



SB-427 button spelter sockets



- Designed for use with mobile cranes
- Can be used to terminate all constructions of wire rope including high performance ropes, anti-rotation ropes and standard 6 strand ropes

Module 6 slide 36

NOTES:

Utilize WIRELOCK® for making termination.

Button spelter sockets are designed for use with mobile cranes. They can be used to terminate high performance, rotation resistant ropes, and standard 6 strand ropes.

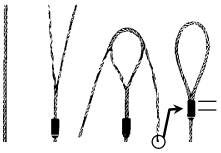
Button spelter terminations have a 100% efficiency rating, based on the strength of the wire rope.



Flemish eye

Basic requirements for proper termination

- Form eye as shown (split 3 and 3 plus core)
- Use proper size sleeve for wire rope size
- Ensure “tails” inserted proper distance
- Properly swage without creating flash, or cracking
- Check for proper “after swage dimension” (with gauge)



EN 13411 – Terminations for steel wire ropes
EN 13414 – Steel wire rope slings

Module 6 slide 38

Fabrication of wire rope slings can only be performed by a trained & competent person.

Kito Crosby offers swage training upon special request. This training program is designed to provide an overview of the proper procedures to properly swage Crosby swage products.

Crosby S505 steel sleeves are available in sizes from 6mm (1/4”) to 114mm (4-1/2”).

Consider Crosby Quic-Pass dies for sizes 6mm (1/4”) to 38mm (1-1/2”) for improved production efficiency.

The QUIC-PASS® swaging system allows “Flemish style” wire rope terminations to be swaged in only two passes.

This is accomplished while maintaining currently published efficiency ratings and utilizing National Swage S-505 Standard “COLD TUFF®” Steel Sleeves.

- Allows the swaging process to be completed in just two passes, resulting in a 50-75% reduction in the number of passes required with conventional swaging systems.
- Allows the dies to close completely with each pass.
- An increase in overall swaging process efficiencies (the job can be performed quicker).
- A reduction in the complexity of swaging (the concern for excess flashing between dies has been eliminated).
- A reduction in training time needed for operators (more user friendly).
- The finished sleeve has a “Hex” appearance that provides a QUIC-CHECK® look to determine if the termination has been swaged and provides a flat surface that allows for ease of I.D. stamping on the finished sleeve.



Turnback eye

Basic requirements for proper termination

- Use proper size sleeve for wire rope size
- Turnback proper amount of rope
- Ensure tail extends up to one rope diameter beyond sleeve
- Swage properly without creating flash, or cracking
- Check for proper “after swage dimension” (with gauge)

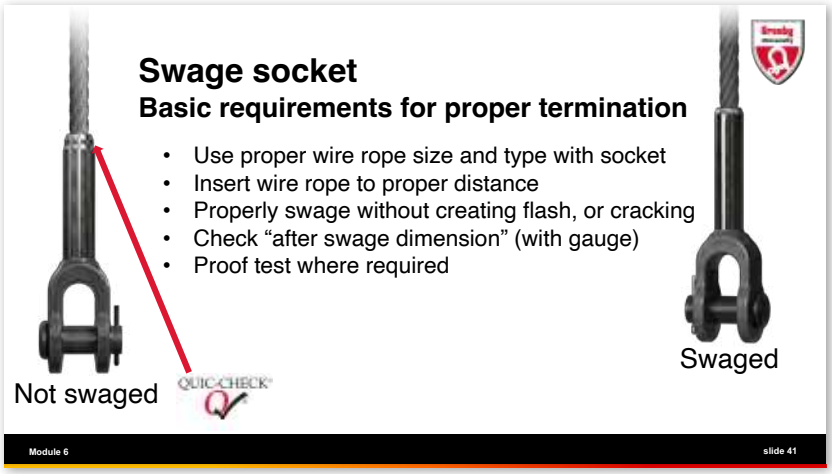
EN 13411 – Terminations for steel wire ropes
EN 13414 – Steel wire rope slings

Module 6 slide 39



NOTES:

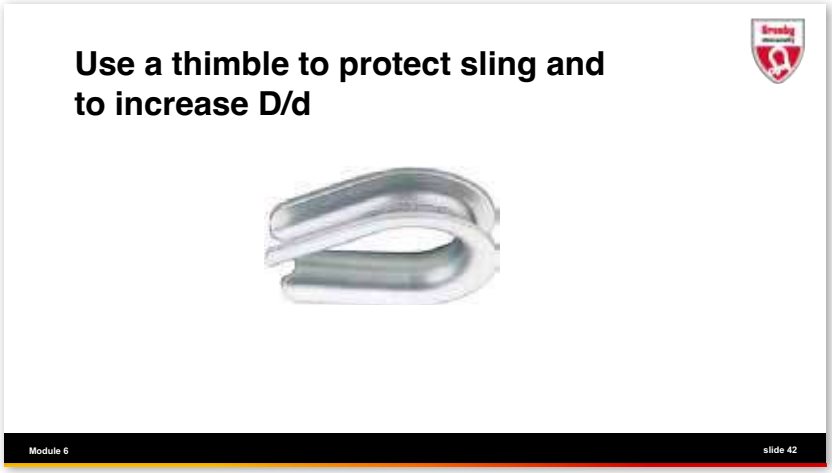
Steel sleeves perform much better than aluminum sleeves in terms of corrosion resistance.



Swage sockets incorporate a reduced machined area of the shank which is equivalent to the proper ‘after swage’ dimension.

Before swaging, this provides for an obvious visual difference in the shank diameter.

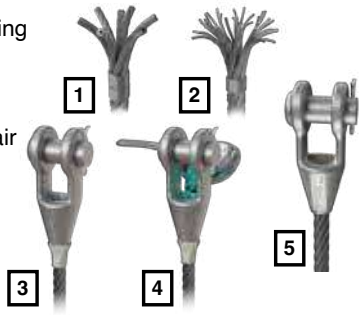
After swaging, a uniform shank diameter is created allowing for a QUIC-CHECK® and permanent visual inspection opportunity.



The use of thimbles does not increase the capacity (WLL) of the wire rope sling. It just gives additional protection to the sling eye.

Spelter socket
Basic requirements for proper termination

- Put socket over the rope before brooming
- Broom and clean wire properly
- Place wire properly in socket in proper alignment
- Pour socket continuously and without air pockets
- Relubricate wire rope at socket
- Proof test where required



Module 6 slide 43

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Spelter socket
Brooming



- Cut out any fiber core
- Unlay the individual wires from each strand
- Including the IWRC, completely, down to the seizing
- Remove any plastic material from broomed area



Module 6 slide 44

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NOTES:

Assembling a socket onto a wire rope can only be performed by a trained & competent person.

Kito Crosby offers socketing training upon special request. This training program is designed to provide an overview of the proper procedures to spelter Crosby sockets.



Wirelock

Wirelock kits are pre-measured and consist of two (2) containers:
• one (1) with resin
• one (1) with granular compound.

Always use the complete kit.

Never mix less than the total contents of both containers!

Each kit has a shelf life clearly marked on each container which must be observed.

The shelf life is 18 months from the date of manufacturing.

Store at temperatures not exceeding 20°C.

Never use out-of-date material.

Booster packs are available for pouring sockets at temperatures below 9° C (48° F).

Wirelock should not be mixed or poured at temperatures below -3° C (27° F).

Wirelock Safety Data Sheets (MSDS) can be downloaded from our website.

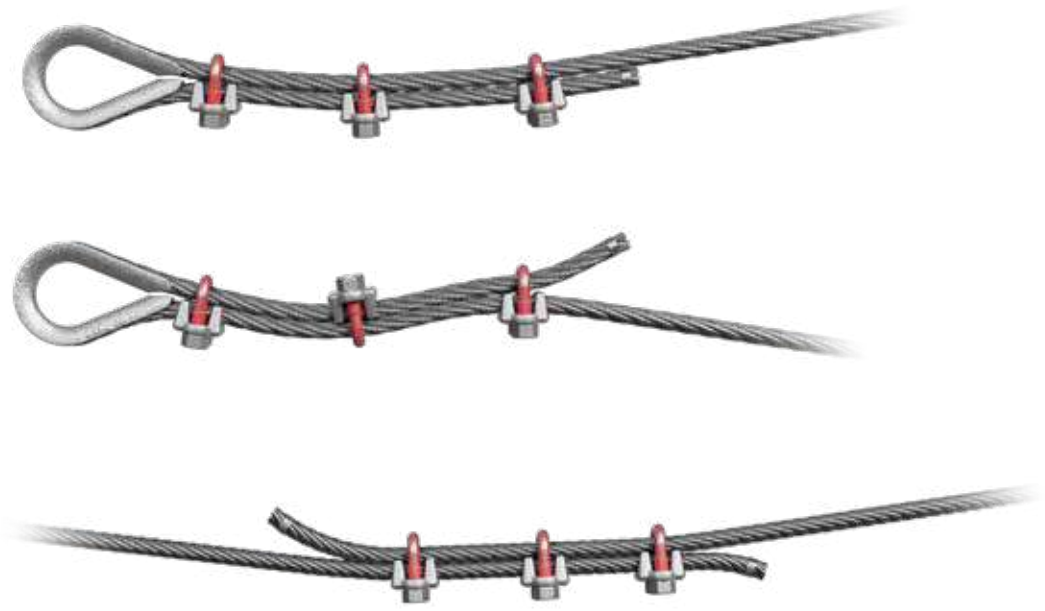
See Crosby catalog or Crosby Wire Rope End Terminations Manual for full information.

What is wrong?

1



2



Welcome to

Inspection of hardware 7

Based on applicable standards and product application information for

Crosby GUNNEBO Industries

Module 7 slide 1

INSPECTION OF HARDWARE

DEFORMATION

Remove from service if there is any significant deformation. Check throat opening of hooks.

WEAR

Remove from service if there is excessive wear.
Wear is excessive if:

- More than 5% wear in throat or eye of hook and other critical areas of hardware.
- More than 10% wear in other areas.

CRACKS, NICKS, GOUGES

Remove from service if cracks, nicks, or gouges are detected.

MODIFICATION

Do not weld on hardware, and never substitute shackle pins or other components. Do not heat, bend or modify hardware in any manner.

PROPER FUNCTION

Improperly installed hardware or malfunction is cause for removal. Check for latches, swivel bearings, locking devices and proper installation of wire rope clips and wedge sockets.

INSPECTION OF WIRE ROPE SLINGS 3

All slings and attachments shall be visually inspected by the person handling the sling each day or prior to each use. In addition, a periodic inspection shall be performed by a competent person, at least once every 6 months (or per legal requirements) and shall include a record of the inspection.

INSPECTION CRITERIA

- Kinking
- Crushing
- Unstranding
- Birdcaging
- Strand displacement
- Core protrusion
- Corrosion
- Broken or cut strands
- Broken wires

BROKEN WIRES

Refer to the applicable standards such as EN 13414 with specific discard criteria and guidance regarding the number of broken wires.

DISTORTION OF WIRE ROPE

Remove from service wire rope slings that have any damage resulting in distortion of the wire rope structure such as: kinking, crushing, unstranding, bird caging, strand displacement or core protrusion.

Inspection of rigging hardware Frequency

Initial: prior to initial use

Frequent: each day before the rigging hardware is used, semi-permanent and inaccessible locations where frequent inspections are not feasible shall have periodic inspections performed

Periodic inspection:

- Normal service – yearly
- Severe service – monthly to quarterly
- Special service – as recommended by a qualified person

Or as required per local regulations

Module 7 slide 4

Inspection of rigging hardware Removal criteria

- Missing or illegible manufacturer's name or trademark and/or rated load identification
- A 10% reduction of the original or catalog dimension
- Bent, twisted, distorted, stretched, elongated, cracked or broken load bearing components
- Excessive nicks or gouges
- Excessive pitting or corrosion

ASME B30.26

Module 7 slide 5

Inspection of rigging hardware Removal criteria

- Indications of heat damage including weld spatter or arc strikes.
- Evidence of unauthorized welding.
- Loose or missing nuts, bolts, cotter pins, snap rings, or other fasteners and retaining devices.
- Unauthorized replacement components.
- Other conditions including visible damage that cause doubt as to the continued use.

ASME B30.26

Module 7 slide 6

NOTES:

The rigging industry has developed general recommendations for the inspection of rigging hardware (fittings):

1. Initial inspection: prior to use. All new, altered, modified, or repaired rigging hardware shall be inspected by a designated person. Written records are not required. However, it is recommended to have certificates for your lifting hardware, as per local legislation.

2. Frequent inspection: a visual inspection shall be performed by the user or other designated person each day before the rigging hardware is used. Semi-permanent and inaccessible locations where frequent inspections are not feasible shall have periodic inspections performed. Any condition that may result in a hazard shall cause the rigging hardware to be removed from service. Written records are not required for frequent inspections.

3. Periodic inspection: a complete inspection of the rigging hardware shall be periodically performed by a designated person. The rigging hardware shall be examined and a determination made as to whether they constitute a hazard. Written records are required and updated certification to be issued when local legislation requires.

Periodic inspection intervals shall be as per local legislation but should not exceed one year. The frequency of periodic inspections should be based on:
(1) frequency of use
(2) severity of service
(3) nature of lifts being made
(4) experience gained

Inspection of rigging hardware
Specific removal criteria

- Shackles - incomplete pin engagement
- Swivel hoist rings – lack of ability to freely rotate or pivot
- Swivels – not able to freely swivel when not loaded, loose or missing nuts, fasteners and retaining devices
- Wire rope clips – insufficient number, improperly tightened nuts, wire rope slippage or rope damage
- Wedge sockets - wire rope slippage or rope damage

ASME B30.26

Module 7 slide 7

NOTES:

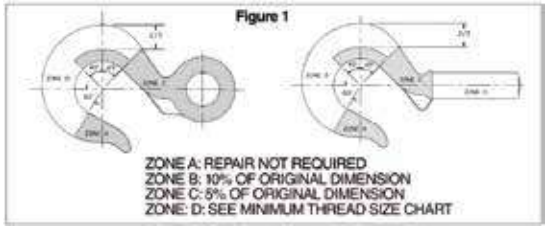
Inspection of hardware - Wear



- 10% or more reduction in any sectional dimension indicates it has excessive wear
- 5% or more in throat or eye of hook
- Measure by comparing to a section of fitting that has no wear, or to the catalog dimensions
- Make sure identification is legible

Module 7 slide 8

The 10% wear allowance is based on any cross-sectional dimension. If wear is in two directions in same area, wear is limited to 5% of cross-section area. Wear is also limited to 5% in two critical areas of hooks.







Excessive wear, remove from service.

Inspection of fittings
Deformation



Any significant permanent deformation, or change in shape, indicates it has been overloaded and must be removed from service.

Module 7 slide 11

Ductile vs brittle failure



Ductile failure shows deformation.

Crosby & Gunnebo Industries products are properly heat treated for improved ductility, impact properties and fatigue.



Brittle failure shows no deformation.

When items are not properly heat treated, the product might suddenly fail with little or no warning.

Module 7 slide 12

NOTES:

Deformation of hooks



Any visible apparent bend or twist from the plane of the unbent hook.

Any distortion causing an increase in throat opening of 5% not to exceed 7mm.

Module 7 slide 13

Crosby QUIC-CHECK marks



Deformation Indicators A-A.

Module 7 slide 15

Quic-Check marks on Crosby hooks facilitate measuring the throat opening. To check, measure the distance between the marks.

Crosby Shurloc (self-locking) hooks also have deformation indicators. The exact distance between those marks can be found in the catalog.

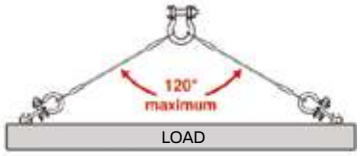
SHACKLES

Fatigue Rated Q&T QUIC-CHECK

HOOKS

G209 G2130 t	G209A G2140* t	CARBON & ALLOY SHACKLES QUENCHED AND TEMPERED				CARBON STEEL WLL		ALLOY STEEL WLL		O THROAT OPENING	A-A INDICATOR*
		D	B	A	C	t	CODE	t	CODE	mm	mm
1	2	9.65	11.20	16.80	36.60	0.75	DC	1.25	DA	22.6	38.1
1.5	2.6	11.20	12.70	19.10	42.90	1.0	FC	1.6	FA	23.1	50.8
2	3.3	12.70	16.00	20.60	47.80	1.6	GC	2.5	GA	25.4	50.8
3.25	5	15.70	19.10	26.90	60.50	2.0	HC	3.2	HA	27.7	50.8
4.75	7	19.10	22.40	31.80	71.50	3.2	IC	5.4	IA	34.5	63.5
6.5	9.5	22.40	25.40	36.60	84.10	5.0	JC	8.0	JA	40.9	76.2
8.5	12.5	25.40	29.50	42.90	95.50	7.5	KC	11.5	KA	53.0	102
9.5	15	29.50	31.80	46.00	108.00	10.0	LC	16.0	LA	57.5	102
12	18	32.80	35.80	51.60	119.00	15.0	NC	22.0	NA	76.5	127
13.5	21	36.10	39.60	57.20	133.00	20.0	OC	31.5	OA	82.5	165
17	30*	38.90	42.20	60.50	146.00	25.0	PC	37.0	PA	76.0	178
25	40*	46.70	51.60	73.20	178.00	30.0	SC	45.0	SA	86.0	203
35	55*	52.60	57.90	82.60	197.00						
55	85*	69.10	70.60	105.00	267.00						

- WLL is based on in-line loading; side loading will reduce the rated working load limit.
- Use a bolt type shackle for permanent installation.
- Use a bolt type shackle anytime the sling or any object may contact the pin causing the pin to rotate.



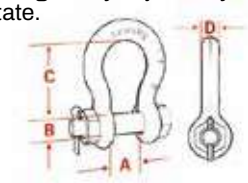
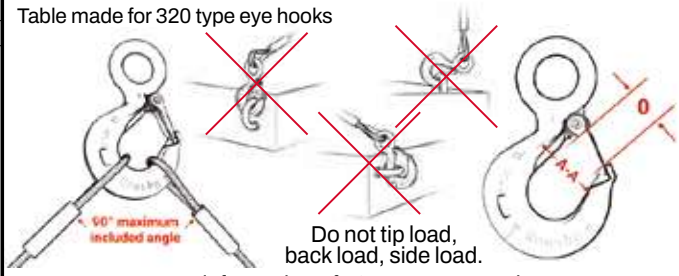


Table made for 320 type eye hooks



Do not tip load, back load, side load.

*Max. deformation of 5%, not to exceed 7mm

For additional information refer to the Crosby catalogue



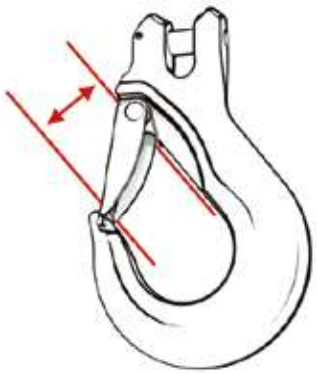


	Crosby Shur-Loc hooks	Gunnebo BK-type hooks	Crosby & Gunnebo
SIZE	MAXIMUM A (mm)	MAXIMUM A (mm)	MAXIMUM B (mm)
6	1	2.2	3.5
7/8	1	2.7	4.5
10	1	3	6
13	1.5	3.3	7
16	2	4	9
18/20	3	5.5	10
22	3	6	11
26	3	6.5	12
32	4	7	13

This table indicates the maximum clearance between hook and latch.
Note: For a griplatch hook measure the difference between dimension A with unloaded spring and dimension A when the latch is pressed against the hook. Clearance B is not applicable.







- Check the function of hook latches, locking pins/ collars on coupling links etc.
- Check hooks thoroughly for widened apertures, which indicate abnormal loading.
- The increase in hook aperture must not exceed 10%.
- No elongation is permitted for coupling components such as G-links, masterlinks, kuplers, C-grabs or C-loks.
- Wear must not exceed 10%.
- Examine all lifting components thoroughly for transversal cracks, wear and other damage.

Field marking of Crosby hooks without QUIC-CHECK marks



Place reference marks only in these two areas:
1. In the tip area
2. In shoulder area centered on shank or eye

Use a round pointed punch, not sharp or pyramid point.

Module 7 slide 16

NOTES:

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Inspection of fittings Cracks and sharp nicks



Any crack, sharp nick or gouge in the surface of any fitting is cause for removal from service.

Module 7 slide 19

Cracks can occur if a properly made fitting is repeatedly overloaded. A crack can also occur if non-heat-treated fittings are used in frequently cycled loads that are within the working load limits.



Cracks are cause for removal from service.

.....

.....

Crosby grinding instructions

Crosby allows a qualified person to remove sharp nicks or gouges with a file or light grinding (pencil grinder).

The qualified person must grind longitudinally following the contour of the fitting.

Do not exceed 5% - 10% reduction of any cross-sectional dimension. Surface finish should be equivalent to the forged finish.

Module 7 slide 21

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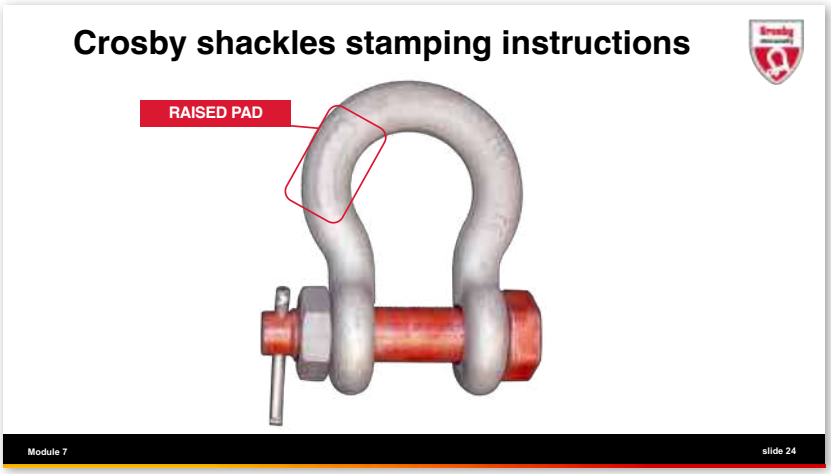
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NOTES:

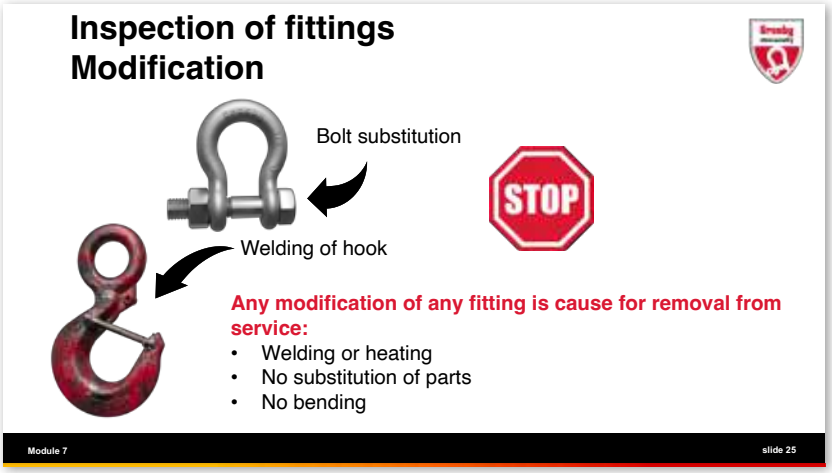
Stamped markings in Crosby & Gunnebo masterlinks and shackles

- Use low stress or dot faced stamps of appropriate size on indicated areas
- Indentation no deeper than 0.5 mm
- Do not stamp fitting less than 13 mm nominal size
- Vibra-etch tool may be used on all surfaces
- Specify stamp as:
  - Round face – full character
  - Or round face – dot design



Crosby shackles capacities 3.25t to 25t have a raised pad on the shackle body.

The raised pad on Crosby shackles is designed to accommodate serial numbers or identification marks. This enhances traceability and inspection management.



Welding on the body and bolt substitution are not allowed. Any modification of fittings is cause for removal from service.

Never modify a shackle by substituting the shackle pin. Always use a shackle pin manufactured by the manufacturer of the shackle.

Any modification will mean that the working load limit is no longer valid. The person modifying the fitting is responsible for design, testing and marking.





Inspection of hardware
Heat damage

- Heat damage caused by exposure to temperatures above 204°C
- Weld spatter
- Arc strikes
- Exposure to excessive temperature will damage the heat treatment and material strength. Severe weld spatter and arc strikes can create stress concentration and are cause for removal from service.



Module 7 slide 28

NOTES:

Hardware with non-ferrous materials or lubricated bearings must not be subjected to elevated temperatures.

Galvanized, plated or painted hardware may suffer degradation of the surface finish.

Extended exposure to elevated temperatures will cause surface scaling and reduction of properties.

Inspection of fittings
Wire rope terminations





More than one broken wire at any (within one wire rope diameter of the fitting) termination is cause for removal from service.



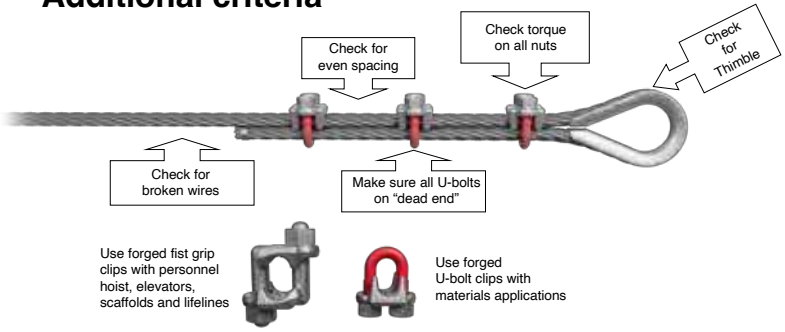
Module 7 slide 29

Severe corrosion at rope end connection which has caused pitting or binding of wires is cause for removal.

Light rusting usually does not affect strength, clean and relubricate the wire rope properly.

Consult wire rope manufacturer

Wire rope clips
Additional criteria



Module 7 slide 30

Re-use of wire rope clips

The U-bolt must fit into the base without requiring a forceful change in U-bolt spread.

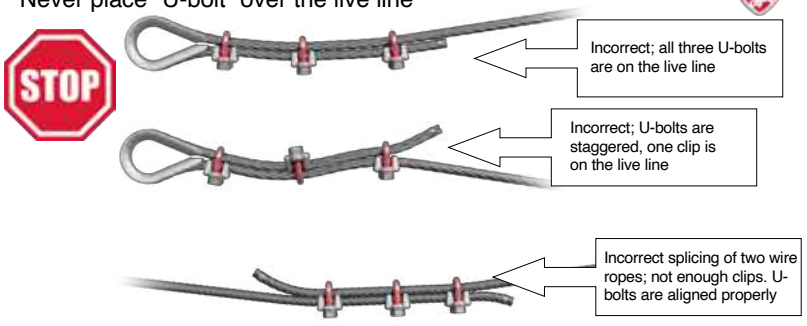
The clip assembly must be properly installed and capable of being torqued to its full recommended value.

The roddles in the clip base must be undamaged.

The clip assembly must be re-torqued after the initial load application.

Never saddle a “dead horse”

Never place “U-bolt” over the live line



Module 7 slide 31

NOTES:





Improper wire rope clip installation. Wire ripe clips should not be used to form a lifting sling.

Wedge socket

Basic requirements for proper termination:

- Live line in line with pin
- Proper tail length:
  (6 to 8 strand wire rope)
  at least 6 diameters, not less than 152 mm
- (Rotation resistant wire rope)
  at least 20 diameters, not less than 152 mm
- Secure tail, do not “clip” to live line
- Apply first load to seat wedge



Module 7 slide 33

Seize ends of the wire rope.

Welding of the tail of the dead end is not recommended when using standard 6 to 8 strand wire ropes.

When using rotation resistant wire rope, **based on wire rope manufacturer,** ensure that the dead end is seized, welded or brazed before inserting into wedge socket to prevent core slippage.

Improper installation of wedge socket

Do not attach dead end to live end or install wedge backwards



Wrong Rope Backward

Wrong Wedge Backward

Wrong Tail to Live line

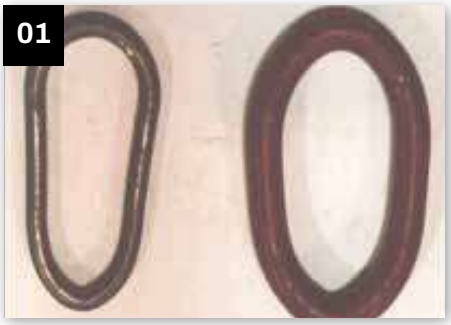
Module 7 slide 34

Never attach the dead-end of the rope directly to the live line with the wire rope clip.



Evaluate the rigging hardware

01



02



03



04





05



06



07



08





09



10



11



12





13



14



Has inspection been properly done?

15



Inspection of Hardware

1. The _____ is the maximum load that can be applied to rigging gear in service.
2. More than _____ broken wire at rope end connection is cause for removal.
3. Stamped markings must be in proper area and must use a _____ stamp.
4. _____ is required at least annually.
5. Remove from service a fitting that is _____ because it indicates it has been overloaded.
6. A _____ fitting must be removed from service because catastrophic failure is likely.
7. Fittings _____ in the field by welding or substitution of components shall be removed from service.
8. _____ in excess of 10% of any cross-sectional dimension is cause for removal of a fitting from service.
9. Check _____ to ensure the live line is in line with the pin and the tail is not clipped to the live line.
10. _____ is required each day the hardware is used.
11. Never _____ shackle pins.
12. _____ is required before first use.

Choose Answer from the Following List

a. working load limit
b. wedge socket
c. deformed
d. low stress
e. Initial inspection
f. substitute
g. modified
h. Wear
i. Frequent inspection
j. one
k. cracked
l. Periodic inspection

Welcome to

Sling hitches and application 8

Based on applicable standards and product application information for

Crosby GUNNEBO Industries

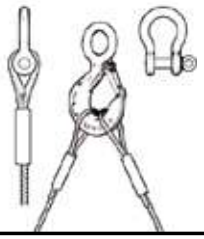
Module 8 slide 1

HITCHES 10

WIRE ROPE, CHAIN AND SYNTHETIC SLINGS

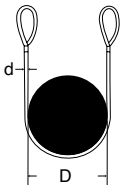
WIRE ROPE SLINGS AND CONNECTIONS TO FITTINGS

Use a thimble to protect sling and to increase D/d ratio. Never place eye over a fitting with a smaller diameter or width than the rope's diameter.

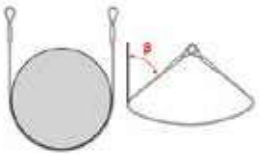


Never place a sling eye over a fitting with a diameter or width greater than one half the length of the eye. 1/3(L) for synthetic slings.





BASKET HITCH

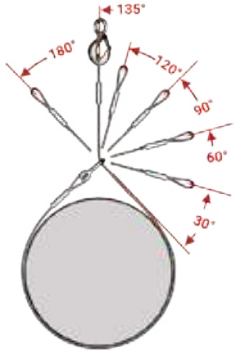


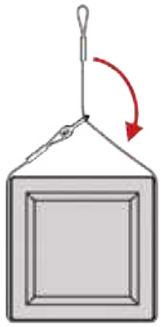
A basket hitch has twice the capacity of a single leg only if the D/d ratio ≥ 25/1 and legs of sling are vertical.
At other angles, see table.

Angle β	Percentage of single leg capacity
0°	200%
30°	170%
45°	140%
60°	100%

CHOKER HITCHES

A choker hitch has a maximum capacity of 80% of the single leg sling only if the angle of choke is 120 degrees or greater.





Angle of choke	Sling rated load percentage of single leg sling capacity
120° - 180°	80%
90° - 119°	65%
60° - 89°	55%
30° - 59°	40%

Selecting slings and hitches for load control

Select the sling to be used considering:

- the **hitch to be used**
- the load that will be applied
- the rigging environment
- the **sling material**



Vertical Hitch | Basket Hitch | Choker Hitch

Module 8 slide 4

NOTES:

Code of practice - Selection of slings

There are numerous factors to be considered in the selection of a sling for a particular task or range of tasks

- Sling type (material)
- Configuration (number of legs)
- Terminal fittings (hooks)
- Environmental conditions

LEEA – CODE OF PRACTICE – 1A5.3

Module 8 slide 5

When handling different types of lifting slings, it's important to consider their material properties, load capacity, inspection requirements, and suitability for specific environments. Each type of sling—synthetic, chain, and wire rope—has its advantages and limitations.

Code of practice – Selection of slings Nature of the load

- **Textile slings** are not suitable for a hot load
- **Chain** might be more durable if load has sharp edges, but even so, edge protection will be necessary
- **Flat woven webbing sling** or a **round sling** is likely to be best if load is polished or delicate in some other ways

LEEA – CODE OF PRACTICE – 1A5.3.5.1

Module 8 slide 6

The nature of the load is an important consideration when selecting lifting slings and hardware.

Code of practice - Selection of slings Environment

- **Chain slings** are likely to be more suitable if the atmosphere is hot (near a furnace).
- A corrosive environment (e.g. use in a plating shop) is a complex problem.
- **Textile slings** should never be stored where they will be exposed to radiated heat. Do not dry wet slings with heat as embrittlement may occur.

LEEA – CODE OF PRACTICE – 1A5.3.5.2

Module 8 slide 7

NOTES:

Environmental conditions can significantly affect lifting operations by impacting the safety, stability, and efficiency of the task. Adverse weather and environmental factors such as wind, salt water, extreme temperatures, and many other factors can increase the risk of accidents, equipment failure, and injuries.

Code of practice - Selection of slings Handling of the sling

- **Fibre slings** are lightest for a given lifting capacity and may be more suitable where frequent lifting and carrying of the sling is necessary.
- **Chain** and **round slings** flex and cannot readily be pushed through a narrow gap.
- **Wire rope** may be able to be pushed through a narrow gap.

LEEA – CODE OF PRACTICE – 1A5.3.5.3

Module 8 slide 8

Different types of lifting slings are not only suited to different lifting tasks, but they also feel and behave very differently when handled by workers. Each sling type comes with its own handling characteristics, which can have a big impact on ease of use, safety, and the physical demands placed on the operator.

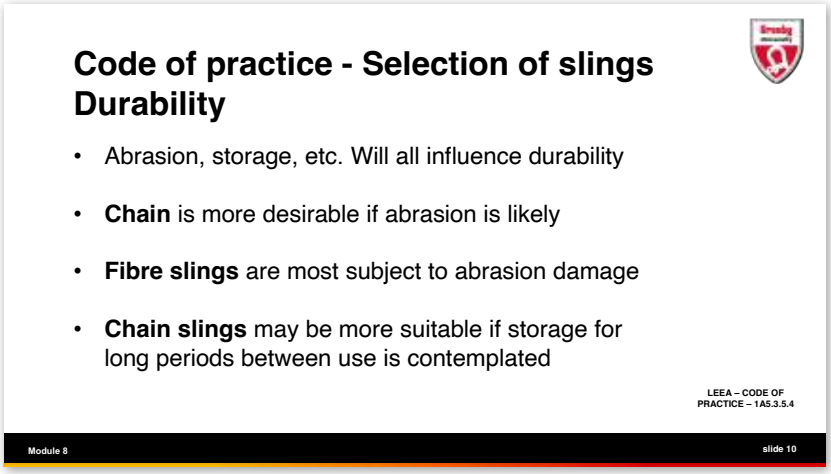
While all lifting slings serve the same basic purpose, the way they feel in the hands, the effort needed to move and position them, and the safety precautions required during handling can vary significantly. Choosing the right sling isn't just about load capacity—it's also about how practical and safe it is to handle in the field.

Code of practice - Selection of slings Handling of the sling

- **Wire rope** or **chain** is hard and cold to touch.
- **Fibre slings** are relatively larger in diameter (useful if pulling is involved) and warmer to handle.
- **Wire rope** is liable to broken wires which can injure hands.

LEEA – CODE OF PRACTICE – 1A5.3.5.3

Module 8 slide 9



NOTES:

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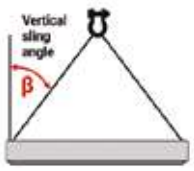
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Advantages and disadvantages of different sling materials

Sling	Advantages	Disadvantages
Textile	Kind to delicate loads Easy to handle due to light weight Relatively low cost	Easily damaged by sharp edged loads Cannot be used for high temperature loads
Chain	Can be use at higher temperatures Can be easy to adjust length More abrasive resistance than other materials	Can damage delicate loads Heavy weight to work with
Steel wire rope	Provides more rigidity than other materials (push) Good strength to weight ratio	Not as flexible Broken wires can expose user to injury

WIRE ROPE SLING CAPACITIES

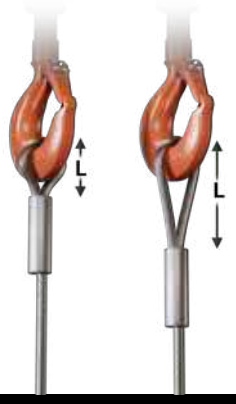
WORKING LOAD LIMITS FOR SLINGS USING STEEL CORED ROPE OF CLASSES 6X19, 6X36 AND 8X36 AND HAVING FERRULE-SECURED EYE TERMINATIONS - TENSILE STRENGTH 1770 KN/MM² - DESIGN FACTOR 5 / 1

WIRE ROPE SIZE		Crosby Q&T CARBON SHACKLE MIN. SHACKLE SIZE FOR A D/d >1 AT LOAD CONNECTION						
MM	MBL (kN)	SHACKLE SIZE (INCH)	VERTICAL (single leg) t	CHOKER t	TWO LEG SLINGS		THREE AND FOUR LEG SLINGS	
					0°< β ≤ 45° t	45°< β ≤ 60° t	0°< β ≤ 45° t	45°< β ≤ 60° t
8	40.3	3/8	0.75	0.60	1.05	0.75	1.55	1.10
10	63.0	7/16	1.15	0.92	1.60	1.15	2.40	1.70
12	90.7	1/2	1.70	1.36	2.30	1.70	3.55	2.50
13	106	5/8	2.00	1.60	2.80	2.00	4.15	3.00
14	124	5/8	2.25	1.80	3.15	2.25	4.80	3.40
16	161	3/4	3.00	2.40	4.20	3.00	6.30	4.50
18	204	7/8	3.70	2.96	5.20	3.70	7.80	5.65
20	252	7/8	4.60	3.68	6.50	4.60	9.80	6.90
22	305	1	5.65	4.52	7.80	5.65	11.80	8.40
24	363	1-1/8	6.70	5.36	9.40	6.70	14.00	10.00
26	426	1-1/8	7.80	6.24	11.0	7.80	16.50	11.50
28	494	1-1/4	9.00	7.20	12.50	9.00	19.00	13.50
32	645	1-3/8	11.80	9.44	16.50	11.80	25.00	17.50
36	817	1-1/2	15.00	12.00	21.00	15.00	31.50	22.50

Rated capacities (t) based on pin diameter or hook no larger than the natural eye width (1/2 x eye length) or less than the nominal sling diameter. Turnback efficiency: k = 0.9 Flemish eye termination offers a higher efficiency. Refer to EN 13414-1 for full details, vertical sling angles greater than 60° are not recommended! Always use the individual sling tag to verify the slings capacity. Chart above is for general planning information only.

Wire rope slings and connection to fittings

Width of hook or diameter of connection must be greater than rope diameter but less than **1/2 L**



Note: Per WSTDA & ASME B30.9 synthetic sling eyes: thickness of hook must be less than 1/3 L

Module 8 slide 13

NOTES:

The capacity of wire rope slings is based on using the proper size hardware with the wire rope slings. The use of a wire rope thimble will provide the best protection to the eye of the sling. In many cases, the use of a thimble is not feasible.

Endless slings (grommets) have a rated capacity that is based on the vertical or single leg. The rated capacity is valid if the D/d of connection to the sling is at least 5/1.



All slings must be protected against edges and abrasive surfaces with materials of sufficient strength and thickness to prevent damage and catastrophic sling failure.

Wire rope slings - Choker hitch



The capacity of a choker hitch is maximum **80% of the single leg**

EN 13414-2

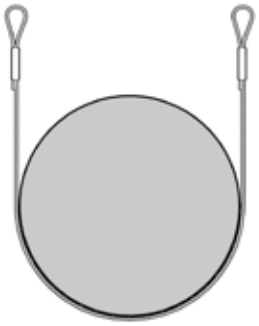
Module 8 slide 14

A choker hitch has a maximum capacity of 80% of the single leg sling only if the angle of choke is 120 degrees or greater.

A double choker, two chokers connected to a load, has 80% of the capacity of a bridle at same sling angle.

Wire rope slings - Basket hitch

The basket hitch has **twice the capacity** of a single leg **if the legs are vertical** and the sling is wrapped around a load that is big enough.



Module 8 slide 16

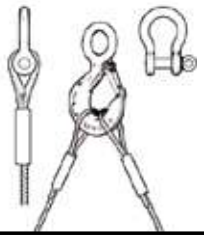
A basket hitch has twice the capacity of a single leg only if the D/d ratio > 25/1 and legs of sling are vertical.

At other angles, the remaining percentage of single leg capacity will be lower and can be checked on page 10 of the Rigging Card.

WIRE ROPE, CHAIN AND SYNTHETIC SLINGS

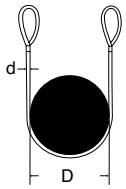
WIRE ROPE SLINGS AND CONNECTIONS TO FITTINGS

Use a thimble to protect sling and to increase D/d ratio. Never place eye over a fitting with a smaller diameter or width than the rope's diameter.



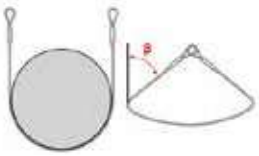
Never place a sling eye over a fitting with a diameter or width greater than one half the length of the eye. 1/3(L) for synthetic slings.





A basket hitch has twice the capacity of a single leg only if the D/d ratio ≥ 25/1 and legs of sling are vertical.
At other angles, see table.

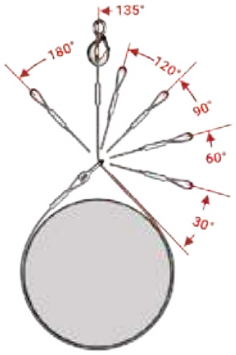
BASKET HITCH

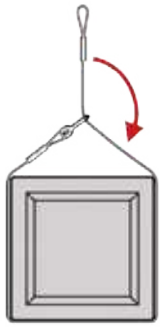


Angle β	Percentage of single leg capacity
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30°	170%
45°	140%
60°	100%

CHOKER HITCHES

A choker hitch has a maximum capacity of 80% of the single leg sling only if the angle of choke is 120 degrees or greater.





Angle of choke	Sling rated load percentage of single leg sling capacity
120° - 180°	80%
90° - 119°	65%
60° - 89°	55%
30° - 59°	40%

Definition D/d ratio

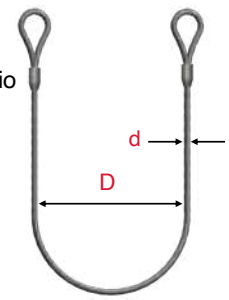
The ratio of the diameter of the object and the diameter of the wire rope bent over the object

Wire rope slings in a basket hitch form a D/d ratio

Wire rope over a sheave form a D/d ratio

The breaking strength of the wire rope sling is affected by D/d ratios smaller than 40/1

This effect is measured by the "efficiency"



Module 8 slide 19

EN 13414-1 states:

1. Hard eyes shall be fitted with thimbles conforming to EN 13411-1 and assembled in accordance with the designer's instruction.
2. The peripheral length of a soft eye shall be at least four rope lay lengths.

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CHAIN SLING CAPACITIES - GRADE 8/80



CHAIN SIZE mm	VERTICAL (t) (single leg)	TWO LEG SLINGS (t)		THREE AND FOUR LEG SLINGS (t)		CHOKER t
		0°< β ≤ 45°	45°< β ≤ 60°	0°< β ≤ 45°	45°< β ≤ 60°	
6	1.12	1.60	1.12	2.36	1.70	0.90
7	1.50	2.12	1.50	3.15	2.24	1.20
8	2.00	2.80	2.00	4.25	3.00	1.60
10	3.15	4.25	3.15	6.70	4.75	2.50
13	5.30	7.50	5.30	11.20	8.00	4.25
16	8.00	11.20	8.00	17.00	11.80	6.40
19	11.20	16.00	11.20	23.60	17.00	9.00
20	12.50	17.00	12.50	26.50	19.00	10.00
22	15.00	21.20	15.00	31.50	22.40	12.00
26	21.20	30.00	21.20	45.00	31.50	17.00
32	31.50	45.00	31.50	67.00	47.50	25.20

Triple leg slings have 50% more capacity than double leg only if the centre of gravity is in the centre of connection point and the legs are adjusted properly. (Equal share of the load) Quad leg slings offer improved stability but do not provide increased lifting capacity. Always use the individual sling tag to verify the slings capacty. Chart above is for general planning information only. Capacities in accordance with EN818-4.

INSPECTION OF CHAIN LINKS

All slings and attachments shall be visually inspected by the person handling the sling each day they are used. In addition, a periodic inspection shall be performed by a designated person, at least annually, and shall include a record of the inspection.

INSPECTION CRITERIA

Wear
Nicks, cracks, breaks, gouges, stretch, bends
Weld spatter
Excessive temperature
Throat opening of hook

CHAIN LINKS

Remove sling from service if links are worn excessively (more than 10% or refer to manufacturer's information), sharp transverse nicks and gouges should be rounded out by grinding (do not exceed wear allowance). Chain links and attachments should hinge freely to adjacent links.

IDENTIFICATION

Chain slings shall have permanently affixed identification stating: size, grade, rated load, vertical sling angle, name of manufacturer and CE (EN818-4)

CHAIN SLING CAPACITIES - GRADE 10/100



CHAIN SIZE MM	VERTICAL (t) (single leg)	TWO LEG SLINGS (t)		THREE AND FOUR LEG SLINGS (t)		CHOKER t
		0°< β ≤ 45°	45°< β ≤ 60°	0°< β ≤ 45°	45°< β ≤ 60°	
6	1.40	2.00	1.40	3.00	2.12	1.12
7	1.90	2.65	1.90	4.00	2.80	1.60
8	2.50	3.55	2.50	5.30	3.75	2.00
10	4.00	5.60	4.00	8.00	6.00	3.20
13	6.70	9.50	6.70	14.00	10.00	5.35
16	10.00	14.00	10.00	21.20	15.00	8.00
19	14.00	20.00	14.00	30.00	21.20	11.20
20	15.60	21.25	15.60	33.10	23.75	12.50
22	19.00	26.50	19.00	40.00	28.00	15.00
26	26.20	37.50	26.50	56.00	40.00	21.20
32	40.00	56.00	40.00	85.00	60.00	32.50

Triple leg slings have 50% more capacity than double leg only if the centre of gravity is in the centre of connection point and the legs are adjusted properly. (Equal share of the load) Quad leg slings offer improved stability but do not provide increased lifting capacity. Always use the individual sling tag to verify the slings capacty. Chart above is for general planning information only. Capacities based on EN818-4 WLL +25%.

INSPECTION OF CHAIN LINKS

All slings and attachments shall be visually inspected by the person handling the sling each day they are used. In addition, a periodic inspection shall be performed by a designated person, at least annually, and shall include a record of the inspection.

INSPECTION CRITERIA

Wear
Nicks, cracks, breaks, gouges, stretch, bends
Weld spatter
Excessive temperature
Throat opening of hook

CHAIN LINKS

Remove sling from service if links are worn excessively (more than 10% or refer to manufacturer's information), sharp transverse nicks and gouges should be rounded out by grinding (do not exceed wear allowance). Chain links and attachments should hinge freely to adjacent links.

IDENTIFICATION

Chain slings shall have permanently affixed identification stating: size, grade, rated load, vertical sling angle, name of manufacturer and CE (EN818-4)

Chain link dimensions

Dimensions:
- width
- diameter
- pitch

Note: the diameter as shown above is sometimes called the chain's nominal diameter.



E = width

D = diameter

L = pitch

Module 8 slide 24

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Alloy steel chain slings
Standards, laws and regulations

Several organizations are involved in the development of standards, legislation and inspection procedures in the field of lifting. We recommend that you obtain relevant information from your national health & safety authority.

- **ISO**, International Organization for Standardization, develops world-wide standards. *www.iso.org*
- **CEN**, Comité Européen de Normalization, develops European standards. *www.cenorm.org*
- **EN 818** for Grade 80 lifting chain, **EN 1677** for chain components.
- **ASTM**, An international standards organization. Formerly known as American Society of Testing and Materials. *www.astm.org*
- **ASME**, The American Society of Mechanical Engineers. *www.asme.org*
- **NACM**, National Association of Chain Manufacturers. *www.nacm.info*
- **OSHA**, Occupational Safety and Health Administration, US Department of Labor.
- *www.osha.gov* and *www.osha.gov/dsg/ guidance/slings/tables-figures.html*

Module 8 slide 25

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Alloy steel chain slings
Training requirements

Sling users shall be trained in the:

✓ Selection
✓ Inspection
✓ Cautions to personnel
✓ Effects of environment
✓ Rigging practices



Module 8 slide 26

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NOTES:

EN 818-2 specifies the manufacturing tolerances for all chain dimensions.

Alloy steel chain slings
Rated load definition

Definition of Rated Load:
The maximum allowable working load established by the sling manufacturer. The terms **rated capacity** and **working load limit** are commonly used to describe rated load.

Do not exceed rated load (WLL) as stated on the sling tag.



EN 818-4

Module 8 slide 27

NOTES:

What is the definition for proof test?
A non-destructive tension test performed by the sling manufacturer or an equivalent entity to verify construction and workmanship of a sling.

What is the minimum proof test load for alloy steel chain slings?
Proof-load requirements for assembled slings are as per local legislation.

What is the minimum proof test load for fittings attached to chain slings?
Shall be a minimum of 2 times the single-leg straight-line hitch rated load.
Per EN 1677, all chain fittings are individually proof-tested to minimum 2.5 x WLL.
Per EN 818-4, lifting chain is proof-tested to minimum 2 x WLL.

Alloy steel chain slings
Identification

Sling identification shall be done by the sling manufacturer. Sling identification should be maintained by the user so as to be legible during the life of the sling.

- Name or trademark of manufacturer
- Grade
- Individual sling identification (serial numbers)
- Nominal chain size
- Number of legs
- Rated load for at least one hitch type and the angle upon which it is based
- Effective Length (reach)



ASME B30.9

Module 8 slide 29

Follow these simple steps in making a sling assembly:

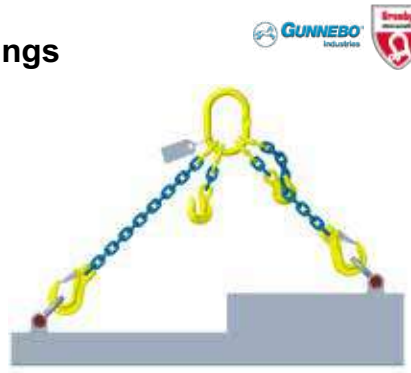
1. Determine the maximum load to be lifted by the sling assembly.
2. Choose the type of sling assembly suited for the shape of the load and the size of the sling assembly for the load to be lifted. The decision must take into account the angle of the sling legs in multi-leg slings.
3. Determine the overall reach from bearing point of master link to bearing point on hook (see Fig. 1).
4. Select components, assemble chain and components.
5. Affix sling identification tag to sling. The tag is available from your authorized distributor.

Each sling shall be marked to show: name or trademark of manufacturer, grade, nominal chainsize, number of legs, rated load for the type(s) of hitch(es) used and angle upon which it is based (reach).

If measurement comes in the link, cut the following link. For two leg type slings, count the links and use an even number for clevis hooks and an odd number for eye hooks. This will position hooks in the same plane. In multileg slings always use the same number of links in each leg.

Alloy steel chain slings
Benefits

- Strong & durable
- Flexible
- Wide range of end fittings
- Heat resistant
- Abrasive resistant
- Easy to adjust
- Easy to inspect
- Easy to store
- 100% recyclable



Module 8 slide 30

Main benefits of adjustable chain slings



1. Ability to lift non-symmetrical loads correctly. (Level and Stable)
2. Flexibility to adjust sling length reduces need for extra slings.



VS



Adjustable Sling Assembly

Non-Adjustable Sling Assemblies

3. Ability to shorten sling leg lengths for low headroom applications

Module 8 slide 31

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Alloy steel chain slings Adjustable: effect on rated load

Traditional standard grab hooks



The rated load of the leg connected with a **standard grab hook** in-line will have a **reduction in the capacity of 20%.**

No reduction in rated load if cradle grab hook is used. Cradle Grab Hook has cradle lugs on both sides of hook that supports the chain link.

Master Grab (MG) & Master Grab Duo (MGD) links



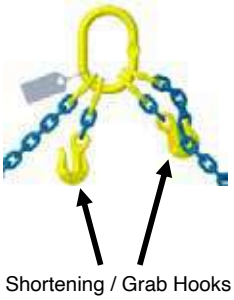
When using the Master Grab or Master Grab Duo Link there is **NO reduction in the chain slings capacity** when utilizing the built-in adjusters to shorten the sling leg.

Module 8 slide 32

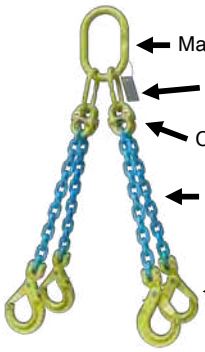
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Traditional alloy steel chain slings Component names



Shortening / Grab Hooks



Masterlink Assembly

ID-tag

Coupling link (lok-a-loy)

Chain Gr100

Safety Hooks

Module 8 slide 33

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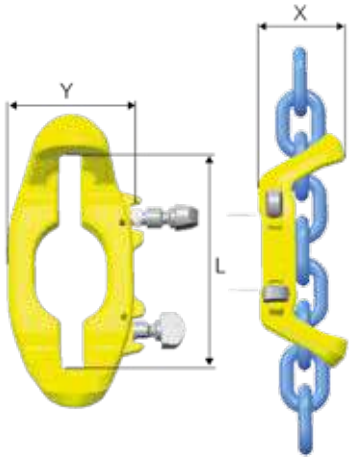
NOTES:

In shortening applications, a 20% reduction of the working load limit is required if the shortening device is not foreseen with supporting lugs on either side.

Midgrab Chain Shortener (MIG)

The MIG is a chain shortener that offers several benefits.

- Instant mounting and positioning on any part of the chain.
- Shortening in either chain direction; up-down.
- Designed to prevent inadvertent chain disengagement.
- Can be set idle on the chain leg when shortening is not required.
- LC version offers secure mounting with locking set on any desired part of the chain with one chain direction open for shortening.
- CC version offers close-open function in both chain directions for safe retention of the chain.



Alloy steel chain slings Hardware



Use master links to collect slings and to connect to hook.

Use Grade 8 (80) or Grade 10 (100) fittings that match the W.L.L. of chain and offer proper securement.

It is not recommended to mix different manufacturer's components when assembling a chain sling.

Module 8 slide 34

NOTES:

The master link type MFH with engineered flat is designed to fit hooks of DIN 15401 and DIN 15402.



Masterlink MFH

Alloy steel chain slings Reach – Effective length

The effective length of an alloy steel chain sling measured from the top bearing surface of the upper terminal component to the bottom bearing surface of the lower terminal component.



OSHA 1910.184

Module 8 slide 35

Unique link design with integrated shortener is key to GrabiQ

- Decreases number of components needed
- Decreases sling weight
- Can improve headroom
- No reduction in working load limit



Master Grab (MG)

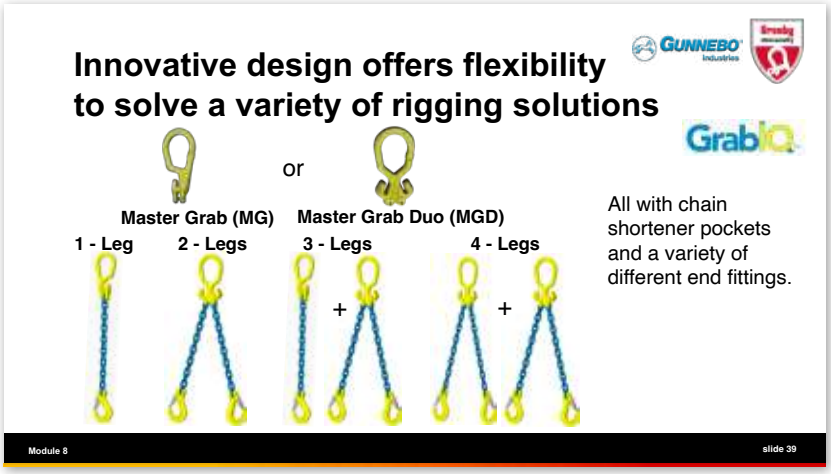


Master Grab Duo (MGD)

Module 8 slide 38

The Gunnebo Industries **GrabiQ** chain system offers solutions that increase the flexibility in lifting operations even further.

The GrabiQ unique design and product range offers you flexibility to solve a variety of material handling solutions, with less components. You gain increased efficiency and reduced costs as compared to other traditional chain sling assemblies.



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NOTES:

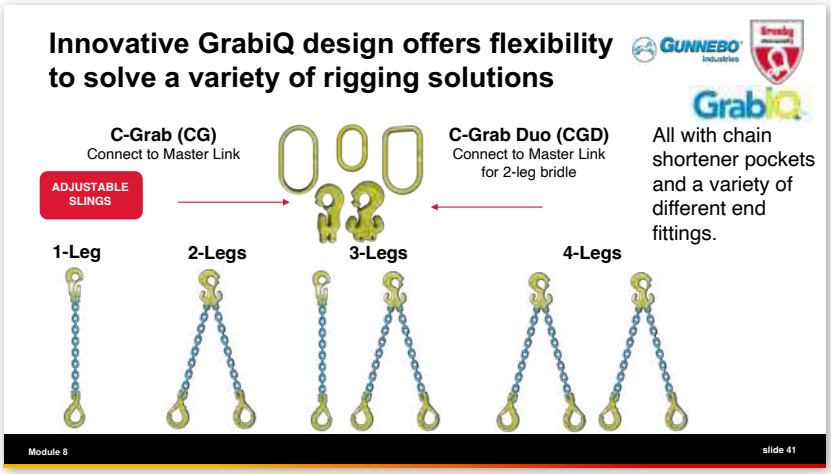
When shortening the chain length in the shortener pockets of the GrabiQ, no reduction of the working load limit is required thanks to the supporting cradle lugs on either side.



7 components
Weight 10mm: 4.3 kg



1 component
Weight 10mm: 2.3 kg



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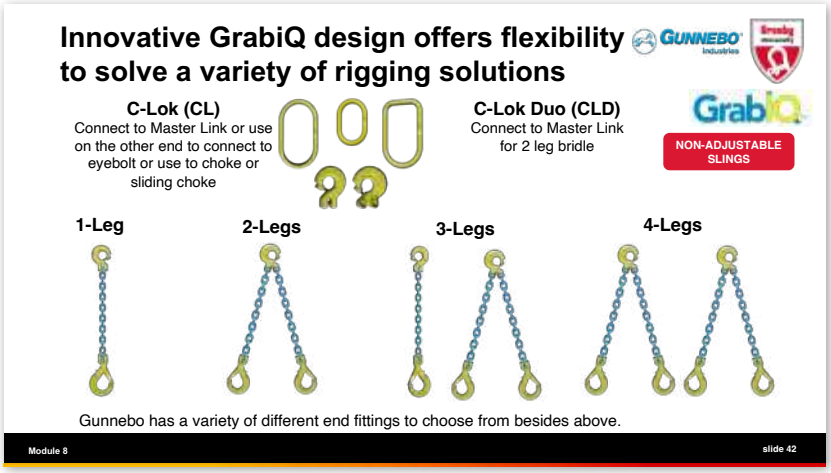
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Our **FlexiLeg** solution allows you to have an instant leg change on site.

With one single master link in combination with five Flexi-legs, we offer a solution that replaces four complete traditional slings, a total of ten legs. In addition, FlexiLeg also gives you the opportunity to modify the chain sling to different lifting operations, whenever and wherever it is needed.

The benefits of instant leg-change:

- Enables the user to change slings, leg by leg.
- Makes the sling lighter and easier to work with.
- Sling legs that are not being used can easily be removed, thereby increasing safety at the work site.
- The quantity of sling material is greatly reduced, providing cost savings.
- The chain sling can be reconfigured on site, thus increasing efficiency.



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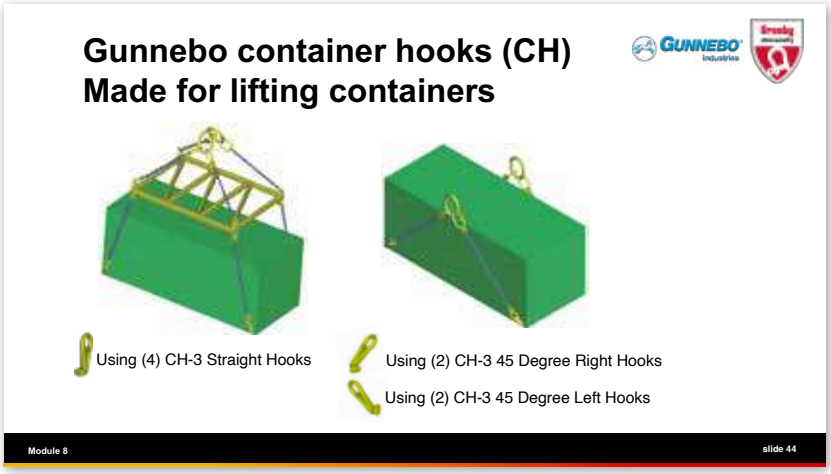
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15 components
Weight 10mm: 13.2 kg



3 components
Weight 10mm: 5.9 kg
(less than half)



NOTES:

The container hooks (CH) are designed for lifting containers in their lower fittings.

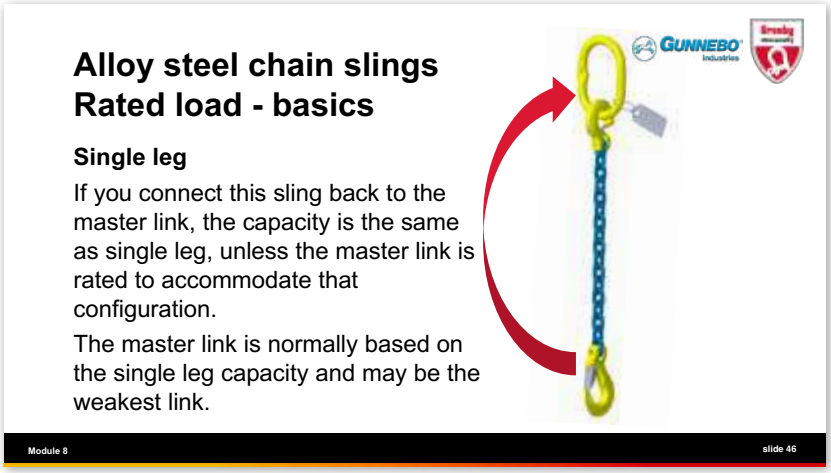


The **single leg** capacity of a sling is the maximum weight or load that can be supported by a sling.

When using chain slings in **choker** applications, the working load limit must be reduced by 20%. Kito Crosby recommends a minimum angle of choke of 120 degrees.

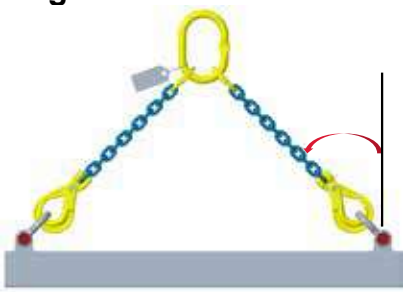
When using chain slings in a **basket hitch**, the working load limit might be increased depending on the vertical angle. Only when the legs are vertical, the basket hitch capacity is double of the slingle leg. At 60° vertical angle, the capacity is equal to single leg.

Slings should be protected from edges, corners or protrusions. These could damage the sling, but also reduce the capacity when in use.



Alloy steel chain slings
Angle of loading

Multiple legs
Slings shall <u>not</u> be used at a vertical angle of more than 60 degrees.



Module 8 slide 48

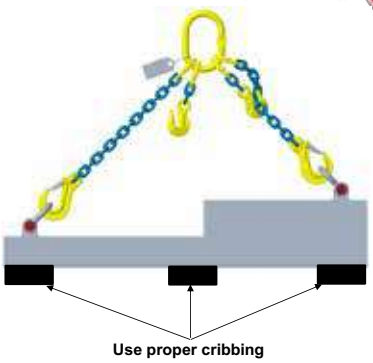
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Alloy steel chain slings
Application tips

Test-lift by carefully lifting the load just clear of the ground. Check the load security and angles before continuing.

When frequently using a sling to its maximum load, we recommend increasing the sling size by one dimension.



Module 8 slide 49

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Alloy steel chain slings
Rated load

Multiple legs
A 4-leg chain sling has <u>no more capacity</u> than a 3-leg!



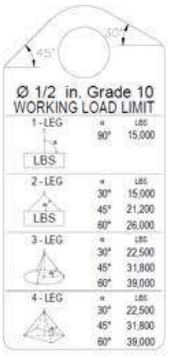
Module 8 slide 50

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NOTES:

FlexiTag – For every GrabiQ sling
- Specially designed for FlexiLeg
- Fits all other GrabiQ slings
- WLL and chain size pre-stamped for 1 to 4 legs
- Leg angle 30/45 degree shown in contour
- Made of stainless steel for use in all weather conditions





The Gunnebo C-Lok as a bottom fitting is a great solution for choker hitch applications. It is not intended to be used as a bottom hook.

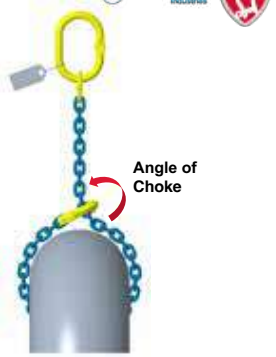
Alloy steel chain slings
Rated load - basics

Choker hitch

The rated load for a choker hitch is based on angle of choke of 120 degrees or greater.

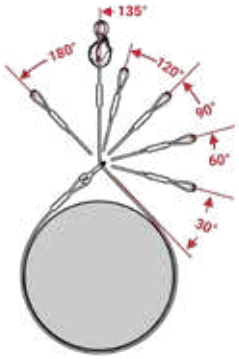
When the choker hitch rating is not identified on the sling, the **choker hitch rating shall be 80%** of the sling's straight-line hitch rating. Unless other ratings are provided by sling manufacturer or a qualified person.

Rated loads for angles of choke less than 120 degrees shall be determined by the sling manufacturer or a qualified person.



Module 8 slide 51

NOTES:



Angle of choke	Sling rated load percentage of single leg sling capacity
120° - 180°	80%
90° - 119°	65%
60° - 89°	55%
30° - 59°	40%

Alloy steel chain slings
Rated load - basics

Choker hitch

In case a choker hitch is used in a 2-legged chain sling, the **choker hitch rating shall be 80%** of the sling's WLL at that specific vertical angle.



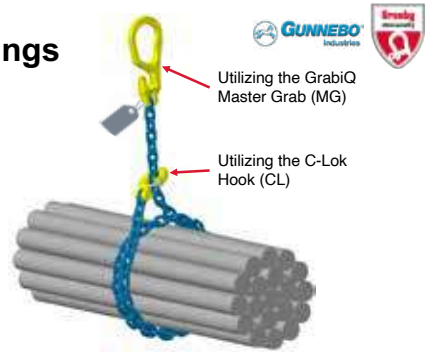
Module 8 slide 52

When using a sling in a choker hitch, the sling rated load percentage of the single leg sling capacity depends on the angle of choke. The same percentages apply for wire rope slings, chain slings and synthetic slings.

Alloy steel chain slings
Application tips

Choker hitch

Loads consisting of separate parts should be secured by wrapping the lifting sling(s) around twice to prevent the load from falling apart



Double Wrap Choker Hitch

Module 8 slide 53

A double wrap choker hitch increases control, as the slings gains a tighter grip and more than 360 degree contact between the sling and the load.

Alloy steel chain slings

Basket hitch
The basket hitch has **twice the capacity** of a single leg **if the legs are vertical** and is used as a true basket hitch.

This basket hitch is designed as a basket hitch, it has a master link on both ends.



Module 8 slide 54

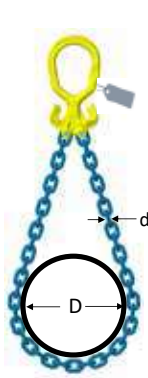
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Alloy steel chain slings
Rated load - basics

Basket hitch
The rated load of a basket hitch shall be decreased when D/d ratios smaller than 6 are used.

Slings should be protected from edges, corners or protrusions.



ASME B30.9

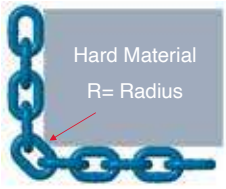
Module 8 slide 57

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Alloy steel chain slings
Rated load - basics





Edge load	R > 2 x chain Ø	R > chain Ø	R < chain Ø
Reduction factor	1.0	0.7	0.5

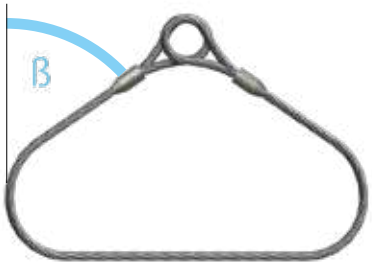
Ø = nominal dia. of chain

Module 8 slide 61

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NOTES:



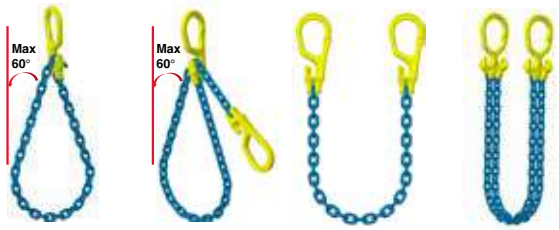
Angle β	Percentage of single leg capacity
0°	200%
30°	170%
45°	140%
60°	100%

When using a sling as a basket hitch, the sling rated load percentage of the single leg sling capacity depends on the vertical angle. The same percentages apply for wire rope slings, chain slings and synthetic slings.

The basket hitch has twice the capacity of a single leg, only if the legs are vertical and used as a true basket hitch.

In case it is difficult to measure and calculate the radius of the load, it is good practice to reduce the capacity of the sling with 50% of the sling's WLL at that specific vertical angle, when used as a basket or choker hitch over a relatively sharp corner.

Alloy steel chain slings
Gunnebo GrabiQ - flexibility
Basket Hitches



No End Fitting Using Adjuster | Master Grab both Ends Using Adjuster | Master Grab Both Ends | Duo Master Grab Both Ends

Module 8 slide 62

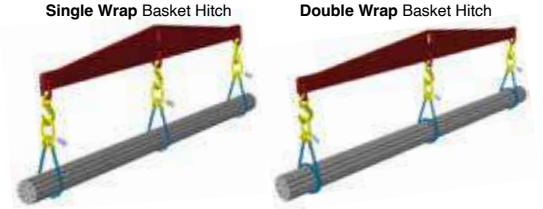
NOTES:

Alloy steel chain slings
Application tips

Basket Hitch

Use a spreader beam.When using basket hitches, make an extra turn around the load to gain a tighter grip and to obtain more than 360-degree contact between the sling and the load.

Single Wrap Basket Hitch | **Double Wrap** Basket Hitch



When using multiple basket or choker hitches, the load should be rigged to prevent the sling from slipping or sliding along the load

Module 8 slide 63

Alloy steel chain slings
Application tips

Twisting and kinking shall be avoided.

Slings shall not be shortened or lengthened by knotting or twisting.

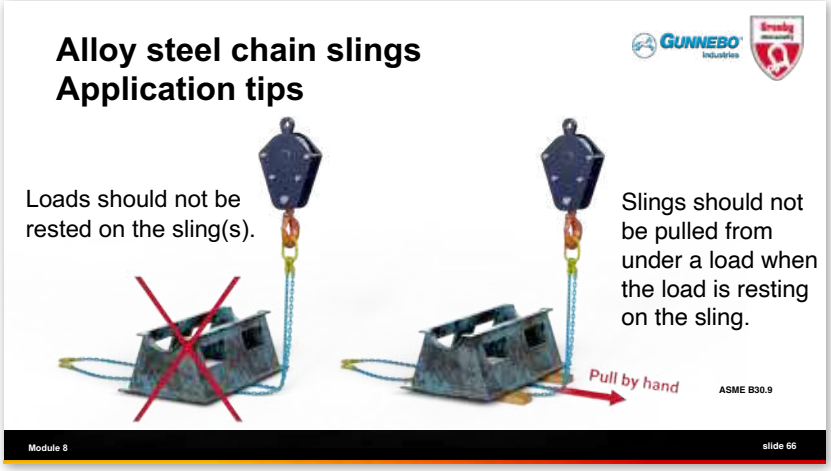


Wrong!

Right!

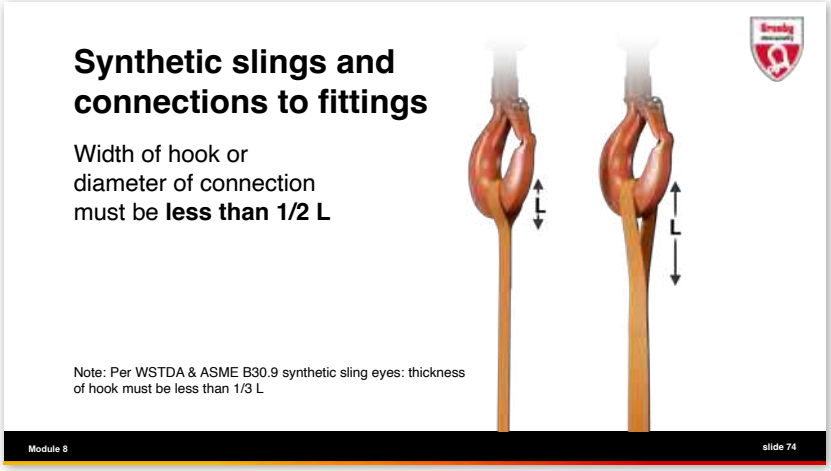
ASME B30.9

Module 8 slide 64



NOTES:

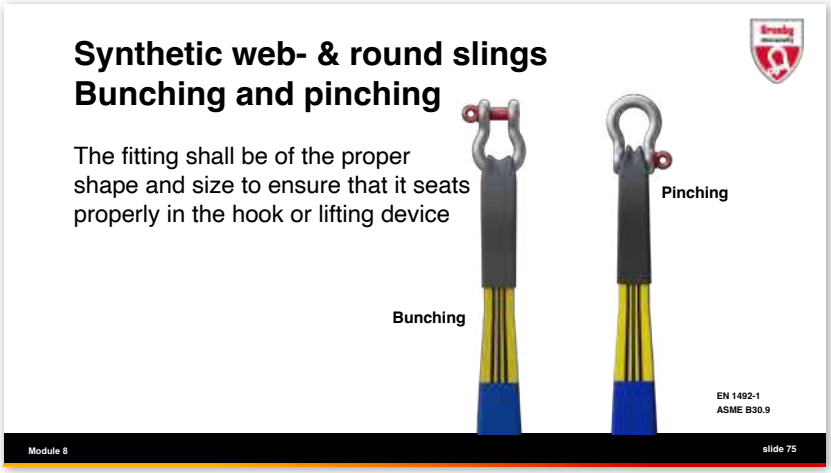
Put blocks under the load to prevent damage on the sling. Before lifting the crane block, pull the sling from under the load by hand to avoid accidental hook-ups or damage on the sling or load due to scraping.



Synthetic slings are foreseen with an identification label that provides choker and basket hitch capacities at different angles.



Basket hitch capacity is double only if legs are vertical. At 60° vertical angle the capacity is equal to single leg.





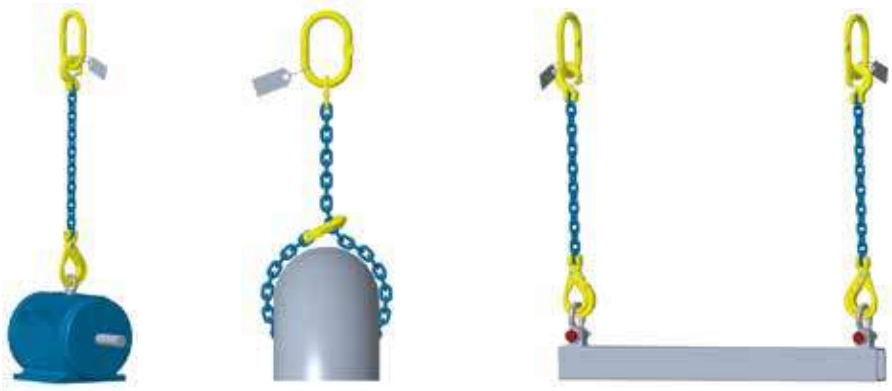
S281 for flat webbing sling



S253 for round sling

Using alloy steel chain sling

Using the chain sling capacity chart, indicate the sling capacity for each hitch.



Sling Hitch	Vertical Leg 13 mm Chain	Choker 13 mm Chain	Two Legs - Vertical 13 mm Chain
WLL			

Crosby

CHAIN SLING CAPACITIES - GRADE 10/100

GUNNEBO Industries

7



CHAIN SIZE MM	VERTICAL (t) (single leg)	TWO LEG SLINGS (t)		THREE AND FOUR LEG SLINGS (t)		CHOKER t
		0°< β ≤ 45°	45°< β ≤ 60°	0°< β ≤ 45°	45°< β ≤ 60°	
6	1.40	2.00	1.40	3.00	2.12	1.12
7	1.90	2.65	1.90	4.00	2.80	1.60
8	2.50	3.55	2.50	5.30	3.75	2.00
10	4.00	5.60	4.00	8.00	6.00	3.20
13	6.70	9.50	6.70	14.00	10.00	5.35
16	10.00	14.00	10.00	21.20	15.00	8.00
19	14.00	20.00	14.00	30.00	21.20	11.20
20	15.60	21.25	15.60	33.10	23.75	12.50
22	19.00	26.50	19.00	40.00	28.00	15.00
26	26.20	37.50	26.50	56.00	40.00	21.20
32	40.00	56.00	40.00	85.00	60.00	32.50

Triple leg slings have 50% more capacity than double leg only if the centre of gravity is in the centre of connection point and the legs are adjusted properly. (Equal share of the load) Quad leg slings offer improved stability but do not provide increased lifting capacity. Always use the individual sling tag to verify the slings capacty. Chart above is for general planning information only. Capacities based on EN818-4 WLL +25%.

INSPECTION OF CHAIN LINKS

All slings and attachments shall be visually inspected by the person handling the sling each day they are used. In addition, a periodic inspection shall be performed by a designated person, at least annually, and shall include a record of the inspection.

INSPECTION CRITERIA

Wear
Nicks, cracks, breaks, gouges, stretch, bends
Weld spatter
Excessive temperature
Throat opening of hook

CHAIN LINKS

Remove sling from service if links are worn excessively (more than 10% or refer to manufacturer's information), sharp transverse nicks and gouges should be rounded out by grinding (do not exceed wear allowance). Chain links and attachments should hinge freely to adjacent links.

IDENTIFICATION

Chain slings shall have permanently affixed identification stating: size, grade, rated load, vertical sling angle, name of manufacturer and CE (EN818-4)

Using alloy steel chain sling

Using alloy steel chain sling capacity chart, select proper chain sling size.



Load weight is 8.000 kg

Two Leg Bridle at Sling Angle	30 Degree Vertical Angle	45 Degree Vertical Angle	60 Degree Vertical Angle
With Hardware Connections			



Wire rope sling applications

1. Minimum length slings?

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2. Size of wire rope at 60°?

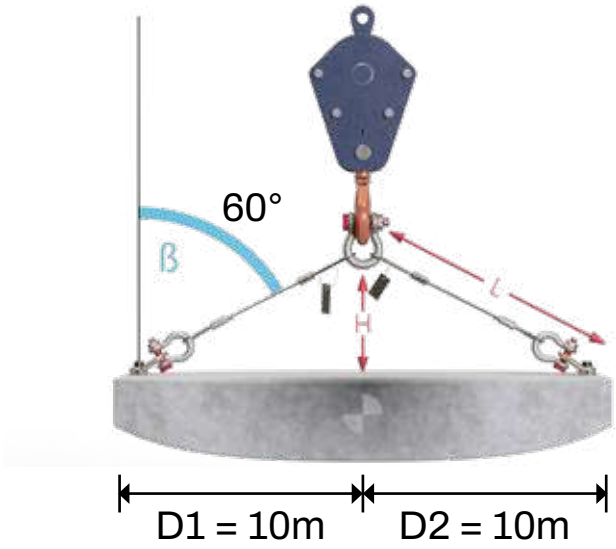
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3. Size of HR125M?

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4. Size of top shackle?

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Total load = 2t

Chain sling applications

1. Minimum length slings?

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2. Size chain grade 100? (size of hooks?)

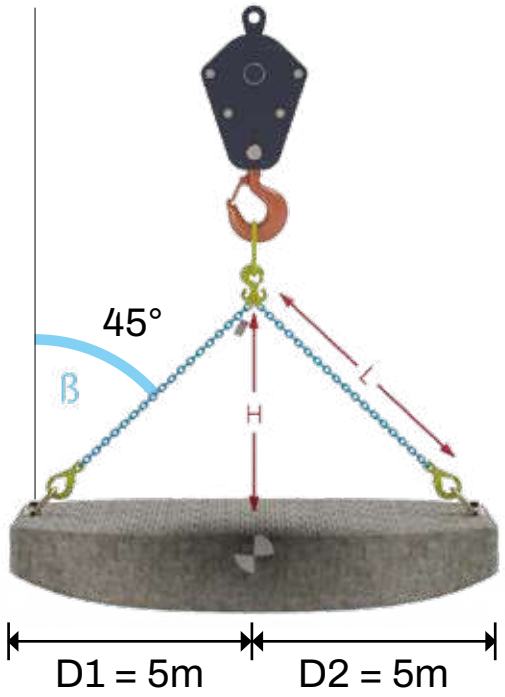
.....

3. Size chain grade 80? (size of hooks?)

.....

4. Size of HRM125M?

.....



Total load = 5t

Welcome to

Inspection of slings

9

Based on applicable standards and product application information for

Crosby GUNNEBO Industries

Module 9 slide 1

INSPECTION OF HARDWARE

DEFORMATION

Remove from service if there is any significant deformation. Check throat opening of hooks.

WEAR

Remove from service if there is excessive wear.
Wear is excessive if:

- More than 5% wear in throat or eye of hook and other critical areas of hardware.
- More than 10% wear in other areas.

CRACKS, NICKS, GOUGES

Remove from service if cracks, nicks, or gouges are detected.

MODIFICATION

Do not weld on hardware, and never substitute shackle pins or other components. Do not heat, bend or modify hardware in any manner.

PROPER FUNCTION

Improperly installed hardware or malfunction is cause for removal. Check for latches, swivel bearings, locking devices and proper installation of wire rope clips and wedge sockets.

INSPECTION OF WIRE ROPE SLINGS 3

All slings and attachments shall be visually inspected by the person handling the sling each day or prior to each use. In addition, a periodic inspection shall be performed by a competent person, at least once every 6 months (or per legal requirements) and shall include a record of the inspection.

INSPECTION CRITERIA

- Kinking
- Crushing
- Unstranding
- Birdcaging
- Strand displacement
- Core protrusion
- Corrosion
- Broken or cut strands
- Broken wires

BROKEN WIRES

Refer to the applicable standards such as EN 13414 with specific discard criteria and guidance regarding the number of broken wires.

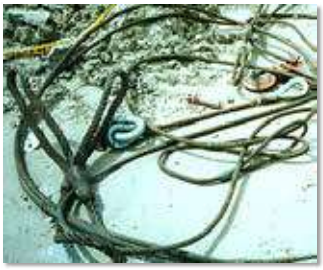
DISTORTION OF WIRE ROPE

Remove from service wire rope slings that have any damage resulting in distortion of the wire rope structure such as: kinking, crushing, unstranding, bird caging, strand displacement or core protrusion.

Sling storage



The good



The bad and the ugly

Module 9 slide 4

Inspection frequency for slings

Initial:
Prior to initial use

Frequent:
Each day or shift before the sling is used

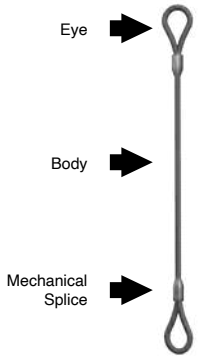
The periodic inspection:
- Normal service – every 6 months
- Severe service – monthly to quarterly
- Special service – as recommended by a qualified person

Or as required per local regulations

Module 9 slide 8

Inspection of wire rope slings Removal criteria

- Missing or illegible sling identification
- Excessive broken wires
- Severe localized abrasion or scraping
- Kinking, crushing, birdcaging, or any other damage resulting in damage to the rope structure



EN 13414-2
ASME B30.9

Module 9 slide 9

NOTES:

STORAGE REQUIREMENTS

Wire rope slings:
- Wire rope slings should normally be kept on a properly designed rack.
- Not to be left lying on the ground where they may be damaged.
- If left suspended from a crane hook, the 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 wire rope slings will be out of use for some time they should be cleaned, dried and protected from corrosion, e.g. lightly oiled or lubricated.

Chain slings:
- Slings should be stored in an area where they will not be subjected to mechanical damage, corrosive action, moisture, extreme temperatures, knots or kinks.

Synthetic slings:
- When not in use, slings should be stored in clean, dry and well-ventilated conditions, at ambient temperature
- On a rack, away from any heat sources, contact with chemicals, fumes, corrodible surfaces
- Away from direct sunlight or other sources of ultra-violet radiation

The rigging industry has developed general recommendations for the inspection of sling. These apply to wire rope slings, chain slings and synthetic slings:

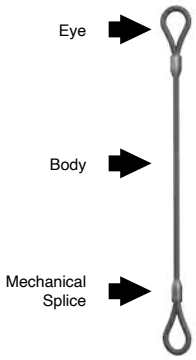
1. **Initial inspection:** prior to use. Written records are not required. However, it is recommended to have certificates for your lifting slings, as per local legislation.

2. **Frequent inspection:** a visual inspection shall be performed by the user or other designated person each day before slings are used. Semi-permanent and inaccessible locations where frequent inspections are not feasible shall have periodic inspections performed. Any condition that may result in a hazard shall cause the slings to be removed from service. Written records are not required for frequent inspections.

3. **Periodic inspection:** a complete inspection of the lifting slings shall be periodically performed by a designated person. The slings shall be examined and a determination made as to whether they constitute a hazard. Written records are required and updated certification to be issued when local legislation requires.

Inspection of wire rope slings
Removal criteria

- Evidence of heat damage
- End attachments that are cracked, deformed or worn
- Severe corrosion of the wire rope, end attachments, or fittings
- Other conditions, including visible damage that cause doubt as to the continued use of the sling



EN 13414-2
ASME B30.9

Module 9 slide 10

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Inspection of wire rope slings
Broken wires



Remove from service

Module 9 slide 11

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Inspection of wire rope slings
Broken wires



Remove from service

Module 9 slide 12

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NOTES:

A wire rope sling shall be removed from service immediately if any of the following conditions are present:

1. **Broken wires:** for single-part slings, 6 randomly distributed broken wires in one rope lay, or 3 broken wires in one strand of one rope lay.
2. **Metal loss:** wear or scraping of 10% of the nominal rope diameter.
3. **Distortion:** kinking, crushing, birdcaging or other damage which distorts the rope structure. the main thing to look for is wires or strands that are pushed out of their original positions in the rope. Slight bends in a rope where wires or strands are still relatively in their original positions would not be considered serious damage.
4. **Heat damage:** any metallic discoloration or loss of internal lubricant caused by exposure to heat.
5. **Bad end attachments:** cracked, bent or broken end fittings caused by abuse, wear or accident.
6. **Bent hooks:** Crosby does not allow any deformation or twisting.
7. **Metal corrosion:** severe corrosion of the rope or end attachments which has caused pitting or binding of wires should be cause for replacement of the sling. Light rust usually does not affect strength of a sling.

Inspection of swaged sleeves
Damage, corrosion, quality of workmanship



Remove from service

Module 9 slide 13

NOTES:

Pitting of the wires or loss of flexibility of the rope due to severe internal corrosion is cause for removal.

Corrosion may occur where slings have been improperly stored or have been used in particularly corrosive conditions, such as moving loads in and out of acid/alkali baths. The effect is readily identified through the loss of flexibility and roughness to the touch. While light surface rusting is unlikely to affect the rope strength, it may be indicative of internal corrosion, the effect of which is not predictable. (EN 13414-2)

Inspection of wire rope slings
Randomly distributed broken wires

6 randomly distributed **broken outer wires** in a **length of 6 x d** but no more than **14 randomly** distributed broken wires in a length of **30 x d** where **"d"** is the nominal rope diameter is cause for **removal**



EN 13414-2

Module 9 slide 14

Inspect for broken wires by examining the "worst" section of the wire rope sling. Place a rope lay across this section. A rope lay is the distance from where a strand spirals down and back up. As a rule of thumb, one rope lay is often 6 to 7 diameters of rope.

Six (6) randomly distributed broken outer wires in a length of 6 d but no more than 14 randomly distributed broken wires in a length of 30 x d where d is the nominal rope diameter is cause for removal. (EN 13414-2)

Inspection of wire rope slings
Concentrated broken wires

3 adjacent broken outer wires in one strand is cause for **removal**



EN 13414-2

Module 9 slide 15







NOTES:

Inspect for metal loss. This includes wear or scraping of the outside individual wires. Inspect for corrosion. Severe corrosion of the rope or end attachments which has caused pitting or binding of wires is cause for removal from service. Light rusting usually does not affect strength of sling.

It is recommended to re-lubricate wire rope slings when they become dry and/or rusty.



Vitalife® products are the preferred wire rope lubricants in the industry because of their ability to penetrate into wire rope and displace water and contaminants, thus reducing wear and corrosion throughout the rope.

- Available in a variety of container sizes.
- Provides inner strand preservation and lubricity.
- Allows for easy visual inspection of the ropes.
- Reduces the friction between the strands of the wire rope, thus extending rope life.
- Adheres to surface of strands, forming an outer film which provides excellent corrosive protection.
- Non-tacky (will not attract dust)
- Vitalife® in aerosol form is a regulated dangerous good. See MSDS sheet for shipping instructions.
- Vitalife® Bio-Lube has been developed especially for environmentally friendly applications.
- Vitalife® 500 has been developed exclusively for ski lifts and tramways.

Inspection of wire rope slings
Kinking



Kinking is cause for removal from service

Module 9 slide 19

Inspection of wire rope slings
Kinking



Kinking is cause for removal from service

Module 9 slide 20

Inspection of wire rope slings



Remove from service

Module 9 slide 21

NOTES:

Kinking, crushing, birdcaging or other damage which distorts the rope structure is cause for removal.

Look for wires or strands that are pushed out of their original positions in the rope. Slight bends where wires or strands are still relatively in their original position would not be considered serious damage.

Inspection of wire rope slings
Dogleg

Look for displaced strand. If a strand is significantly dislocated, remove from service





Module 9 slide 23

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Inspection of wire rope slings
Strand displacement



Remove from service



Module 9 slide 24

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Inspection of wire rope slings
Bird caging





Remove from service

Module 9 slide 25

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NOTES:

Eye deformation is not usually detrimental to sling strength as long as there are no broken wires or gross distortion of the lay of strands.

A sling should be removed from service when distortion locks the strands or flattens the rope in the eye so strands cannot move and adjust.



Wire rope slings - Temperature



Steel core slings

From -51° C to 204° C

Fiber core slings

From -51°C to 82°C

Module 9 slide 26

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Wire rope slings
Chemical active environments

The strength of wire rope slings can be degraded by chemically active environments.

Sling materials my be susceptible to damage from caustic or acid substances, vapors or fumes.

Strongly oxidizing environments attack all common sling materials.

The sling manufacturer or qualified person should be consulted before slings are used in chemically active environments.



ASME B30.9

Module 9 slide 27

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NOTES:

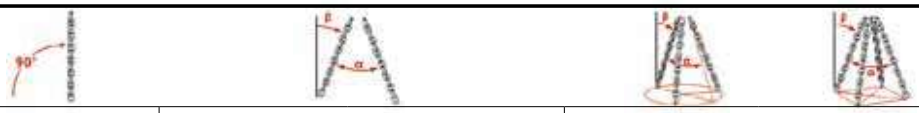
Inspect for any metallic discoloration or loss of internal lubricant caused by exposure to heat.

Heat damage as evidenced by discoloration of the wires, loss of lubrication or pitting of the wires caused by electric arcing is cause for removal from service. (EN 13414-2)

Repair of wire rope slings

- Slings shall be repaired only by the sling manufacturer or a qualified person. A repaired sling shall be marked to identify repairing agency.
- The wire rope used in the sling shall not be repaired. Repairs shall be restricted to end attachments and fittings.
- All repaired slings shall be proof tested, except when replacing identification.
- Any replacement component or part of the wire rope sling should be in accordance with the appropriate European Standard for that component or part.
- Components that are cracked, visibly distorted or twisted, severely corroded or have deposits that cannot be removed should be discarded and replaced.
- Minor damage such as nicks and gouges to terminal fittings may be removed by careful grinding or filing. The surface should blend smoothly into 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 manufacturer's specified minimum dimensions or by more than 10% of nominal thickness of the section.

CHAIN SLING CAPACITIES - GRADE 8/80



CHAIN SIZE mm	VERTICAL (t) (single leg)	TWO LEG SLINGS (t)		THREE AND FOUR LEG SLINGS (t)		CHOKER t
		0°< β ≤ 45°	45°< β ≤ 60°	0°< β ≤ 45°	45°< β ≤ 60°	
6	1.12	1.60	1.12	2.36	1.70	0.90
7	1.50	2.12	1.50	3.15	2.24	1.20
8	2.00	2.80	2.00	4.25	3.00	1.60
10	3.15	4.25	3.15	6.70	4.75	2.50
13	5.30	7.50	5.30	11.20	8.00	4.25
16	8.00	11.20	8.00	17.00	11.80	6.40
19	11.20	16.00	11.20	23.60	17.00	9.00
20	12.50	17.00	12.50	26.50	19.00	10.00
22	15.00	21.20	15.00	31.50	22.40	12.00
26	21.20	30.00	21.20	45.00	31.50	17.00
32	31.50	45.00	31.50	67.00	47.50	25.20

Triple leg slings have 50% more capacity than double leg only if the centre of gravity is in the centre of connection point and the legs are adjusted properly. (Equal share of the load) Quad leg slings offer improved stability but do not provide increased lifting capacity. Always use the individual sling tag to verify the slings capacty. Chart above is for general planning information only. Capacities in accordance with EN818-4.

INSPECTION OF CHAIN LINKS

All slings and attachments shall be visually inspected by the person handling the sling each day they are used. In addition, a periodic inspection shall be performed by a designated person, at least annually, and shall include a record of the inspection.

INSPECTION CRITERIA

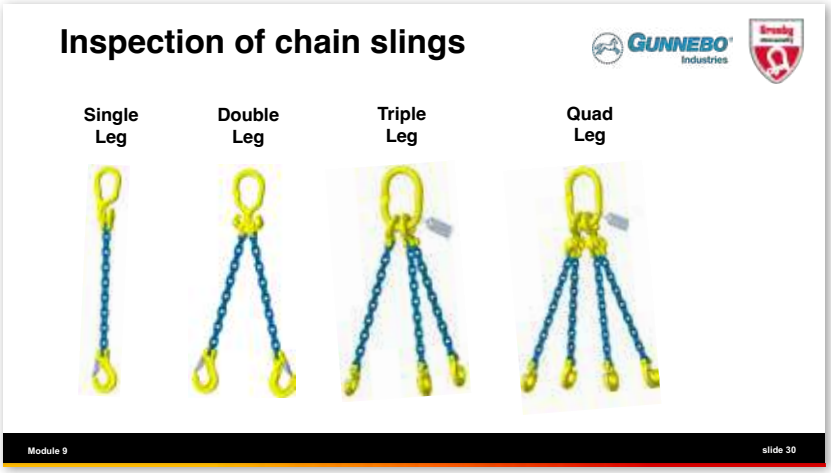
Wear
Nicks, cracks, breaks, gouges, stretch, bends
Weld spatter
Excessive temperature
Throat opening of hook

CHAIN LINKS

Remove sling from service if links are worn excessively (more than 10% or refer to manufacturer's information), sharp transverse nicks and gouges should be rounded out by grinding (do not exceed wear allowance). Chain links and attachments should hinge freely to adjacent links.

IDENTIFICATION

Chain slings shall have permanently affixed identification stating: size, grade, rated load, vertical sling angle, name of manufacturer and CE (EN818-4)



NOTES:

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Inspection of chain slings
Removal criteria

- Missing or illegible sling identification
- Cracks or breaks
- Excessive wear, nicks or gouges
- Stretched chain links or components
- Bent, twisted or deformed chain links or components



EN 818-6
EN 1677
ASME B30.9

Module 9 slide 32

NOTES:

Inspection of chain slings
Removal criteria

- Evidence of heat damage
- Excessive pitting or corrosion
- Lack of ability of chain or components to hinge freely
- Weld spatter
- Other conditions, including visible damage, that cause doubt as to the continued use of the sling



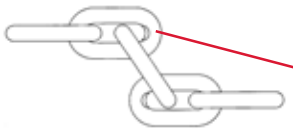
EN 818-6
EN 1677
ASME B30.9

Module 9 slide 33

Chain sling inspection

Chain link wear

- The chain must be slackened and the adjoining links pushed back to allow inspection of the contact surfaces of each link.







- Material wear on chain links must not exceed 10%.

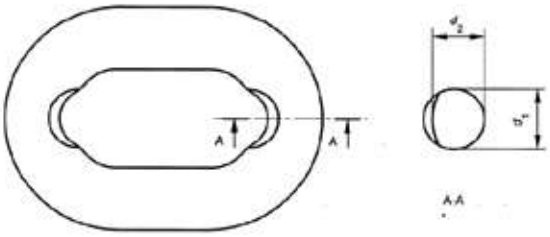
EN 818-6
ASME B30.9

Module 9 slide 34

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 (d1) and one at right angles, (d2) may be tolerated until the mean of these diameters has been reduced to 90 % of the nominal diameter (dn). (EN 818-6)

$$\frac{d1 + d2}{2} > 0{,}9\,dn$$



Chain sling inspection
Stretch (elongation)



Compare reach vs sling tag

Module 9 slide 35

NOTES:

Measure the reach of sling legs to make sure they correspond to the value stamped on the chain sling identification tag. If any leg is longer, there is a possibility that the sling has been subjected to overloading or excessive wear.

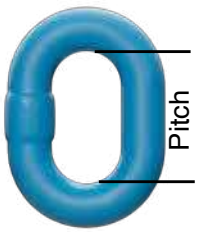
Never replace only 1 leg of a sling.

An increase in the reach could mean that the chain sling has been stretched or elongated.

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Chain sling inspection
Determining chain pitch



e.g. 10mm chain
Pitch = 3 x 10mm = 30mm

Module 9 slide 37

Maximum wear on the diameter of the link = 10%

Example:

- single leg chain sling
- 10mm diameter
- Leg length = 3m (= 3000mm)

Number of chain links per leg:
Length/Pitch = 3000/30 = 100 links

Total elongation of a leg due to allowable wear:
100 links x 1mm wear x 2 sides = 20 cm

Wear on chain links would rather occur on load chain of chain hoists as there is more friction on chain links in hoists.

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Chain sling inspection
Gunnebo chain gauge

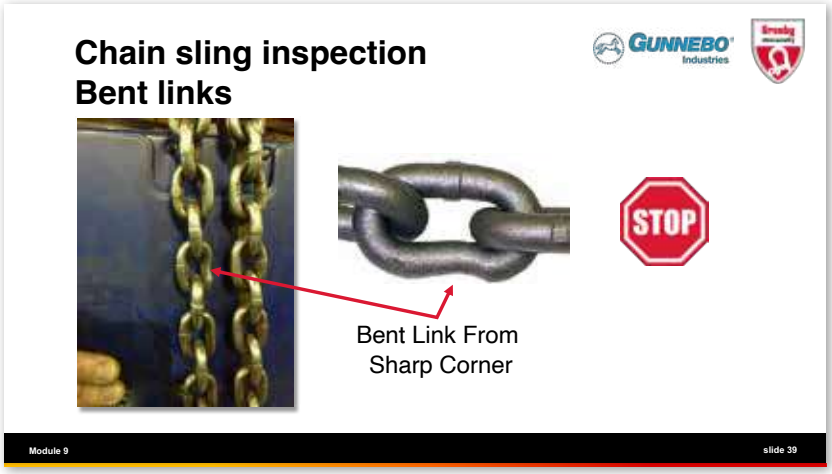


Module 9 slide 38

A calliper is a useful tool to check chain slings for wear and deformation.

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NOTES:

Bent chain links are not allowed and cause for removal from service. Bending can occur when the sling is not in-line but used in a choker or basket hitch, with chain links not protected against sharp corners of the load.

The bent Link could be from overloading the link using a grab hook.



Clean each sling prior to inspection to allow visual inspection.

Check for cracks, nicks or gouges. Sharp transverse gouges should be rounded out by light grinding, do not exceed the wear allowance. If any portion of any link exceeds the allowable wear, remove from service.



Weld spatter and/or arc strikes on chain and/or fittings are cause for removal from service. They might negatively affect the performance characteristics as chain & fittings are heat treated.

Chain sling inspection
Other damage



Pitting and corrosion

Chain failure

Module 9 slide 43

NOTES:

Repair of chain slings

- Slings shall be repaired only by the sling manufacturer or a qualified person. A repaired sling shall be marked to identify repairing agency.
- Cracked, broken, or bent chain links or components shall not be repaired, they shall be replaced.
- Minor damage such as nicks and gouges may be removed by careful grinding or filing. Removal of the damage should not reduce the thickness by more than 10 % of nominal thickness of the section.
- Mechanical coupling links shall not be used within the body of an alloy chain sling to connect two pieces of chain.
- All repaired slings shall be proof tested, except when replacing identification.

Inspection of chain slings
Deformation and stretch





Remove from service

Module 9 slide 44

Alloy steel chain slings
Chemical active environments

The strength of alloy steel chain slings can be degraded by chemically active environments.

This includes exposure to chemicals in the forms of solids, liquids, gases, vapors or fumes.

The sling manufacturer or qualified person should be consulted before slings are used in chemically active environments.



ASME B30.9

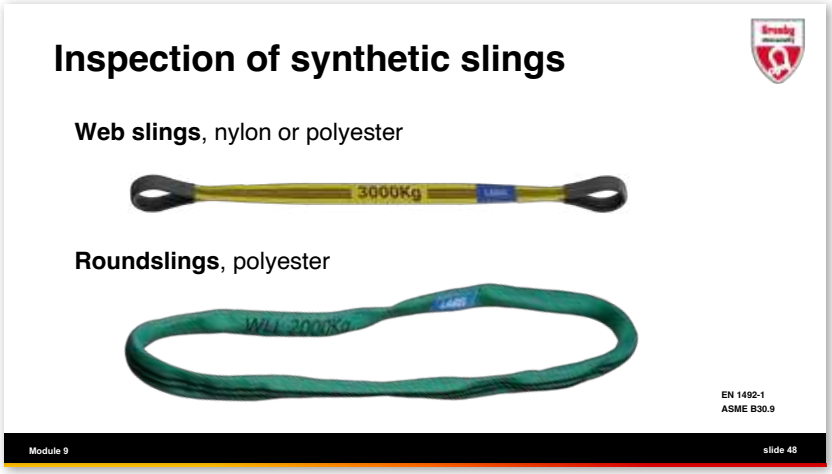
Module 9 slide 45

Hot dip galvanized Grade 8 chain

The hot dip galvanized lifting range is designed to meet the specific challenges from corrosive environments in which they will have a longer life expectancy.

Why Hot-dip galvanizing?

HDG is the process of coating steel with a layer of zinc for added corrosion resistance. It involves immersing the steel material in molten zinc through a multi-step galvanizing line. The resulting material is encased in several layers of zinc and zinc-iron alloys, making it extremely tough.



NOTES:

In flat webbing slings, all of the fibres are load bearing.

In synthetic round slings, the load bearing fibres are “wound” within a protective jacket. The protective jacket is not load-bearing and only protects the load bearing fibres.

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WEB SLING CAPACITIES

8



VERTICAL (single leg) t		CHOKER t	BASKET t	TWO LEG SLINGS		THREE AND FOUR LEG SLINGS	
				0°< β ≤ 45° t	45°< β ≤ 60 t	0°< β ≤ 45 t	45°< β ≤ 60 t
Violet	1.0	0.8	2.0	1.4	1.0	2.1	1.5
Green	2.0	1.6	4.0	2.8	2.0	4.2	3.0
Yellow	3.0	2.4	6.0	4.2	3.0	6.3	4.5
Grey	4.0	3.2	8.0	5.6	4.0	8.4	6.0
Red	5.0	4.0	10.0	7.0	5.0	10.5	7.5
Brown	6.0	4.8	12.0	8.4	6.0	12.6	9.0
Blue	8.0	6.4	16.00	11.2	8.0	16.8	12.0
Orange	10.0	8.0	20.00	14.0	10.0	21.8	15.0

Folding, bunching or pinching of synthetic slings, which occurs when used with shackles, hooks or other applications will reduce the rated load.
Crosby designed fittings for use with synthetic slings. Always use the individual sling tag to verify the slings capacty.
Chart above is for general planning information only. Capacities in accordance with EN1492-1/2.

INSPECTION OF SYNTHETIC SLINGS

All slings and attachments shall be visually inspected by the person handling the sling each day they are used. In addition, a periodic inspection shall be performed by a competent person, at least annually, and shall include a record of the inspection. Examination periods to be further determined by a competent person.

INSPECTION CRITERIA

Acid or caustic burns
Melting or charring
Holes, cuts
Tears, snags
Broken stitches
Worn stitches
Excessive abrasion
Knots

ROUND SLING NOTES

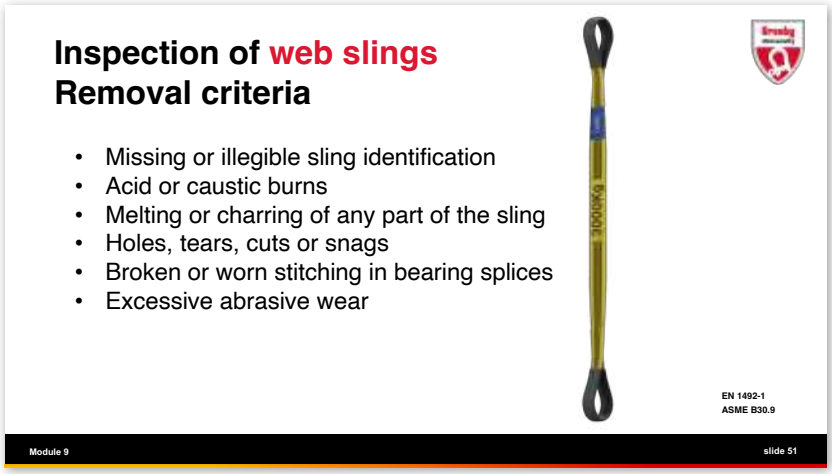
Remove from service roundslings that have core fiber exposed by holes, tears, cuts, embedded particles, wear or snags.Remove from service round slings that have melting, charring or weld spatter on any part of sling.

IDENTIFICATION

Web slings and round slings shall have a colour coding and permanently marked indicating: manufacturer’s trademark, serial number, WLL and CE (EN1492-1/2)



NOTES:

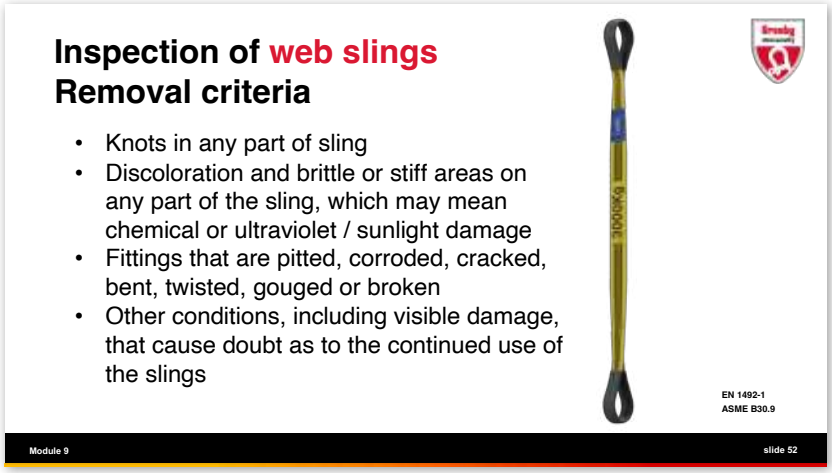


Inspection of web slings Ultra-Violet Lights

The strength of synthetic web slings can be degraded by exposure to sunlight or UV-light. Visual signs of degradation are:

- Bleaching out of web sling color
- Increased stiffness of web sling material
- Surface abrasion in areas not normally in contact with the load

Caution: Degradation can take place without indications. Consult sling manufacturer.



When placing sewn eye on hardware, make sure there are no sharp edges or surfaces that can cause abrasion of eye.

Do not force the eye over the hardware. Make sure that the width of hook or diameter of shackle or trunnion is no bigger than 1/2 the length of the sewn eye.

Inspection of web slings Damage



Remove from service

Module 9 slide 54

Inspection of roundslings



Endless

Endless with hardware

Bridle with hardware

Module 9 slide 55

Inspection of polyester roundslings Removal criteria

- Missing or illegible sling identification
- Acid or caustic burns
- Evidence of heat damage
- Holes, tears, cuts, abrasive wear or snags that expose the core yarns
- Broken or damaged core yarns
- Weld spatter that exposes core yarns



EN 1492-2
ASME B30.9

Module 9 slide 56

NOTES:

When placing sewn eye on hardware, make sure there are no sharp edges or surfaces that can cause abrasion of eye.

Do not force the eye over the hardware. Make sure that the width of hook or diameter of shackle or trunnion is no bigger than 1/2 the length of the sewn eye.

Damage to the stitching near the sling eye is cause for removal from service. The hook needs to be checked for deformation or overload. If ok, a new latch needs to be installed on the hook.

Inspection of polyester roundslings Removal criteria

- Roundslings that are knotted
- Discoloration and brittle or stiff areas on any part of the slings, which may mean chemical or other damage
- Fittings that are pitted, corroded, cracked, bent, twisted, gouged or broken
- Other conditions, including visible damage, that may cause doubt as to the continued use of the sling

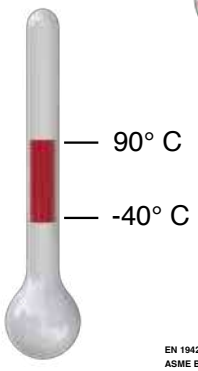


EN 1492-2
ASME B30.9

Module 9 slide 57

Nylon and polyester slings Temperature

Shall not be used at temperatures
- in excess of 90°C
- or below -40°C



EN 1942-2
ASME B30.9

Module 9 slide 58

Nylon and polyester slings Chemical active environments

Acids
Nylon: little to total degradation
Polyester: resistant to many acids

Alkalis
Nylon: resistant to many alkalis
Polyester: little to total degradation



If exposure to chemicals is likely, the manufacturer or supplier should be consulted.

EN 1942-2
ASME B30.9

Module 9 slide 59

NOTES:

Repair of synthetic slings

- Slings which have become wet in use, or as the result of cleaning, should be hung up and allowed to dry naturally. Do not dry wet slings with heat as embrittlement may occur.
- Damaged slings should be withdrawn from service. Never attempt to carry out repairs to the slings yourself.

Nylon is subject to degradation in acids, ranging from little to total degradation. polyester is resistant to many acids, but is subject to degradation, ranging from little to moderate in some acids.

Polyester is subject to degradation in alkalis, ranging from little to total degradation. Nylon is resistant to many alkalis, but is subject to degradation ranging from little to moderate in some alkalis.

Consult sling manufacturer for specific chemical resistance and degradation.

Evaluate the slings































16



17



18



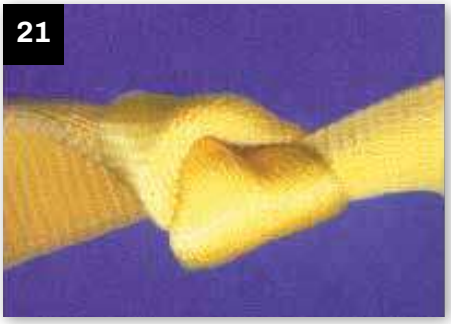
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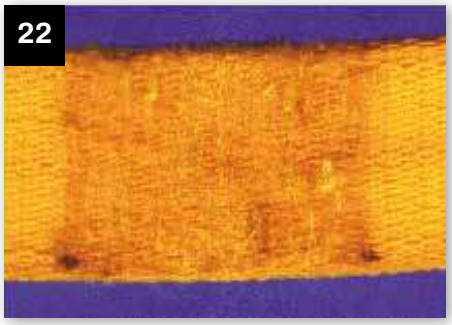
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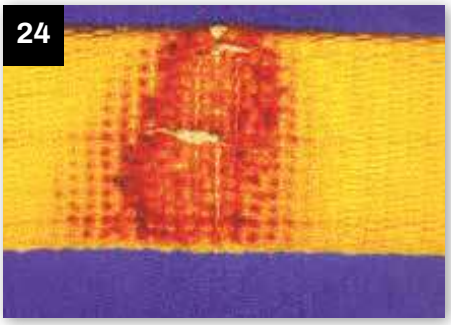
22



23



24



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26



27



28



29



30



Inspection of Slings

1. Inspect _____ for wear, nicks, cracks, breaks, gouges, stretch, bend and discoloration from excessive temperatures.
2. Inspect _____ for broken wires, abrasion, kinking, crushing, bird caging, evidence of heat damage and corrosion.
3. Inspect _____for acid or caustic burns, melting, holes, tears, cuts, abrasive wear, knots, broken or worn stitching.
4. Inspect _____ for wear, distortion, corrosion, and cracks.
5. _____ is required before first use.
6. The proper operating temperature for a steel core wire rope sling is _____.
7. _____ is required each day or shift before the sling is used.
8. Wire rope slings should be _____ by rated load, manufacturers name or code, CE mark and local legal requirements.
9. Alloy chain slings shall have _____ identification stating size, grade, rated load based on angle of load, reach, number of legs, name of sling manufacturer, CE marks and local legal requirements.
10. The proper operating temperature range for nylon and polyester slings is _____.
11. Material wear on chain links must not exceed _____.
12. _____ is required at least annually.

Choose Answer from the Following List

a. -51°C to 204°C

b. Periodic inspection

c. Frequent inspection

d. chain slings

e. end fittings

f. synthetic slings

g. Initial inspection

h. wire rope slings

i. permanently affixed

j. 10%

k. identified

l. -40°C to 90°C

Welcome to

Working with blocks

10

Based on applicable standards and product application information for

Crosby

Module 10

slide 1

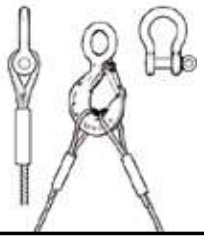
HITCHES

10

WIRE ROPE, CHAIN AND SYNTHETIC SLINGS

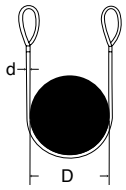
WIRE ROPE SLINGS AND CONNECTIONS TO FITTINGS

Use a thimble to protect sling and to increase D/d ratio. Never place eye over a fitting with a smaller diameter or width than the rope's diameter.

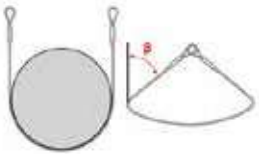


Never place a sling eye over a fitting with a diameter or width greater than one half the length of the eye. 1/3(L) for synthetic slings.





BASKET HITCH

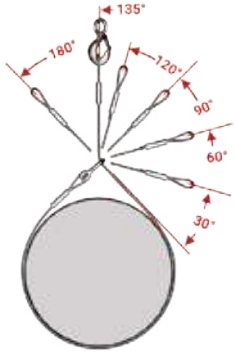


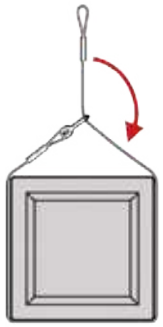
A basket hitch has twice the capacity of a single leg only if the D/d ratio ≥ 25/1 and legs of sling are vertical.
At other angles, see table.

Angle β	Percentage of single leg capacity
0°	200%
30°	170%
45°	140%
60°	100%

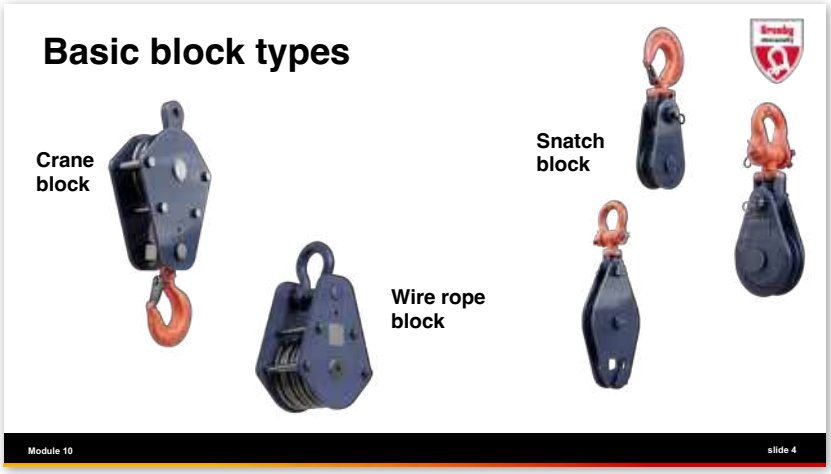
CHOKER HITCHES

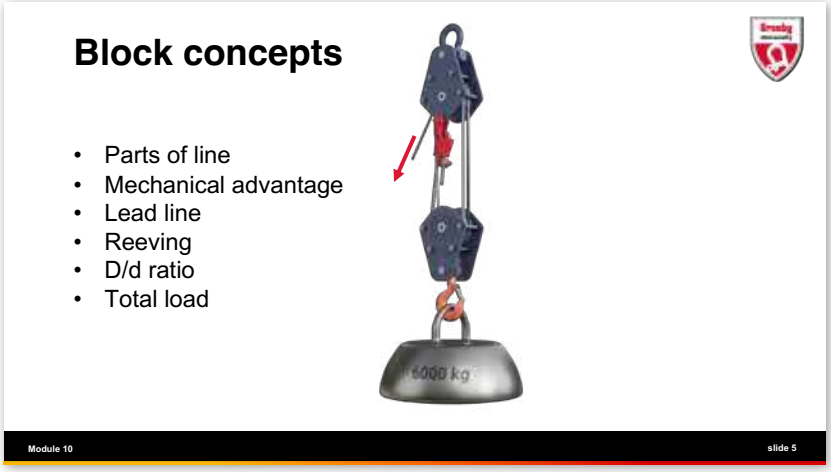
A choker hitch has a maximum capacity of 80% of the single leg sling only if the angle of choke is 120 degrees or greater.





Angle of choke	Sling rated load percentage of single leg sling capacity
120° - 180°	80%
90° - 119°	65%
60° - 89°	55%
30° - 59°	40%







NOTES:

Understanding block concepts will assist in the safe and efficient applications of blocks.

Mechanical advantage: the leverage gained by multiple parts of line. The speed of the block will be reduced as parts of line increase.

Lead line: the wire line leading from the block to the winch

Reeving: the physical arrangement of the wire line through the block

D/d ratio: the pitch diameter (centre of wire rope to centre of wire rope) of the sheave divided by the wire rope diameter

Total load: the total load includes all the loads on the primary end fitting. The working load limit of the block must be greater than the total load on the block.

A closer look at mechanical advantage finds that the lead line pull is directly affected by the parts of line.

The use of multiple parts of line allows the winch to lift a load greater than the winch capacity.

Mechanical advantage

Mechanical advantage is the leverage gained by multiple parts of line

Lead line pull (Tension) = Total weight (load) / Number of parts of line



Module 10 slide 7

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Mechanical advantage

Mechanical advantage is the leverage gained by multiple parts of line

Lead line pull (Tension) = 6 000 kg / 4 parts of line

Lead line pull (Tension) = 1 500 kg



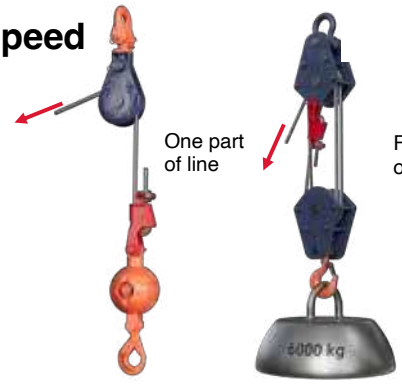
Module 10 slide 8

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Block system speed

For same winch speed (rpm), the system with four parts of line will have a hoisting rate of 1/4th of the single part of line.



Module 10 slide 9

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NOTES:

The load on the lead line under static (no movement) conditions can be readily calculated if the load is divided by the number of parts of line as expressed in the following formula:

$$\text{Lead line pull (Tension)} = \frac{\text{Total weight (load)}}{\text{Number of parts of line}}$$

For example, in a 4-part system to support 6.000 kg, the lead line load will equal:

$$\text{Lead line pull (Tension)} = \frac{\text{6 000 kg}}{\text{4 parts of line}}$$

$$\text{Lead line pull (Tension)} = \text{1 500 kg}$$

The ability to support a total load greater than the winch line pull comes at a cost. the amount of wire rope required to be pulled to raise the load increases and, as a result, the block system is slower as parts of line increase.

In this block system, there are 4 parts of line. To raise the block 1 meter, 4 meter of wire rope would be required to be winched in.

For the same winch speed (rpm), the block system with four parts of line will have a hoisting rate of 1/4 the single part of line.

Total load

- The total load placed on the primary end fitting of the block determines the working load limit required.
- The total load includes all loads, the load on the end fitting.
- The total load is often greater than the weight of the load being lifted.



Module 10 slide 10

NOTES:

The total load placed on a block includes stationary, the loads placed on the end fitting of the block. The end fitting of a block may be a hook, shackle or an eye. The total load must include the load weight and all rigging weight.

The total load placed on a block determines the working load limit required. The working load limit must be greater than the total load rigged on the block. It is important to note that the total load on a block can be greater than the weight of the load being lifted.

The total load on a block includes all loads placed on the primary end fitting. In the 4-part block system, the total load on the lower block is the 6.000 kg placed on the load hook. The total load on the upper block is the 6.000 kg plus the weight of the lower block and the 1.500 kg of winch line pull. A total of 7.500 kg plus.

The effects of friction on mechanical advantage

- When the block moves, mechanical advantage is reduced as a result of friction and the work required to bend the wire rope
- The tension in the lead line is increased as a result

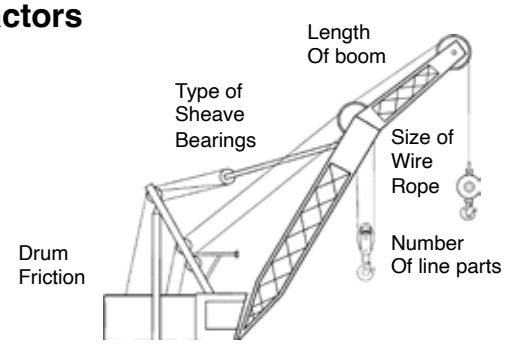


Module 10 slide 11

The calculation of lead line stationary, and total load is simple only as long as this block is stationary, or friction of sheave bearings is minimal.

When the block moves, mechanical advantage is reduced as a result of friction and the work required to bend the wire rope. the tension in the lead line and each part of line is increased as a result.

Overhaul weight Factors



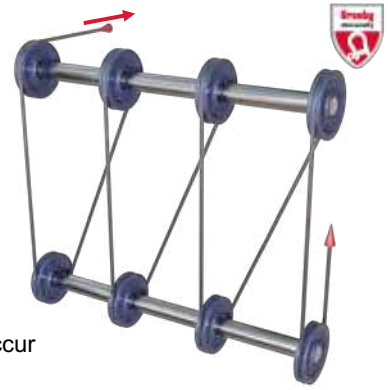
Module 10 slide 13

To determine the weight of the block or overhaul ball that is required to freefall the block, the following information is needed:

- size of wire rope
- number of line parts
- type of sheave bearing
- length of crane boom
- drum friction

Refer to the Kito Crosby catalog for calculation on overhaul weights.

Straight lacing



Pros:
- Blocks can run close together
- Reeving is simple
- No reverse bending

Cons:
- Tilting occurs
- Line and sheave scrub can occur

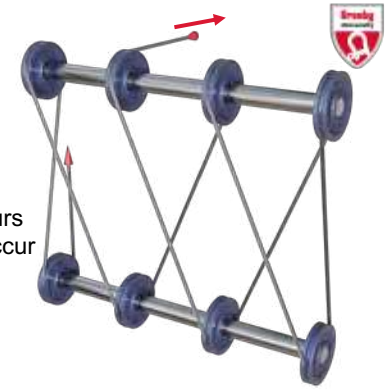
Module 10 slide 15

NOTES:

Straight laced reeving is a basic method of putting rope through a set of blocks. The end of the rope is fed through the outside sheave of the lower (traveling) block. This continues to the last sheave. Straight lacing has been found to be acceptable for 4 up to 5 sheaves when the dead weight of the load block and its centre of gravity is low enough to resist the dynamic torque of the rope, which tends to rotate block.

Consult the manufacturer's crane handbook for the proper reeving method.

Skip reeving



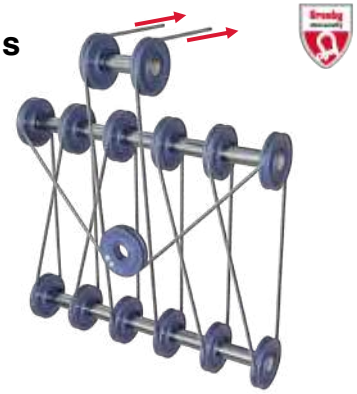
Pros:
Blocks are more balanced

Cons:
- Reverse bending of rope occurs
- Line and sheave scrub can occur when blocks are close

Module 10 slide 16

Skip reeving is the physical arrangement of the wire line being located from sheave to another sheave and "Skipping" one sheave in between. Skip reeving is a method used to achieve a more balanced dynamic loading of free suspended load blocks. Skip reeving results in reverse bending when the rope is bent one way as it passes over a sheave, then it is bent the opposite way when it passes over the next sheave.

Block reeving - dual leads



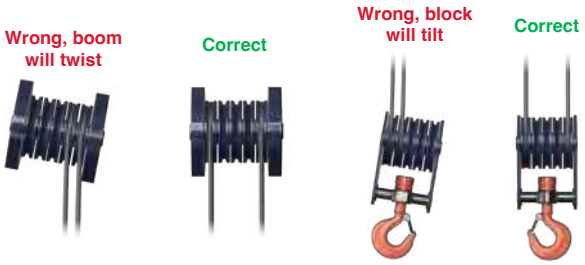
- Large capacity mobile cranes
- Many overhead cranes

Module 10 slide 17

Reeving in large capacity crane and many overhead crane block applications can involve other techniques. These techniques include the use of dual lead lines and equalizer sheaves.

Symmetrical reeving

Boom tip sheaves and block sheaves should be symmetrically reeved



Module 10 slide 18

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Block reeving and the Working Load Limit

The working load limit of blocks are based on the use of **all sheaves**

If fewer sheaves are used, symmetrically load the sheaves and **reduce the working load** limit proportionally



Module 10 slide 19

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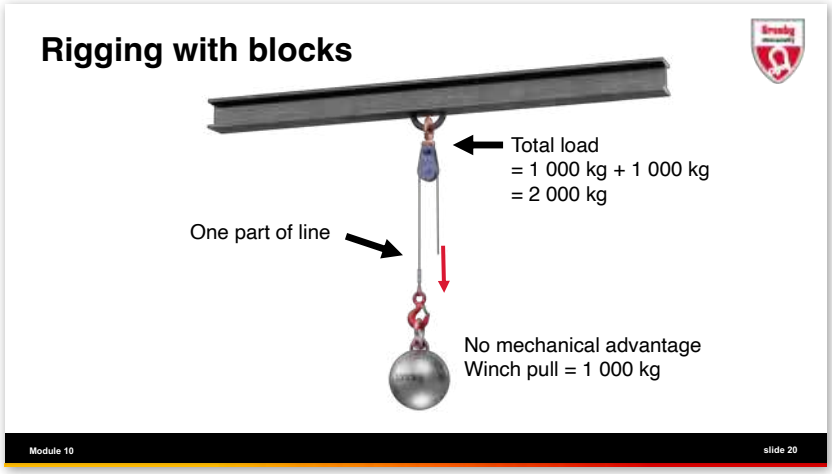
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NOTES:

Static balance is the placing of the wire rope reeving to load the stationary sheaves and boom point evenly.
The number of sheaves is determined by the number of sheaves in the boom point of the crane. Blocks are designed to utilize all sheaves to attain the full working load limit. If the number of sheaves used (reeved) is less, the allowable load on the block must be proportionally reduced. This must be done regardless of wire rope capacity.

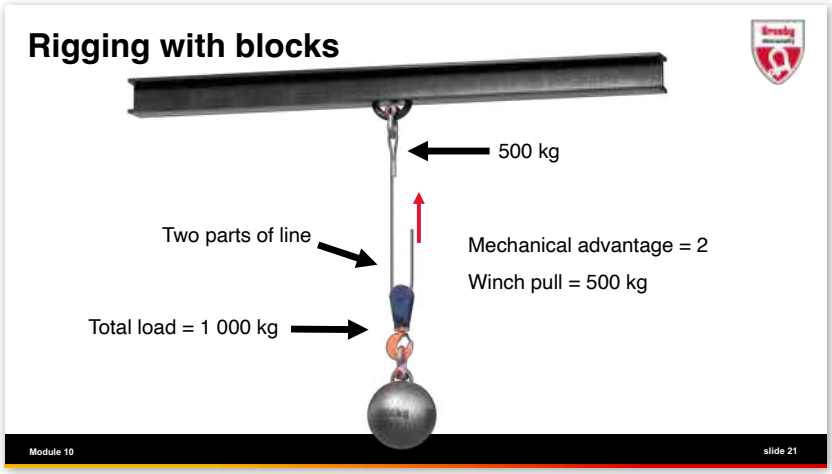
In a 30-ton block, if 50% of the sheaves are used, the block working load limit must be adjusted down to 15 tons.

When fewer sheaves are used, it is also very important to symmetrically reeve the sheaves.

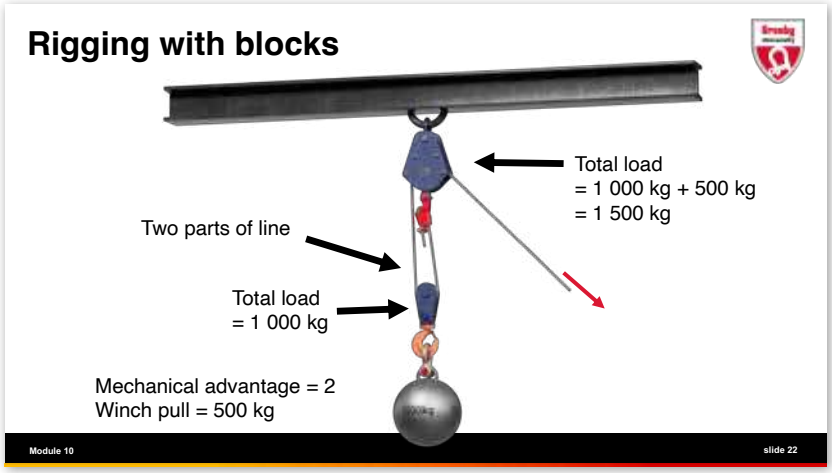


NOTES:

In example #1, the parts of line is 1, thus there is no mechanical advantage, or it is said to be 1. The winch pull on lead line would need to be 1.000 kg to raise the 1.000 kg load. The total load on the upper snatch block is 1.000 kg load plus the 1.000 kg line pull, or 2.000 kg total load. so, the required working load limit of the block would be 2.000 kg. Since there is only 1 part of the line, 1 meter of wire rope will need to be winched in to raise the load 1 meter.



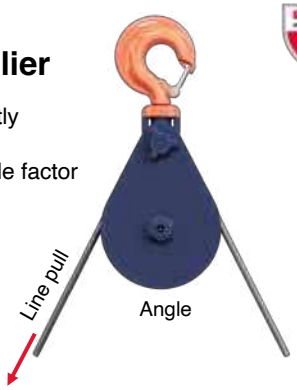
In example #2, the parts of line is 2, thus the mechanical advantage is 2. To raise a 1.000 kg load, the winch would have to pull 1.000/2 or 500 kg, the total load and the required capacity for the block is the 1.000 kg that the hook sees. Since there are 2 parts of line, 2 meter of wire rope will need to be winched in to raise the load 1 meter.



In example #3, there are 2 parts of line, resulting in a mechanical advantage of 2/1.
To raise the 1 000 kg load, the winch would have to pull 1 000/2 or 500 kg. The total load and required capacity for the lower block is the 1 000 kg that the hook sees. The total load and required capacity for the upper block is 1 000 kg load plus 500 kg winch pull or 1 500 kg. Since there are 2 parts of line, 2' of wire rope will need to be winched in to raise the load 1'.

Block loading and the angle factor multiplier

- The total load on the block can be greatly different from the line pull
- Total load on the block = line pull x angle factor
- At 0 degrees the multiplier is 2
- As the angle increases the angle factor decreases
- At 120 degree the multiplier is 1



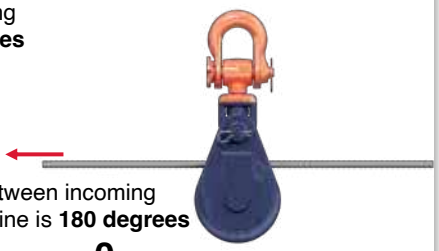
Module 10 slide 23

Block loading and the angle factor multiplier



Angle between incoming and exit line is **0 degrees**

The multiplier is 2



Angle between incoming and exit line is **180 degrees**

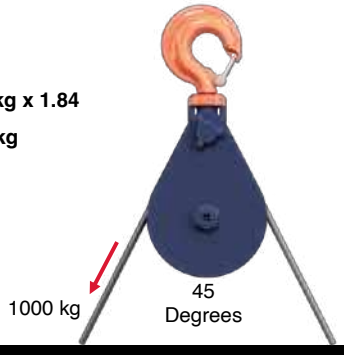
The multiplier is 0

Module 10 slide 25

Block loading and the angle factor multiplier

Total load = 1000 kg x 1.84

= 1840 kg



Module 10 slide 27

NOTES:

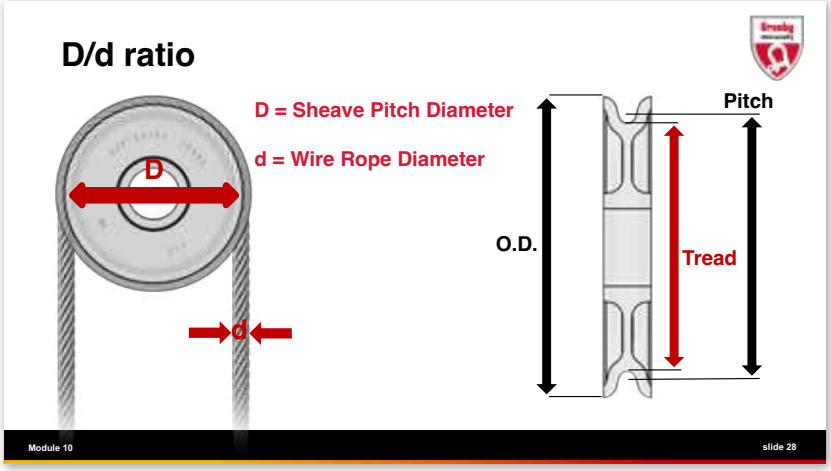
A single sheave block used to change load line direction can be subjected to total loads greatly different from the weight being lifted or pulled.

The total load value varies with the angle between the incoming and departing lines to the block.

Total load = Line pull x Angle factor

The following chart indicates the factor to be multiplied by the line pull to obtain the total load on the block.

Angle Factor Multipliers			
Angle	**Factor**	**Angle**	**Factor**
0°	2.00	100°	1.29
10°	1.99	110°	1.15
20°	1.97	120°	1.00
30°	1.93	130°	.84
40°	1.87	135°	.76
45°	1.84	140°	.68
50°	1.81	150°	.52
60°	1.73	160°	.35
70°	1.64	170°	.17
80°	1.53	180°	.00
90°	1.41	—	—



NOTES:

Strength Efficiency
Bending wireline reduces its strength. To account for the effect of bend radius on wireline strength when selecting a sheave, use the table of page 17 of the Rigging Card.

Fatigue Life
Repeated bending and straightening of wireline causes a cyclic change of stress called "fatiguing." Bend radius affects wireline fatigue life. A comparison of the relative effect of sheave diameter on wireline fatigue life can be determined as shown in the table on page 17 if the Rigging Card.

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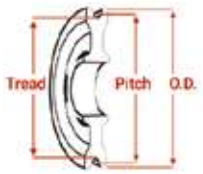
D/d RATIO - BLOCKS & SHEAVES

Crosby WEDGE SOCKETS QUIC-CHECK



D = SHEAVE PITCH DIAMETER

d = WIRE ROPE DIAMETER



	EFFICIENCY ROPE REDUCES ITS BENDING STRENGTH	FATIGUE LIFE REPEATED BENDING AND STRAIGHTENING OF WIRE ROPE CAUSES "FATIGUING"
D/d	STRENGTH EFFICIENCY COMPARED TO CATALOG STRENGTH IN %	RELATIVE FATIGUED BENDING LIFE
40	95%	
30	93%	10
25	92%	6.6
20	91%	3.8
18	90%	2.9
16	89%	2.1
14	88%	1.5
12	87%	1.1
10	86%	
8	83%	
6	79%	
4	75%	
2	65%	
1	50%	

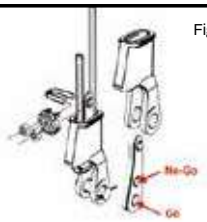


Figure 1





Figure 2

ASSEMBLY SAFETY

- Use only with standard 6 to 8 strand wire rope of designated size. For intermediate size rope, use next larger size socket. Tail length of dead end as per figure 1.
- Align live end of rope with centre of pin. (see figure 1)
- Secure dead end section of rope. (see figure 1)
- Do not attach dead end to live end. (see figure 2)
- Use a hammer to seat wedge and rope as deep into socket as possible before applying first load.
- Refer to figure 1 for assembly of Crosby terminator wedge socket.
- Dead end should be seized, brazed or welded before inserting into socket. Method used depends on type or wire rope. Refer to wire rope manufacturer for instructions. Seizing is normally the preferred method. Welding on the tail of standard wire rope is not recommended.

OPERATING SAFETY

- Apply first load to fully seat the wedge and wire rope in the socket. This load should be of equal or greater weight than loads expected in use. Tighten nuts on clip to recommended torque.
- Efficiency rating of the wedge socket termination is based upon the catalogue breaking strength of wire rope. The efficiency of a properly assembled wedge socket is 80%. (80% only with use of EEIP steel wire rope)

For additional information refer to the Crosby catalogue

McKissick snatch blocks

- McKissick snatch blocks have a secondary securement system which retains the end fitting connection bolt when the block is in the closed position
- Fittings are forged and quenched and tempered
- McKissick Champion snatch blocks are fatigue rated



Module 10 slide 30

NOTES:

Selection and application of McKissick snatch blocks



For long term application use a snatch block with bolt, nut and cotter (split) pin

Make sure that the hairpin is **always** in place to prevent accidental loosening of the hook bolt and the retention spool nut



Round retention nut screwed and staked on the end of the hook bolt spool

Module 10 slide 31

When using a snatch block, always visually check if the hairpin and/or cotter pin is still fitted properly to secure the bolts preventing accidental loosening of these bolts.

Selection and application of McKissick snatch blocks

- Standard McKissick snatch blocks are offered in bronze bushed and straight roller bearings
- **Plain bronze bushing**
  - Slow line speeds
  - Infrequent and intermittent use
- **Straight roller bearings**
  - Slow to medium line speeds
  - Intermittent and more frequent use



Module 10 slide 32

M-491 Tower/Derrick block

- M-491 tower / derrick is designed with sealed tapered roller bearings
- Available in painted or galvanized version
- Sealed tapered roller bearings:
  - Faster line speeds
  - Frequent to continuous use

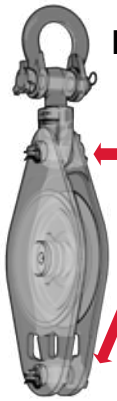


Module 10 slide 33

NOTES:

Make sure that the hairpin is always in place to prevent accidental loosening of the hook bolt and the retention spool nut.

M-491 Tower/Derrick block



Mckissick M-491 Tower / Derrick hoist blocks have a secondary securement system which retains the end fitting connection bolt and lower bolt when the block is in the closed position

Shackle fitting swivels for easy positioning



Sheave lubrication through center pin for easy and proper maintenance

Module 10 slide 34

Snatch blocks must be included in the lifting equipment frequent and periodic inspection program. The following is a partial list of inspection points. Refer to the Kito Crosby general catalog and various ASME/OSHA publications for full information.

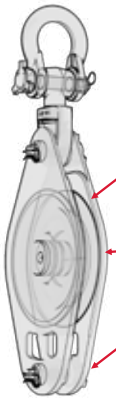
- Always make sure that the hairpin is in place to prevent accidental loosening of the hook bolt and the retention spool nut.
- The swivel assembly and sheave assembly cannot be separated.
- The hook bolt cannot be removed if lock clip is in place on the end of the hook bolt.

As part of the periodic inspection, open the block and do a visual inspection:

1. Ensure that the round retention nut is secure and properly staked with 3 stakes.
2. Verify that the hook bolt cannot be removed, ensure that the snap ring clip is in place on the end of the bolt.
3. Ensure there is no damage or excessive wear that would require removing the snatch block from service.
4. Verify that the sheave is easy to rotate, offering no resistance or wobble.

ASME B30.26 defines the inspection requirements for rigging blocks.

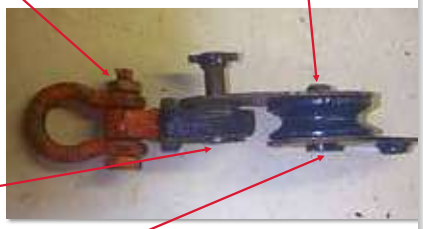
Selection and application of M-491 Tower/Derrick block



- Side plate design reduces the gap between sheave rim and side plate
- Larger sheave D/d ratio increase wire rope strength efficiency and enhance fatigue life
- Sheave assembly captured in block if loss of center pin occurs
- Lower bolt also provided

Module 10 slide 35

Snatch block: open position for inspection



Module 10 slide 39

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Block inspection Initial inspection

- Meets application requirements
  - Capacity
  - Wire Line Size
  - Sheave Diameter
  - Number of Sheaves
- Ready for service
- Tightness of locking devices



Module 10 slide 42

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Block inspection Frequent inspection

- Proper function
- Hooks + latch and attachments
- Side plates
- Fasteners
- Bearings
- Sheaves



Module 10 slide 43

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NOTES:

Initial inspection:
Prior to use, all new, altered, modified, or repaired rigging blocks shall be inspected by a designated person. Written records are not required. However, check if certification is needed for the equipment as per local legislation.

Frequent inspection:
a) A visual inspection shall be performed by the user or other designated person each shift before the rigging block is used. Semi-permanent and inaccessible locations where frequent inspections are not feasible shall have periodic inspections performed.
b) Conditions that may result in a hazard shall cause the rigging block to be removed from service. Rigging blocks shall not be returned to service until approved by a qualified person.

Written records are not required.

Periodic inspection:
A complete inspection of the rigging block shall be periodically performed by a designated person. Periodic inspection intervals shall not exceed one year. The frequency of periodic inspections should be based on:
1) frequency of use
2) severity of service conditions
3) nature of lifts being made
4) experience gained on the service life of hardware used in similar circumstances

Written records are mostly required for periodic inspections, as per local regulations.

Removal criteria:
Rigging blocks shall be removed from service if damage is present and shall only be returned to service when approved by a qualified person.

Block inspection
Periodic inspection

- Wear on pins or axes, rope grooves, side plates, bushing or bearings, and fittings
- Deformation in side plates, pins and axles, fitting attachment points, trunnions
- Misalignment or wobble in sheaves
- Security of nuts, bolts, pins and other locking methods
  Proper positioning of sheave pin nuts



Module 10 slide 44

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Block inspection
Periodic inspection

- Hook or shackle to swivel case clearance
- Deformation or corrosion of hook and nut threads
  Surface condition and deformation of hook
- Hook latch for deformation, proper fit and operation
- Side plates for weld corrosion or weld cracking



Module 10 slide 45

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Block inspection
Heavy and severe service

Initial inspection:
- Upon receipt

Frequent inspection:
- Daily

Periodic inspection:
- Quarterly to annually

Or as required per local regulations

Further disassembly required for visual inspection and NDT of key load bearing components may be required.



Module 10 slide 46

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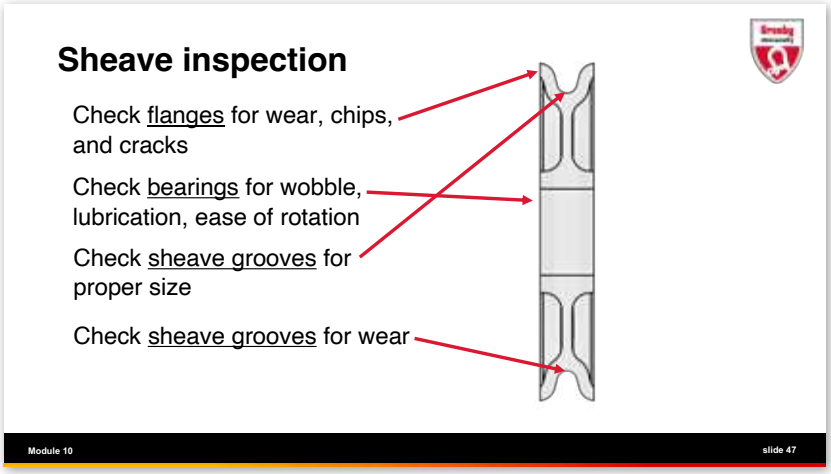
NOTES:

Remove from service criteria includes:

1. Loose pins and axles
2. Daylight between gage and base or sheave groove
3. Rope print in sheave groove
4. Wobble of sheave bearings or bushings
5. Misalignment of sheaves
6. Any weld cracking or corrosion of welded side plates or sheaves
7. Missing or modified snap rings on locking devices
8. Sheave pin nuts should be checked for proper positioning. Pins for tapered roller bearings should be tightened to remove all end play during sheave rotation. Pins for bronze bushings and straight roller bearings should have a running clearance of 0,79 mm (0,031") per sheave of end play and should be adjusted accordingly. remove from service if cannot be adjusted.
9. The hook or shackle-to-swivel case clearance is set at 0,79 mm (0,031") to 1,58 mm (0,062") at the factory. Increased clearance can result from component wear. Remove from service if clearance exceeds 4,57 mm (0,18").
10. Deformation or corrosion of hook and nut threads
11. Deformation of hook
12. Missing or defective latch

There are additional specific rejection criteria for each block type and series.

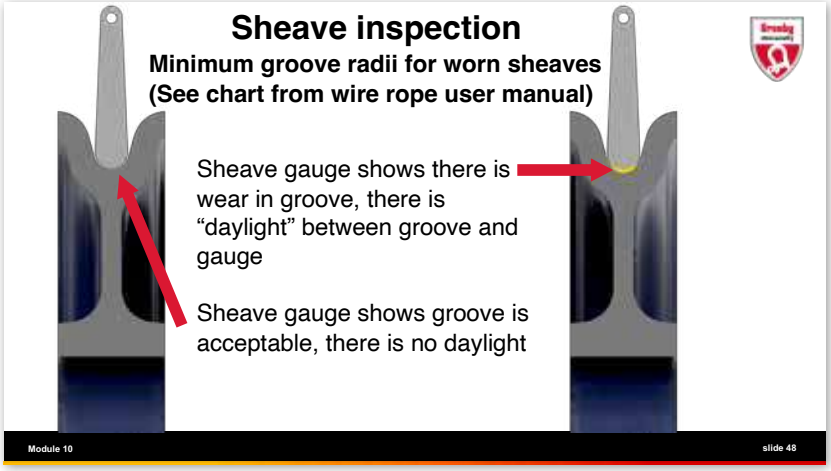
ASME B30.5 and ASME B30.2 require the inspection of hooks and latches as part of crane's frequent and periodic inspection.



NOTES:

McKissick® Roll-Forged Heavy Duty Sheaves are made by upsetting and forming the groove and flange walls in multiple steps, eliminating the need to split and weaken the groove. This exclusive forging process adds extra strength to the critical groove section.

We can also custom design and manufacture sheaves to your exact requirements. McKissick roll forged sheaves can be furnished balanced or with lightening holes.



Lubrication:
The frequency of lubrication depends upon frequency and period of product use as well as environmental conditions, which are contingent upon the user's good judgment. Assuming normal product use, the following schedule is suggested when using lithium-base grease of a medium consistency.



Category II inspection McKissick overhaul balls



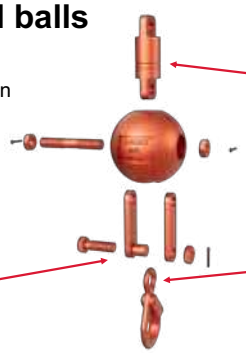
Basic inspection points

- Cracking or Impact Damage of any Component
- Modification such as Welding or Cutting
- Substitution of Parts (or Missing Parts)
- Excessive Deformation
- Excessive Wear
- *Restricted Movement of the Swivel
- *Excessive Case to End Fitting Clearance

* For Swiveling Only

Module 10 slide 51

Category II inspection McKissick Swiveling overhaul balls



Module 10 slide 52

Inspection of McKissick Non-swiveling overhaul balls



Module 10 slide 53

NOTES:

Frequent inspection of McKissick overhaul balls is critical to ensure safety and reliability. Periodic inspections are as per local regulations.
Next to the proper functioning, the key areas to inspect are cracking, impact damage, modifications, substitution of parts, deformation and wear.

The type, frequency and severity of application for overhaul balls is the sames as for blocks.

Lubrication of mckissick swiveling overhaul balls:

The frequency of lubrication depends on frequency and periods of use, environmental conditions and the user's good judgment.

As a minimum, lubrication schedule should include:
1. Every 14 days for frequent swiveling
2. Every 45 days for infrequent swiveling

Swiveling overhaul balls:

Swivel
Inspect the swivel for ease of rotation and general tightness. Restricted movement or excessive play (case to end fitting clearance) should result in removal from service.

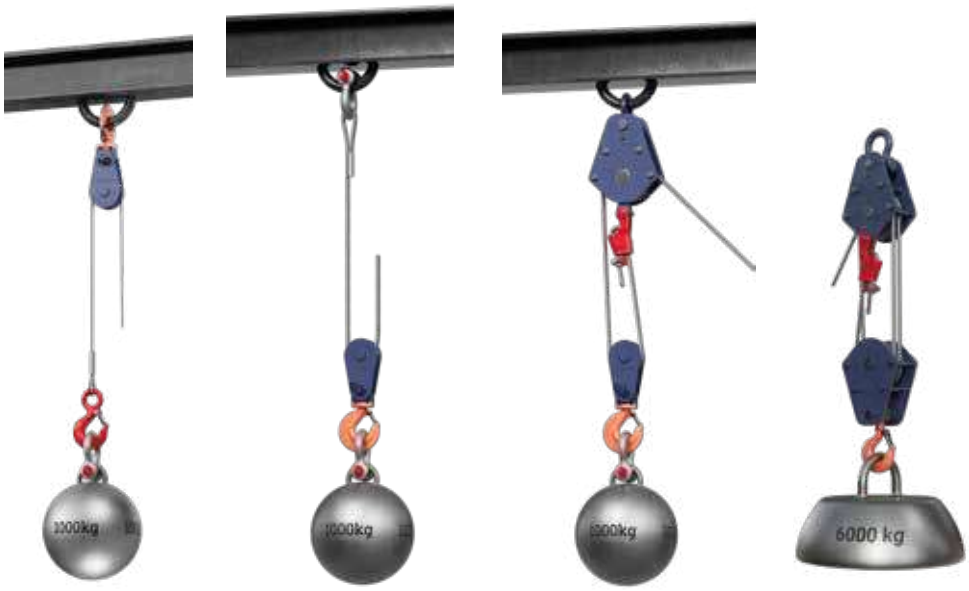
Bolts & sleeve:
Check bolts and sleeve for wear and deformation (none allowed). No substitution of parts is allowed.

Link plates:
Check link plates for wear and deformation (none allowed).

Hook:
Check the hook for deformation, wear and proper functioning of the latch. Maximum wear in the eye of the hook is 5% of the original catalog dimension.

For **non-swiveling overhaul balls,** the same inspection criteria apply for the bolt & sleeve, link plates and hook.

Rigging with blocks



Load weight	1000 kg	1000 kg	1000 kg	6000 kg
Parts of line				
Mechanical advantage				
Line pull				
WLL lower block				
WLL upper block				
Wire pulled to raise 1 m				

Working with Blocks

1. The number of wires supporting a traveling block is called _____.
2. The total load on a block is the sum of all loads on the _____.
3. The working load limit of a block must be greater than the _____ it “sees”.
4. A block that has a 320 mm sheave and 20 mm wire line has a _____ of 16/1.
5. The strength of wire rope is _____ when the D/d < 40/1.
6. A block with a D/d of 24/1 will have a rope life that is _____ than a block with a D/d of 16/1.
7. A block with a winch line pull of 1.000 kg and four parts of line can lift _____.
8. A hook in a block must have a _____.
9. To raise a 4.000 kg load, a winch would have a pull of _____ if two-parts of line.
10. To lower a block without a load, _____ is often needed.
11. Wire rope is placed into a block by _____.
12. For a block system to have mechanical advantage, you usually must have a _____ block.
13. In the “real” world, a block with four parts of line will have a true mechanical advantage that is less than 4/1 because of _____.

Choose Answer from the Following List

a. end fitting
b. reeving
c. total load
d. 4.000 kg
e. parts of line
f. D/d ratio
g. traveling
h. overhaul weight
i. reduced
j. greater
k. 2.000 kg
l. latch
m. friction

Welcome to

Lifting clamps

11

Based on applicable standards and product application information for

GUNNEBO Industries

Crosby

Module 11

slide 1

Production overview



Overview



Cutting machine



Welding robot



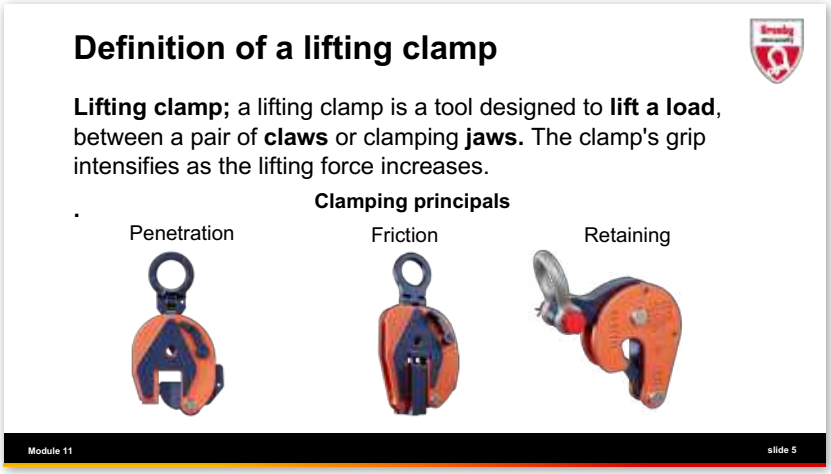
Paint & drying area

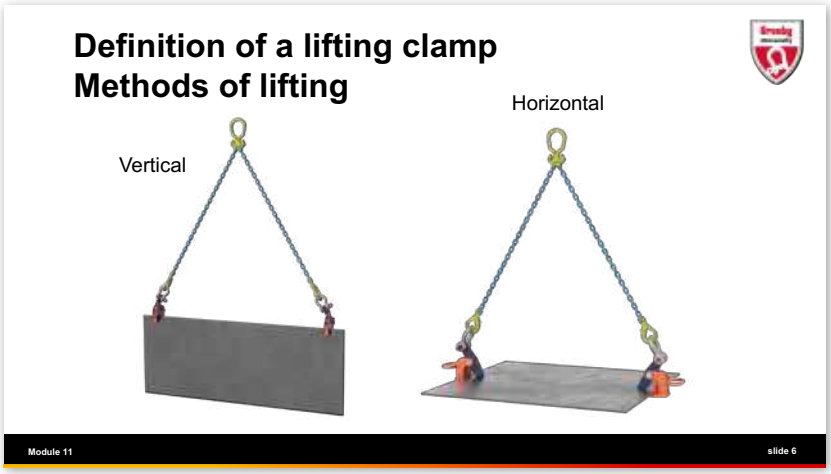


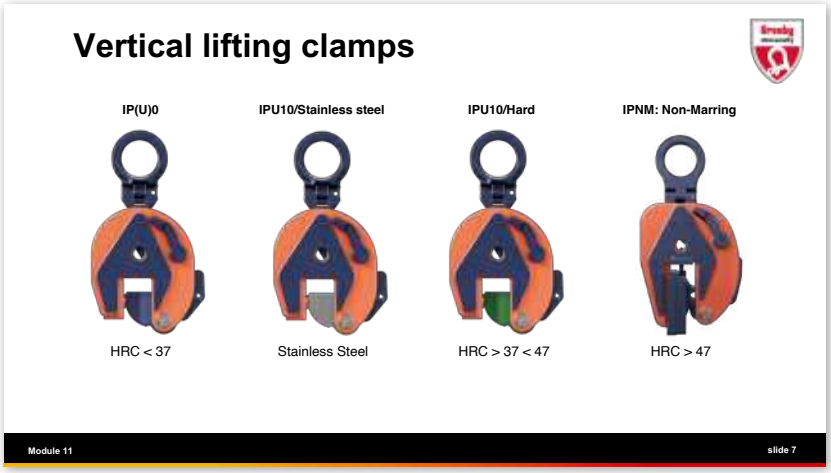
Assembly unit



Testbench







NOTES:

Lifting clamps provided with pivot and camsegment need to penetrate the steel plate in order to have proper grip and a safe lift. The pivot and camsegment mostly leave a mark in the steel plate lifted. Vertical lifting clamps have a minimum and maximum WLL stamped into the body.

Non-marring lifting clamps operate based on friction, which means they do not leave any markings or damage on the plate. The body of non-marring clamps is mostly bigger compared to standard lifting clamps, as the clamping force needs to be high enough to lift the load safely.

Non-marring (NM) clamps have poly-urethane pads on each side clamping the load. The NM-type vertical clamp only works based on friction. The body is mostly bigger than standard vertical clamps as the clamping force needs to be bigger to keep the load. NM-type clamps do not have a minimum WLL.

Depending on the hardness of the steel plate to be lifted, select the proper lifting clamp.

- IP(U)10 - Standard clamp for materials with a surface hardness to 363HV10 (345 HB / 37 HRC).
- IP(U)10S - For use with stainless steel material.
- IP(U)10H - For use with materials with a surface hardness to 472HV10 (450 HB / 47 HRC).
- IPNM - For use with materials with any surface hardness, also > 472HV10 (450 HB / 47 HRC).



NOTES:

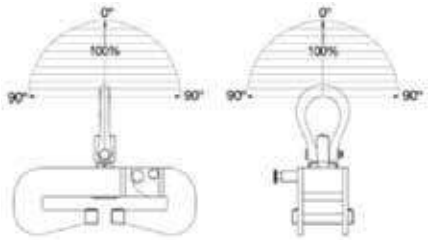
Horizontal lifting clamps need to be used in pairs. There is no minimum WLL for horizontal lifting clamps.

For lifting multiple plates in horizontal position, the IPPE clamps are recommended.

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IPTKA clamps maintain full WLL at angles up to 90°.

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IP Startec clamps are designed for lifting, transferring and controlled tilting of steel beams. They are equipped with a handle for easy placement.



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Drum clamps

IPVK

WLL: 0,5 t





IPDV

WLL: 0,5 t



Module 11 slide 12

NOTES:

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Definition of a lifting clamp

Components of a lifting clamp



Load carrying components

- Lifting eye
- Lifting eye shaft
- Body
- Camsegment
- Camsegment shaft
- Pivot

Non load carrying components

- Latch
- Spring

Module 11 slide 13

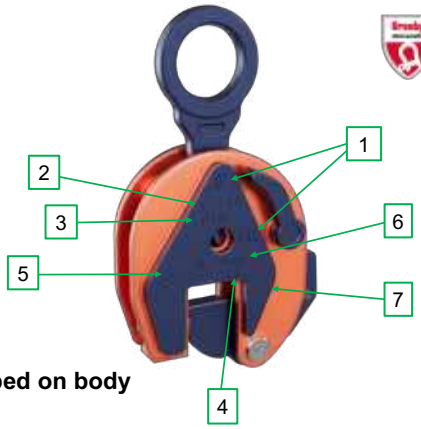
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Markings:

1. Manufacturer
2. Minimum & maximum WLL
3. Type
4. CE marking
5. Serial number
6. Jaw opening (mm & inch)
7. Year of production

All data is permanently stamped on body



Module 11 slide 16

The minimum & maximum Working Load Limit stamped in each Crosby IP clamp is the rated capacity for the clamp.

For vertical clamps, the minimum load placed on clamp must be 10% of the WLL stamped in the body

Or: 5% of the WLL for plate surface hardness <27rc (900 n/mm²)

Or: 5% minimum load also applies on IP(U)10 with WLL 0.5t

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Lifting clamps
Use the proper clamp

- The clamp shall be applied to the load in accordance with the instruction manual.
- Always use the correct size and style of lifting clamp for the lift.



Module 11 slide 17

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Lifting clamps
The Working Load Limit

Most clamps are rated **individually**:

- **Vertical lifting clamps** - IPU10/S/H, IP10, IPNM10
- **Pretension horizontal clamps** - IPBC, IPHGZ
- **Steel beam clamps** - IPTK/IPTKW, IPBKZ, IPBHZ, IPBSNZ, IPTKU, IPTKUD, IPBTO, IPSTARTEC
- **Small profile clamp** - IPV(U)Z
- **Drum clamp** - IPDV, IPVK
- **Positioning clamp** - IPSC

Model	Working Load Limit (t)*	IPU10 Stock No.
IPU10	0.5	2701675
IPU10	1	2701663

The catalog rating and the Working Load Limit stamped in clamp are the same.

Module 11 slide 19

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Lifting clamps
The Working Load Limit

Selected clamps are rated **in pairs**:

- Non-locking horizontal clamps - IPH10 / IPH10J / IPH10JE / IPHOZ
- With magnets, torsion spring and handle (depending on type)

Model	Working Load Limit (Per Pair) (t)*	IPH10 Stock No.
IPH10	.5+	2703297
IPH10	1+	2703298
IPH10	2	2703522
IPH10	3	2703523

The catalog rating is based on the pair BUT **the Working Load Limit stamped in each clamp is the individual clamp's capacity.**

Module 11 slide 20

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NOTES:

It is key to select the proper clamp for the application it is designed for.

The temperature of the load should not exceed the maximum allowable limits of the clamp.

Crosby IP clamps can be used with ambient temperatures between –40°c and +100°c. Other clamps may be different. Check with the manufacturer.

Never weld, straighten, alter or heat (treat) a clamp.

An operator shall not use a lifting device that is tagged "out of service" or otherwise designated as nonfunctioning.

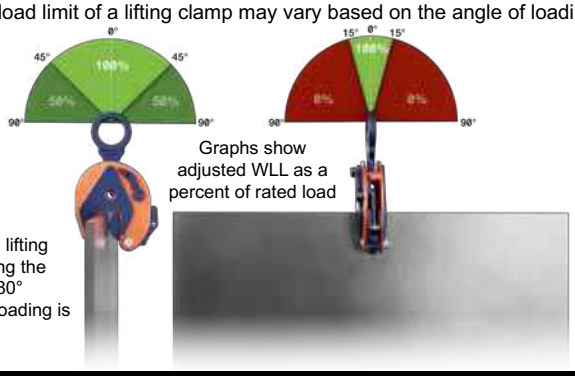
"Out of service" tags on lifting devices shall not be removed without the approval of the person placing them or an authorized person.

Caution should be taken that operating markings or tags shall not be removed or defaced. Missing or illegible markings or tags shall be replaced.

When selecting or ordering spare parts for horizontal lifting clamps, specify the WLL of the clamp individually (stamped on the body) in order to avoid confusion.

IP10 lifting clamps – fixed hoisting eye

The working load limit of a lifting clamp may vary based on the angle of loading



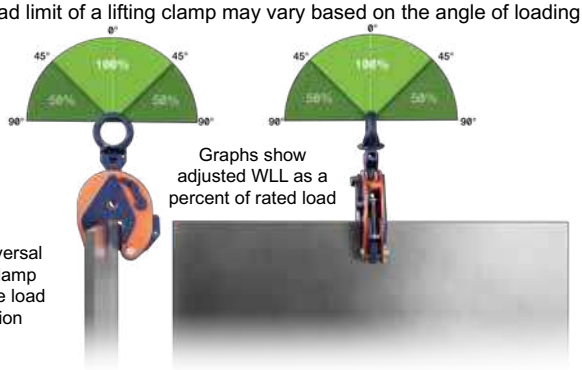
Graphs show adjusted WLL as a percent of rated load

The IP10 vertical lifting clamp allows lifting the load through a 180° turning but side loading is limited to 15°

Module 11 slide 21

IPU10 lifting clamps – universal hoisting eye

The working load limit of a lifting clamp may vary based on the angle of loading



Graphs show adjusted WLL as a percent of rated load

The IPU10 universal vertical lifting clamp allows lifting the load from any direction

Module 11 slide 22

IP10 & IPU10 lifting through 180° turning



As one end of load is on ground, while the load is rotated from horizontal to vertical, the clamp will see max 50% of load, so reduction of the WLL is not required.

Module 11 slide 23

NOTES:

The type IP10 vertical lifting clamp is used for lifting, turning (180°) and vertical transfer of steel plates and constructions.

IP10 clamps have a straight/fixed hoisting eye and shall not be side loaded exceeding 15°. All IP10 clamps are built with a latch that locks in both the open and closed positions. This allows the operator to easily position the clamp, close the latch and move away from the load before the lift begins.

When the load is vertical and off the ground, the clamp will see 100% of load.

The rated load of the clamp must exceed or be equal to the weight of the load.



Multiple clamps - the rigging triangle
Vertical clamps with universal hoisting eye

The sling angle multiplier must be considered.
If vertical sling angle is 45 degrees or greater, each clamp's WLL must be 50% of the WLL stamped in body.





Module 11 slide 25

NOTES:

Only use vertical lifting clamps with a universal hoisting eye when using them in a 2-leg sling.

Multiple clamps - the rigging triangle
Horizontal clamps



Do not use horizontal clamps with a vertical sling angle greater than

- **30 degrees** for IPBC, IPHOZ, IPH10, IPHNM, IPPE
- **90 degrees** for IPHGZ, IPHGUZ, IPBHZ

The clamp will have its full rated WLL per piece stamped in the body

The load multiplier must be considered

Module 11 slide 26

Most horizontal lifting clamps, have 100% of the WLL only when the vertical angle does not exceed 30°. When the sling length is at least as long as the distance between the positioned lifting clamps, the vertical angle will not exceed 30°.

Multiple clamps rated in pairs
Horizontal clamps

When rated in pairs, the Working Load Limit in the catalog is the **WLL per pair**.

Model	Working Load Limit (Per Pair) (t)*	IPH10 Stock No.
IPH10	.5+	2703297
IPH10	1+	2703298
IPH10	2	2703522
IPH10	3	2703523

IPH10



IPHOZ



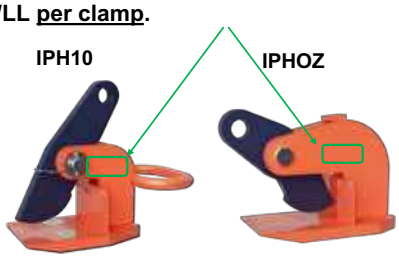
Module 11 slide 27

The IPHOZ horizontal lifting clamp is designed to lift sagging (bending) plates. The positioning of the camsegment allows to clamp the plate when it intends to slide out due to sagging.

IPHGZ & IPHGUZ type horizontal clamps can also be used to lift sagging plates.

Multiple clamps rated in pairs
Horizontal clamps

The working load limit stamped in each Crosby IP clamp is **always** the **WLL <u>per clamp</u>**.



Model	Working Load Limit (Per Pair) (t)*	IPH10 Stock No.
IPH10	.5+	2703297
IPH10	1+	2703298
IPH10	2	2703522
IPH10	3	2703523

Module 11 slide 28

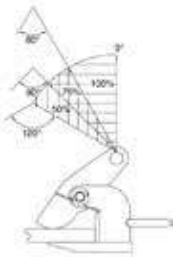
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Multiple clamps rated in pairs
Horizontal clamps

- Do not use at vertical sling angle greater than 30˚
- For bigger angles, reduction of WLL is required
- When rated in pairs, at least two clamps must be used, the WLL stamped in the body is the maximum weight that can be lifted per clamp.





Module 11 slide 29

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Lifting clamps
Opening the clamp

- The clamp shall be applied to the load in accordance with the instruction manual
- Open the clamp by pulling the latch towards the jaw
- Ensure the pivots and camsegment teeth are clean



Module 11 slide 30

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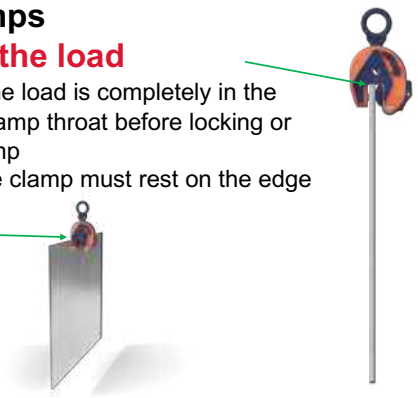
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NOTES:

Lifting clamps

Placing on the load

- Ensure that the load is completely in the back of the clamp throat before locking or using the clamp
- The jaw of the clamp must rest on the edge of the load



Module 11 slide 31

NOTES:

1. Open the clamp by pulling the safety latch towards the jaw.
2. Place the clamp securely on the plate so that the jaw of the clamp rests on the plate.
3. Now pull the safety latch toward the hoisting eye. The clamp will now close and will remain on the plate in pretensioned position, allowing lifting to commence.
4. As soon as the load is at its destination, the load should be lowered and the connection assembly between the hoisting eye of the clamp and the lifting mechanism should be allowed to go slack and allow the hoisting eye to move freely.
5. The clamp may now be used again immediately if visually inspected and approved or put away in opened position. This position will protect the teeth from damage.

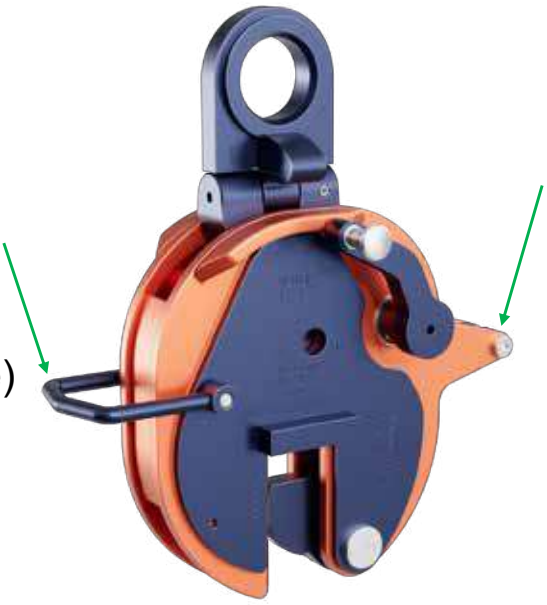
IP(U)10 clamps with working load limits of 12 tons and up have special hook-up devices (temporary hoisting eyes) built in to assist in the placement and installation of these large-sized clamps.

Lifting clamps

Placing on the load

> WLL 12t

Clamps 12t WLL and up are fitted with special hook-up facilities (temporary hoisting eye) to enable easy placement of the clamp in horizontal position.



Module 11 slide 32

IPU10 12t
Weight = 57 kg

When not using the temporary hoisting eye for installation, the clamp “pushes” itself away from the plate when closing the latch, creating a gap between clamp and plate.



Module 11 slide 33

NOTES:

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IPU10 12t
Weight = 57 kg



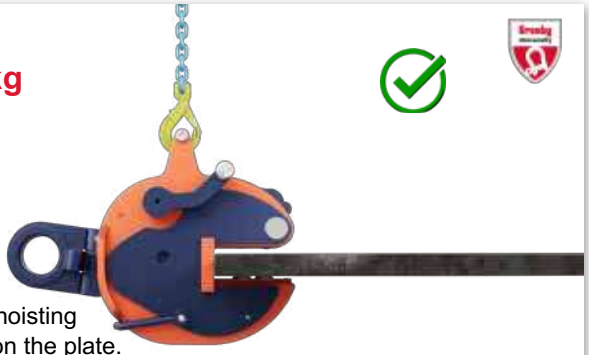
The plate could “click” and not being taken by both pivots which creates a **hazardous situation**.

Module 11 slide 34

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IPU10 12t
Weight = 57 kg



Use the temporary hoisting eye for installation on the plate. When the plate touches pivot and camsegment and the back of the jaw, close the latch.

Module 11 slide 35

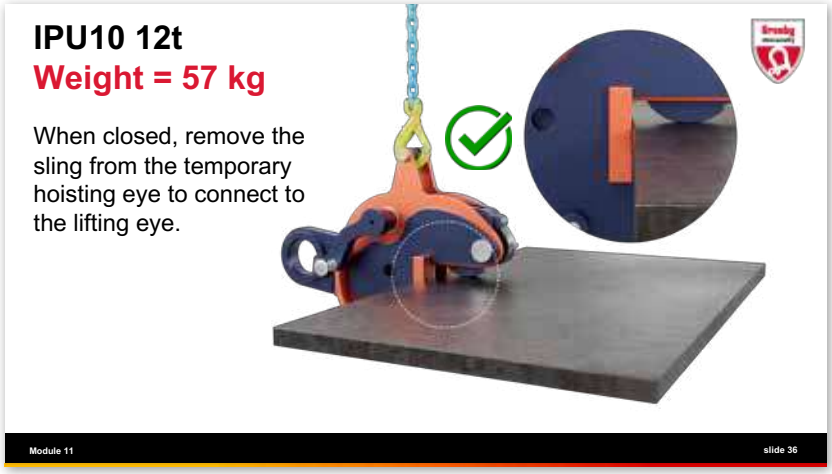
Installation of the vertical lifting clamp can be done with either the pivots below the plate or above.

Technically, both installations will work and lift the plate properly as long as the steel plate is touching the back of the jaw when the clamp is in a closed position.

Installing the vertical lifting clamp with the pivot(s) down is often the preferred option as the latch to close the clamp will be on the top side and easier to operate.

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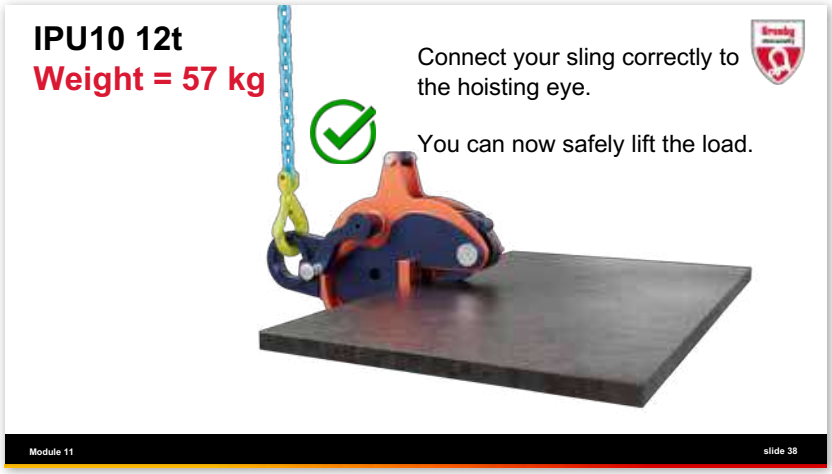
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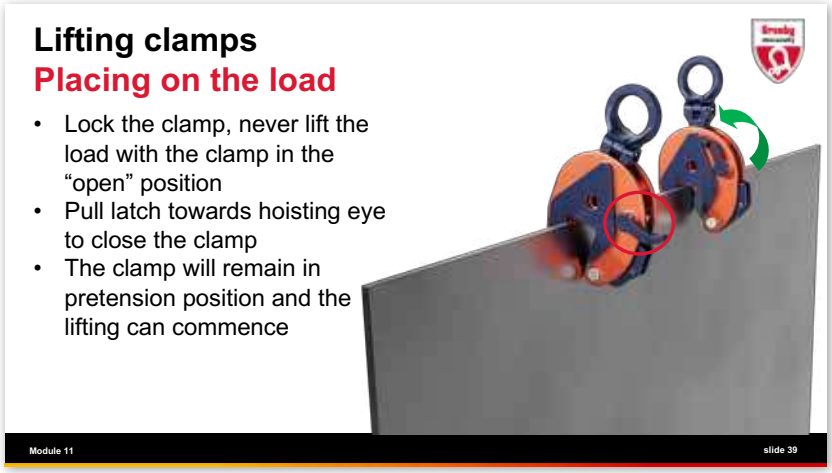


NOTES:

When closed, remove the sling from the temporary hoisting eye to connect to the lifting eye.

Under no circumstance lift the load with the temporary hoisting eye!





Lifting clamps
Locking the clamp

- Do not attempt to unlock the clamp while lifting (supporting) a load
- Keep the clamp in the locked position whenever it is supporting a load



Module 11 slide 40

Lifting clamps
Releasing the load

- Lower load until sling and clamp is fully free of tension
- The hoisting eye must be able to move freely
- Pull latch toward jaw, allowing the clamp to be opened



Module 11 slide 41

Lifting clamps
Operating procedures

- Before lifting, the operator shall make sure that the ropes or chains are not kinked
- Crane or hoist hooks must have a latch
- Use a sling to connect clamp to the crane hook



ASME B30.20
EN 13155

Module 11 slide 44

NOTES:

Storing of lifting clamps:

The clamp, when not in use, should be stored at an assigned location.

Store locking clamps in a locked open position to protect teeth & pivot from damage.

Always keep clamps clean and lubricated.

Inspect clamps before storing.

When storing a clamp in a closed position, the camsegment will rest on the inner ring of the pivot and could cause damage (wear) to the pivot and/or camsegment.

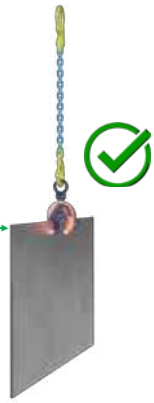


Operating procedures:

- The operator shall avoid carrying the load over people
- The operator and other personnel shall stay clear of the load
- The operator shall not ride or allow others to ride on the load
- Never lift over personnel
- Never lift over safety areas
- Hands Off - Step Away - Safe Space

Lifting clamps
Operating procedures

- The clamp shall not handle any load for which it is not designed
- **Never lift more than one plate at a time in a vertical lift**



ASME B30.20
EN 13155

Module 11 slide 45

NOTES:

It is important that both the pivot(s) and camsegment grab the steel plate. Under no circumstance, lift more than 1 plate at a time in a vertical lift. The load might slip out and drop.

Lifting clamps
Operating procedures

- Make sure hook fits into eye of clamp
- Do not allow crane hook to be supported by the clamp
- Best practice is to use a chain sling (or other sling) with WLL greater than or equal to clamp
- Use of a chain sling allows proper fit in clamp eye and allows flexibility at the connection



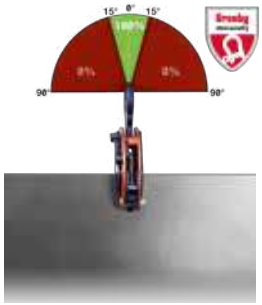
Module 11 slide 46

When the load and clamp are lowered, verify that the load does not snag or foul on anything that can release the load prematurely.

Lifting clamps
Operating procedures

- The clamp shall not be used for side pulls unless designed for it
- Do not side pull a clamp with a fixed hoisting eye





Use a clamp with universal hoisting eye when used in a 2-leg sling.

ASME B30.20
EN 13155

Module 11 slide 48

Lifting clamps
Operating procedures

- Care should be taken to make certain the load is correctly distributed for the clamp being used
- Long or large plates should be lifted with more than 1 clamp
- When using 2 or more clamps, you should use an equalizing beam when possible



ASME B30.20
EN 13155

Module 11 slide 49

NOTES:

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Lifting clamps
Operating procedures

- Always balance the load by placing the clamp(s) above the centre of gravity
- Always maintain control of load



Module 11 slide 50

When a vertical lifting clamp in a single leg application is not used exactly above the centre of gravity, the load will slightly tilt and could damage the pivot(s) and camsegment.

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Lifting clamps type IPBC
Operating procedures

- Open the clamp by pulling up the grip on the camsegment.
- Place the clamp securely on the material to be lifted, so that the jaw of the clamp rests against the plate or flange. Keep base (pivots) against the load.
- Close the clamp by letting go of the grip. The clamp will remain on the material in pretensioned position, allowing lifting to commence.



Module 11 slide 51

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Lifting clamps type IPBC
Operating procedures

- As soon as the load is at its destination let the crane hook descend until the clamp is fully free of load, meaning that the lifting chain is no longer tensioned.
- The clamp can now be removed from the load by pulling up the camsegment.



Module 11 slide 52

NOTES:

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Lifting clamps type IPBC
Operating procedures

- Be aware of fingertips when installing IPBC clamps.
- Only start lifting the load when hands are no longer touching the clamps.
- The clamp will remain on the material in pretensioned position, allowing lifting to commence.



Module 11 slide 53

Be aware of fingertips when installing IPBC clamps. Only start the lift when hands are no longer toughing the clamp.



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Inspection classifications

Initial
By assigned person prior to initial use

Frequent
By operator before & during each lift, daily / weekly / monthly

Periodic
By qualified person quarterly / semi-annually / yearly

ASME B30.20
EN 13155

Or as required per local regulations

Module 11 slide 55

ASME B30.20 requires:

Frequent inspection: visual examinations by qualified person with records not required.

- normal service – monthly
- heavy service – weekly to monthly
- severe service – daily to weekly
- special or infrequent service - as recommended by a qualified person before and after each occurrence.

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Lifting clamps
Frequent inspection

Visual inspection by the operator before and during each lift is required



Proper function



ASME B30.20
EN 13155

Module 11 slide 57

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Lifting clamps
Frequent inspection



Ensure that the plate surface is free of scale, grease, oil, paint, ice, dirt and coatings that might impede the contact of the teeth with the plate.

Module 11 slide 58

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Lifting clamps
Frequent inspection

- Ensure the pivot(s) and camsegment teeth are free of dirt, clean them if necessary
- Check for damage to camsegment teeth and pivot





Module 11 slide 59

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NOTES:

Frequent inspection:

The operator shall inspect the clamp before and during every lift for any indication of damage or deformation.

If markings are not clear, the clamp should not be used and be removed from service.

Observations during operation will be made for any damage or deformation that might occur during the lift.

Check all functional operating mechanisms before and after every lift.

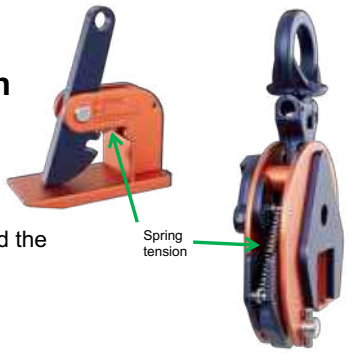
Check camsegment teeth and pivot for excessive wear, remove from service in case of doubt.

Camsegment: Remove from service if the sharpness of 50% or more of one tooth is missing. Remove from service if 50% or more of one tooth is not sharp or damaged.

Pivot: Remove from service if 50% or more of a pivot's ring is damaged or not sharp.

Lifting clamps
Frequent inspection

- Press hoisting eye and verify adequate spring tension
- When hoisting eye is released the clamp should freely return to closed position



Module 11 slide 60

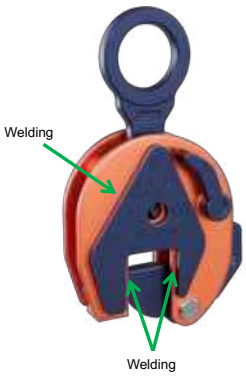
NOTES:

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Lifting clamps
Frequent inspection

- Inspect body for wear, cracks, deformation, or other damage
- Remove from service if operation (opening or closing) of clamp is stiff or heavy



Module 11 slide 61

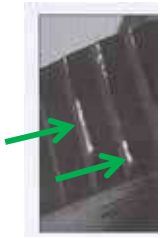
In addition to the visual inspection of the welding on the clamps' body, also inspect the hoisting eye for wear, cracks, deformation, or other damage, especially at contact (load bearing) zone.

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Lifting clamps
Frequent inspection

- Remove from service if the sharpness of 50% or more of one tooth is missing
- Remove from service if 50% or more of one tooth is not sharp or damaged.





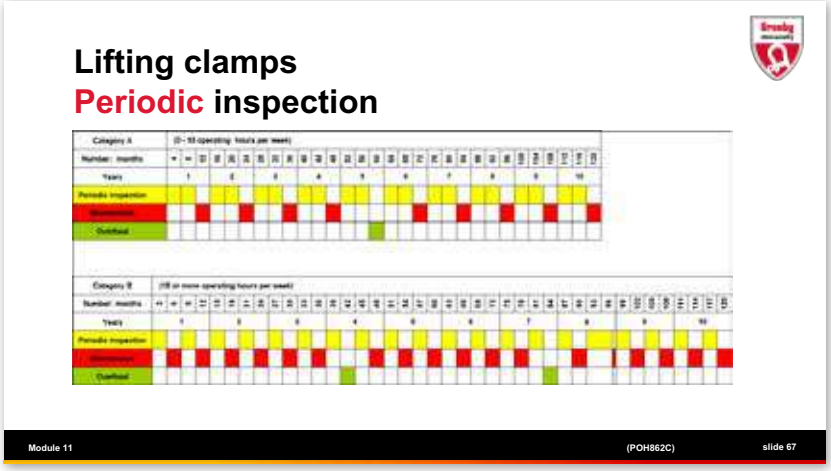


Lifting clamps
Frequent inspection

Remove from service if 50% or more of a pivot's ring is damaged or not sharp.







NOTES:

Periodic inspection:
- Periodic inspection interval is as per local legislation.
- A complete inspection shall be performed at required intervals.
- A qualified person shall determine if any indications of damage or deformation constitute a hazard.
- Depending on the number of operating hours per week, but at least once a year by a qualified person.
- Document the inspection when it was carried out and by whom.
- Remove from service if any defects or deformation are detected.
- The inspection includes a detailed evaluation of all clamp parts.
- If taken out of service, the removal date and return to operation date should be documented.

Crosby has spare parts available for all types of lifting clamps.
For lifting clamps up to 9t, maintence sets are available which include a camsegment, pivot, spring and replacement safety pins.
For lifting clamps up to 6t, repair (overhaul) sets are available which contain all spare parts except the lifting eye and body.

CrosbyIP Repair & Maintenance Training

We recommend that periodic repair and maintenance of CrosbyIP lifting clamps is performed by an authorized repair center.

Kito Crosby offers training to selected partners. These repair & maintenance courses are led by our technical specialists. In a combination of theory and interactive training modules and practice, we teach the basics for the proper repair and maintenance of CrosbyIP lifting clamps.





Discuss the use of lifting clamps

01





02



03



04







05



06



07



08



09



10



11





Crosby®

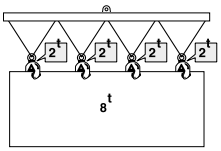
SAFETY FIRST

General

IPU10	IPU10S	IPU10H	IPNM10
			
For Steel ≤ 363 HV10	For Stainless steel ≤ 363 HV10	For harder steel >363 HV10 ≤472 HV10	Non Marring, no minimum WLL & no maximum hardness

Vertical and Horizontal Lifting

- Determine Center of Gravity, and ensure the load is proportionally divided over the clamps



Round Surfaces

W.L.L. (t)	Clamp	Min. Diameter	Max. Material Thickness
0.5	IP(U)10	round 160 mm	16 mm
1	IP(U)10	round 160 mm	20 mm
2	IP(U)10	round 400 mm	30 mm
3	IP(U)10	round 600 mm	40 mm
4.5	IP(U)10	round 600 mm	40 mm
6	IP(U)10	round 600 mm	50 mm



Stenciled in Vertical Clamps

- Minimum load is 10% of clamp's rated W.L.L.
- For plate surface hardness till 279 HV10 only 5% of WLL is needed

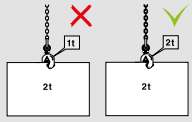


WARNING:
Read, understand and follow the instructions and the product information in applicable operator's manual before using clamps.
Only trained and competent personnel should install, operate, inspect and repair this equipment. Only use genuine CrosbyIP replacement parts.

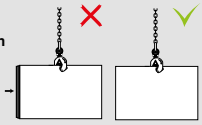
Copyright © Kito Crosby Stock# 9999 953 REV 11/2024

Vertical Transport

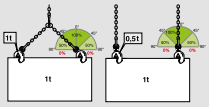
- Never exceed the W.L.L.



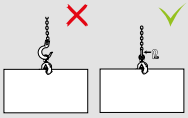
- Never lift more than 1 plate at a time



IPU10
- Lifting angle larger than 45° = lower W.L.L. by 50%



- Never use a crane hook too large and/ or too heavy for the hoisting eye



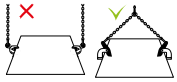
- Do not touch any obstacles during lifting



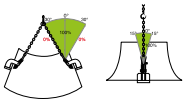
Crosby training is available at your site

Horizontal Transport

- Never use a vertical clamp for horizontal lifting



IPHOZ
- Never exceed lifting angles

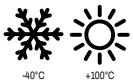


IPH10
- Lifting angle larger than 45° = lower W.L.L. by 50%

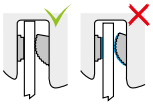


Maintenance

- Ambient temperature and/or temperature load material



- For IPNM10: -20°C to +70°C
- Keep gripping surface and load surface clean



kitocrosby.com/crosbyip

Poster available in various languages.

Lifting Clamps

1. All vertical clamps have a _____ WLL and a _____ WLL.
2. Do not _____ the clamp while lifting a load.
3. Lift only _____ piece of material at a time with a vertical plate clamp.
4. Inspect the _____ for wear, damage or cracks.
5. The clamp should be removed from service if the camsegment or pivot has _____ of one tooth or ring damaged.
6. Use a clamp with an _____ hoisting eye when used in a two-leg sling.
7. The clamp shall be applied to the load in accordance with the _____.
8. Ensure the pivot and camsegment teeth are _____.
9. _____ lift the load with the clamp in the “open” position.
10. Best practice is to use a _____ with a WLL greater than or equal to the clamp.
11. Always ensure the load is completely in the back of the _____ before locking or using the clamp.
12. Always balance the load by placing the clamp above the _____.

Choose Answer from the Following List

a. maximum

b. one (1)

c. unlock

d. body

e. 50% or more

f. minimum

g. Never

h. centre of gravity

i. universal

j. clean

k. chain sling (or other sling)

l. instruction manual

m. throat

Welcome to

Manual chain blocks & lever hoists

12

Based on applicable standards and product application information for

KITO

Module 12 slide 1

KITO

LEVER HOISTS

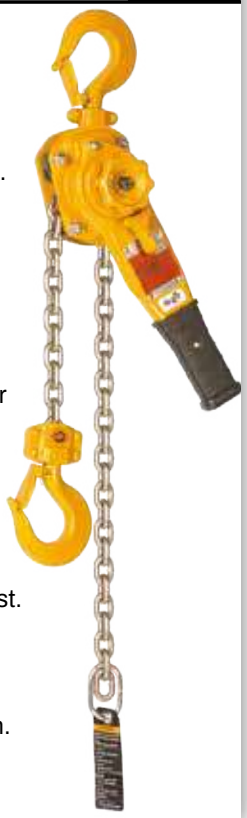
19

Type	Load capacity [kg]	Standard lifting height* [m]	Weight [kg]
LB008	800	1.5	5.7
LB010	1 000	1.5	5.9
LB016	1 600	1.5	8.0
LB025	2 500	1.5	11.2
LB032	3 200	1.5	15.0
LB063	6 300	1.5	26.0
LB090	9 000	1.5	40.0

Check LB Lever Hoist owner's manuals for more details and variants of the LB.
*Further standard lifting heights: 3.0 m and 6.0 m.

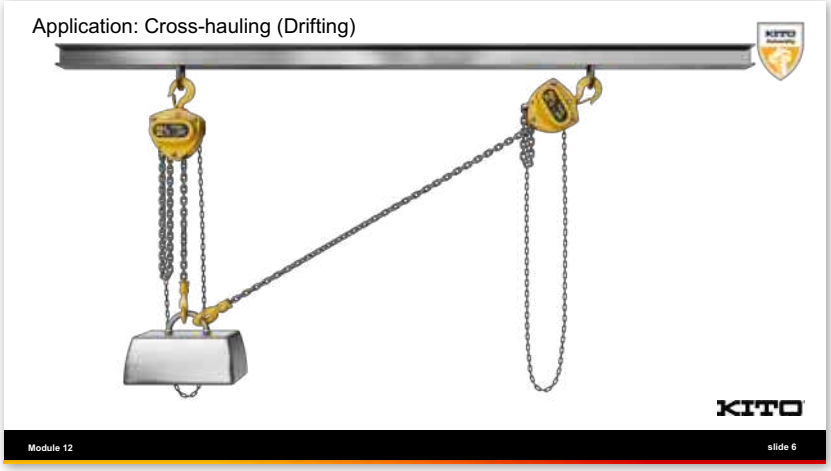
PRE-USE INSPECTION CRITERIA

- Clear **identification** on the nameplate.
- **Body:** no missing, damaged, or broken fasteners or nuts. No dents, cracks, twists, warping of parts.
- **Top & bottom hook:** smooth rotation and operation, no deformation, latch functioning properly.
- **Chain:** no stretched, worn, twisted, bent links. No weld spatter, nicks, or gouges. No pitting or excessive corrosion.
- **Handle:** no bends or twists. No damage to rubber grip. Rotates smoothly without binding.



OPERATIONAL TEST

- Turn selector lever to neutral ('N').
- Pull free chain knob away from the hoist.
- Load chain to be pulled smoothly through the hoist.
- Re-engage free chain knob.
- Turn the selector lever to the up ('UP') position.
- Crank the handle to raise the hook.
- Turn the selector lever to the down ('DN') position.
- Crank the handle to lower the hook.

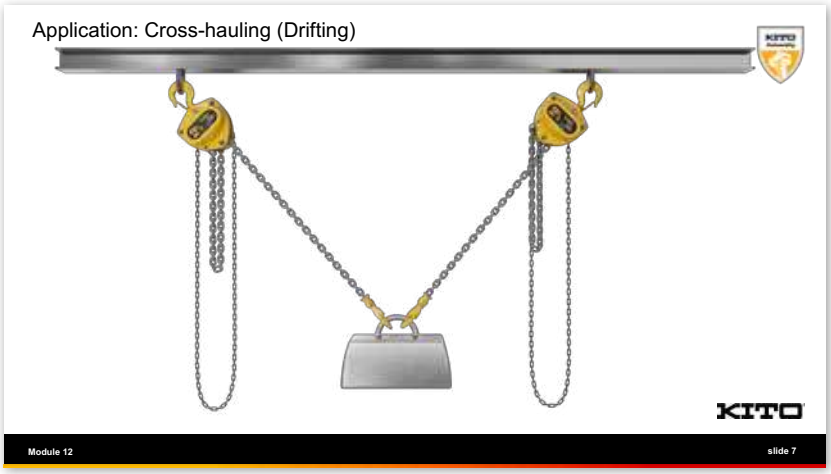


NOTES:

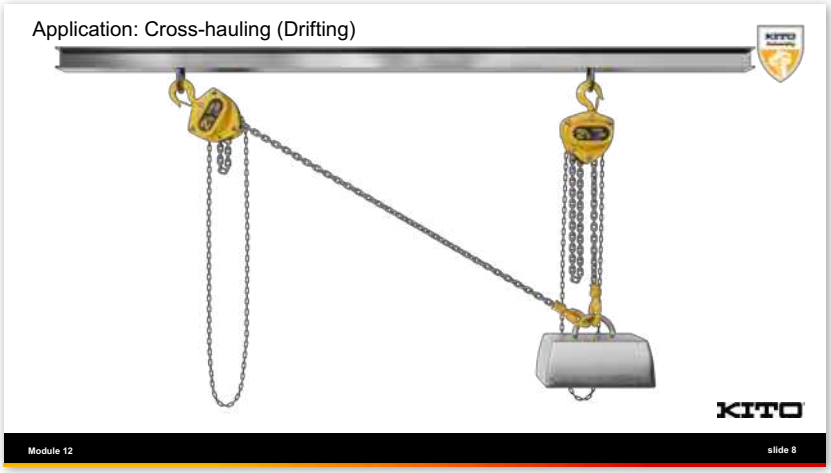
Manual chain hoists are designed for vertical lifting & positioning. Any deviation from vertical must be confirmed with the manufacturer. Some can be used at strong angles while others may not.

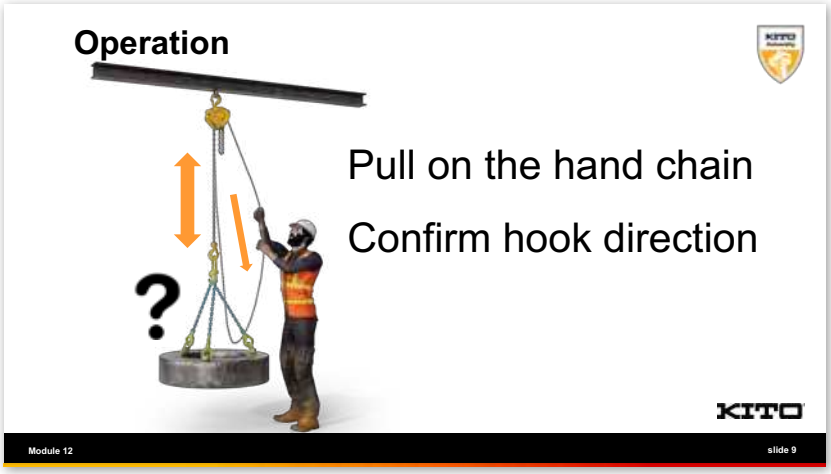






Chain blocks are commonly used in angle-based applications.





NOTES:

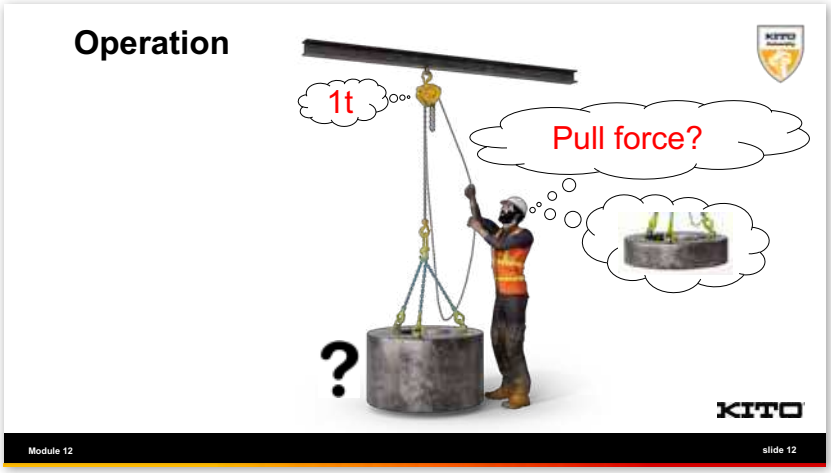
Pull on one side of the hand chain - confirm the direction of movement of the lower hook as the hand chain is pulled through the hoist body.

To reverse direction of the bottom hook, pull on the opposite leg of hand chain.

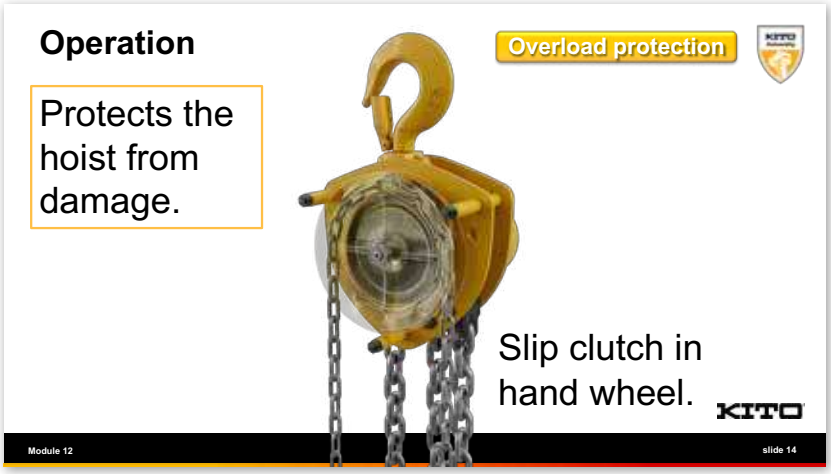


There are different pull forces for different hoists of the same capacity rating.

Do not use chain blocks as a scale. Determine the weight of the load before lifting it.



Do not intentionally operate a hoist until the slip clutch engages. That would be the same as using the hoist as a scale to assess the weight of the load or whether the hoist can lift it.

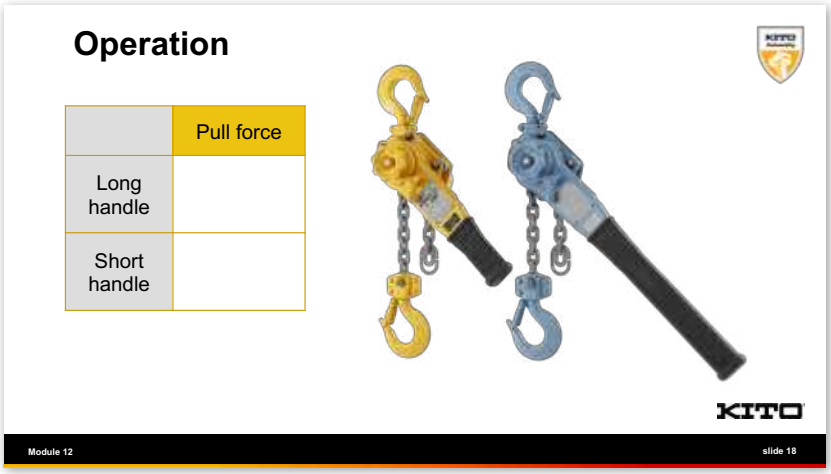


NOTES:

The purpose of overload protection, such as a slip clutch, is to protect the hoist from damage in the event of an excessive overload.

A slip clutch is a mechanism integrated or built into the hand wheel. A couple of coned spring washers sandwich a brake pad; one side is connected to the hand wheel while the other is connected to the gear drive.

The friction from the pressure caused by the coned washers keeps the mechanism working when you pull on the hand chain. However, if the load is too heavy, the coned washers can no longer maintain the grip (or friction) on the pad which allows the unit to slip; which is why it is often called a slip clutch. When it slips, the operator can continue to pull on the hand chain but the load will not move.



On a 750kg long-handle lever hoist, the pull force to lift or pull a full 750kg load is around 29 kg.

The basic design style of a Kito lever hoist is one that uses double reduction gearing to give a higher mechanical advantage from the gearbox. You will recognize this type by the oval-shaped gearbox. The handle is still needed to provide additional mechanical advantage but it does not need to provide as much mechanical advantage as the long handle does on the design style with basic gearing.

If we use the short-handle design to pick up that same 750kg load, the pull force on the handle is 29kg, which is the same as the long-handle unit.

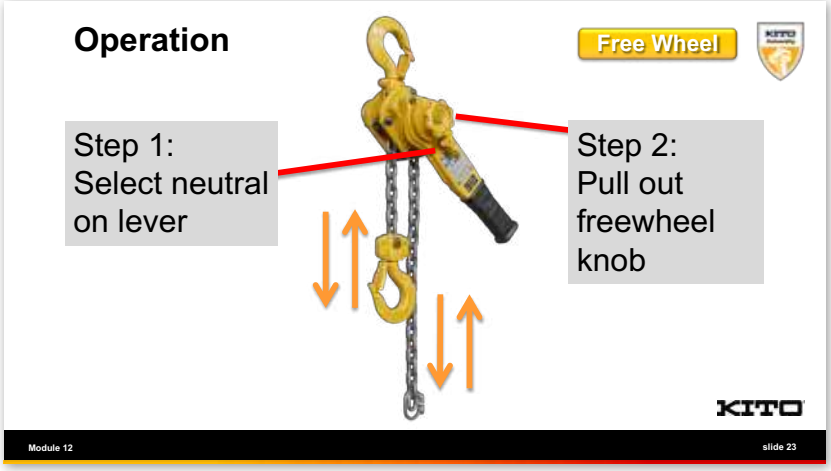
The pull force for the long-handle design for 1.5t is 40kg. For the Kito short-handle design, the pull force for 1.5t is only 30kg.



Lever hoists are often used to pull or tension. In such application, it can be difficult to estimate how much load is on the hoist.

Under no circumstance, use a tube or any other device to make the handle longer for additional mechanical advantage. If it takes more than one hand to pull the lever handle, the hoist is likely being overloaded (please note this just serves as a guideline).

The Kito lever hoist type LB OLL is fitted with overload limiter.



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NOTES:

Not all lever hoists function in the same manner. Functionally, a lever hoist will do 3 things:
- raise the hook
- lower the hook
- go into a free-chain mode whereby we can move the chain through the hoist unrestricted.

It is important to know how the hoist functions before a load is put onto the hook.

The Kito LB lever hoist has an intentional 2-step process to **go into free-chain mode**.
Step 1 is to switch the direction selector into the middle (or neutral) position.
Step 2 is to pull the freewheel knob outward to release the mechanism for neutral operation. You can now pull the chain freely in either direction.

To **re-engage,** it is an intentional 2-step process to return to the lifting or lowering function.
Step 1 is to stop the load side chain from moving. This can be done by either anchoring the bottom hook to a load and pulling the slack out of the chain line or by grasping the hook-side chain and holding it firmly.
Step 2 is rotate the freewheel knob clockwise approximately ¼ turn.

If a lever hoist is locked up:
- Engage the freewheel knob
- Set selector to the “Down” position
- Hold body, turn handle counterclockwise

KITO®

LEVER HOISTS

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Type	Load capacity [kg]	Standard lifting height* [m]	Weight [kg]
LB008	800	1.5	5.7
LB010	1 000	1.5	5.9
LB016	1 600	1.5	8.0
LB025	2 500	1.5	11.2
LB032	3 200	1.5	15.0
LB063	6 300	1.5	26.0
LB090	9 000	1.5	40.0

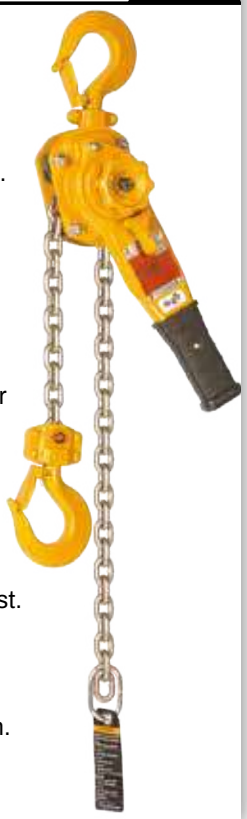
Check LB Lever Hoist owner’s manuals for more details and variants of the LB.
*Further standard lifting heights: 3.0 m and 6.0 m.

PRE-USE INSPECTION CRITERIA

- Clear **identification** on the nameplate.
- **Body:** no missing, damaged, or broken fasteners or nuts. No dents, cracks, twists, warping of parts.
- **Top & bottom hook:** smooth rotation and operation, no deformation, latch functioning properly.
- **Chain:** no stretched, worn, twisted, bent links. No weld spatter, nicks, or gouges. No pitting or excessive corrosion.
- **Handle:** no bends or twists. No damage to rubber grip. Rotates smoothly without binding.

OPERATIONAL TEST

- Turn selector lever to neutral (‘N’).
- Pull free chain knob away from the hoist.
- Load chain to be pulled smoothly through the hoist.
- Re-engage free chain knob.
- Turn the selector lever to the up (‘UP’) position.
- Crank the handle to raise the hook.
- Turn the selector lever to the down (‘DN’) position.
- Crank the handle to lower the hook.





NOTES:

Never tip load on hooks. Only lashing hooks are designed for tip loading.





Lever hoists are designed to lift, pull, tension, or position in any orientation or angle (vertical, horizontal, inverted) as long as the line of force between the top and bottom hooks is straight.

Improper installation or use can damage the hoist.

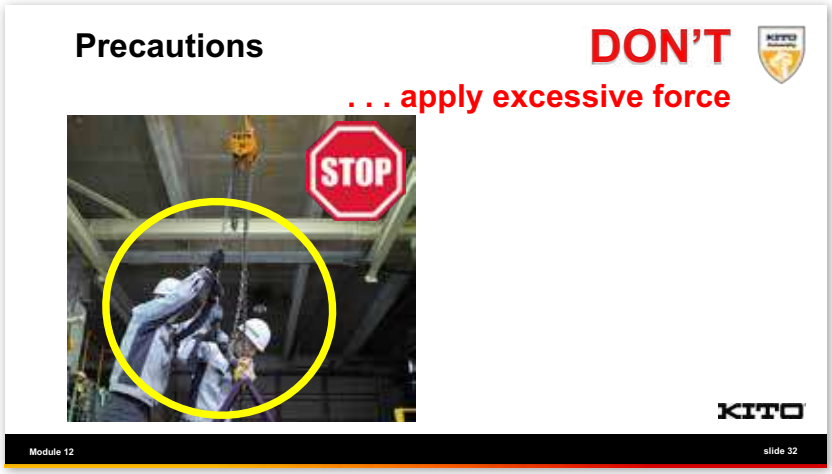


It is not allowed to use load chain of manual chain & lever hoists in a choker or basket hitch.



NOTES:

Do not allow the load chain to contact the edges or corners of steel plates. The contacted links will be subjected to additional forces (bending force) that could damage the load chain leading to a catastrophic failure.



Do not modify or exert excessive operating forces on or modifications to lever or manual chain hoists.

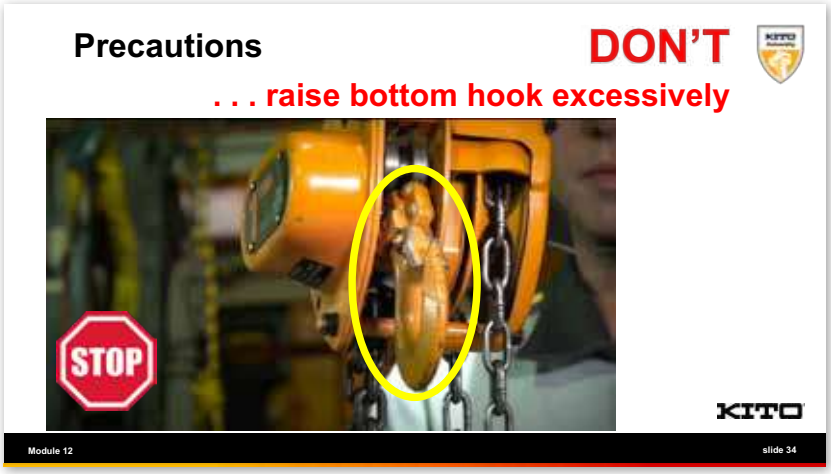
- Do not operate the lever by applying your full body weight.
- Do not have 2 or more people pulling on the hoist hand chain.
- Do not extend the lever by attaching a pipe or cheater bar to it.
- Do not use the hoist by jumping on the lever handle.



Do not conduct work on supported loads; instead, support load adequately before conducting work on the load.

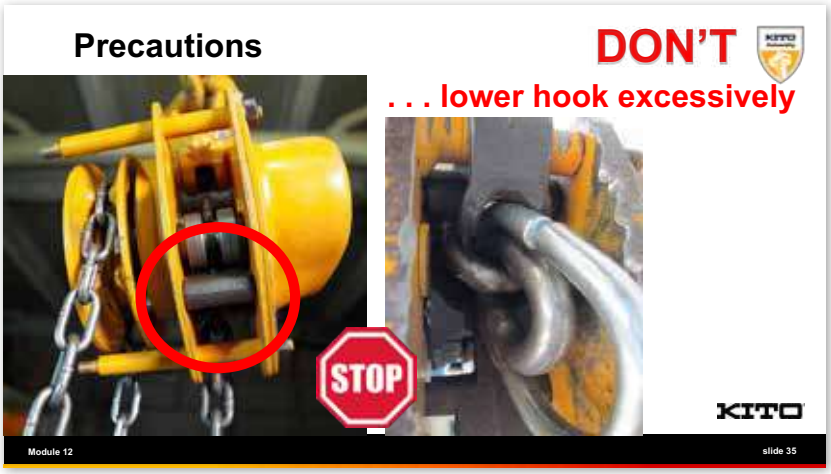
Do not perform welding or cutting operations on the load while being supported by the hoist.

Do not use the load chain as a grounding for welding



NOTES:

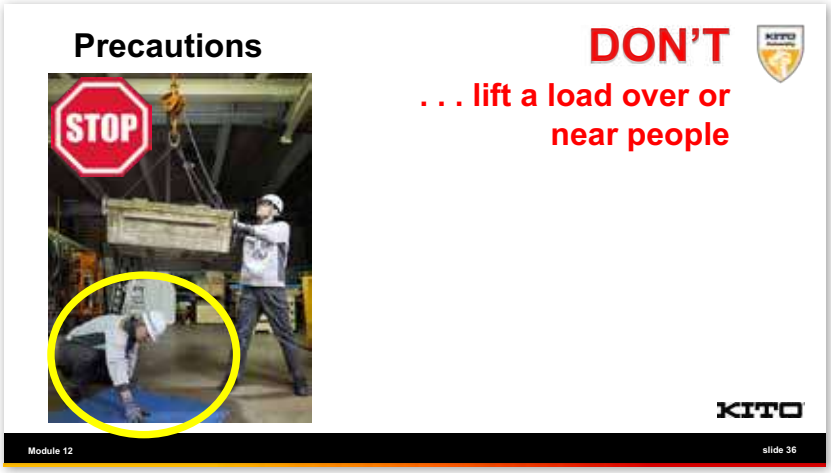
Don't over-lift to the point where the bottom hook contacts the hoist body.



Do not over-lower the bottom hook to the point where all the chain is let out as this can apply undue force to various components of the hoist and lead to component failure.

On a manual chain hoist, the hand wheel may over-rotate causing severe strain on the pinion which could lead to a failure.

On a lever hoist, the dead-end stopper has been pulled inward on the hoist body and may be subjected to extreme forces that could cause the stopper to dislodge from the hoist body (also causing damage to hoist body). The load chain may also be overstressed causing a failure from the bending force on the link (shown by the broken link in the image on the right).



Be cautious when hoisting loads near people. Take every precaution not to get too close to other workers and always alert them to your hoisting activities.

- Do not use the hoist to support, lift, or transport people.
- Do not go under a lifted load or its path.
- Do not move a lifted load over people.

NOTES:

Precautions

DON'T

. . . leave a lifted load unattended



KITO

Module 12 slide 37

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Precautions

. . . when using 2 hoists on 1 load…



both hoists must have rated capacities equal to or more than the load.

KITO

Module 12 slide 38

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Precautions

ALWAYS

. . . have an escape plan



KITO

Module 12 slide 39

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It is important for a hoist operator to have a plan for what to do if the hoist process goes wrong.

Know the escape route and obstacles that may impede the route. Clear the obstacles beforehand or know how to get around them if ever required to do so.

Type	Load capacity [kg]	Standard lifting height* [m]	Weight [kg]
LB008	800	1.5	5.7
LB010	1 000	1.5	5.9
LB016	1 600	1.5	8.0
LB025	2 500	1.5	11.2
LB032	3 200	1.5	15.0
LB063	6 300	1.5	26.0
LB090	9 000	1.5	40.0

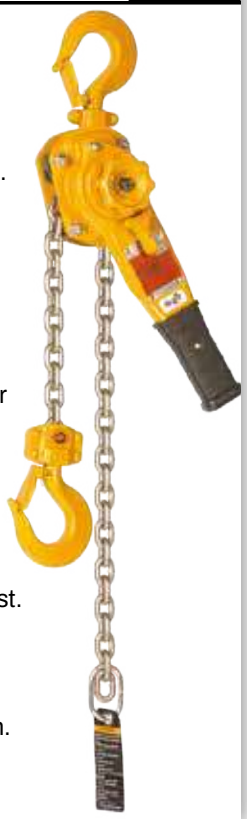
Check LB Lever Hoist owner's manuals for more details and variants of the LB.
*Further standard lifting heights: 3.0 m and 6.0 m.

PRE-USE INSPECTION CRITERIA

- Clear **identification** on the nameplate.
- **Body:** no missing, damaged, or broken fasteners or nuts. No dents, cracks, twists, warping of parts.
- **Top & bottom hook:** smooth rotation and operation, no deformation, latch functioning properly.
- **Chain:** no stretched, worn, twisted, bent links. No weld spatter, nicks, or gouges. No pitting or excessive corrosion.
- **Handle:** no bends or twists. No damage to rubber grip. Rotates smoothly without binding.

OPERATIONAL TEST

- Turn selector lever to neutral ('N').
- Pull free chain knob away from the hoist.
- Load chain to be pulled smoothly through the hoist.
- Re-engage free chain knob.
- Turn the selector lever to the up ('UP') position.
- Crank the handle to raise the hook.
- Turn the selector lever to the down ('DN') position.
- Crank the handle to lower the hook.



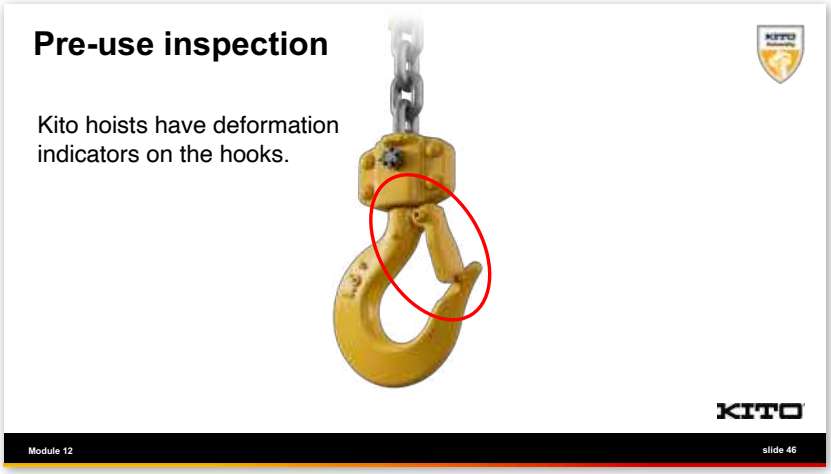


Pre-use inspection

Top & bottom hook
- Smooth rotation & operation
- No deformation
- Latch functioning properly

Load chain
- No stretched, worn, twisted or bent links
- Remove from service when wear on load chain is 2,5% or more
- No weld spatter, nicks or gauges
- No pitting or excessive corrosion

Hoist body & lever
- Clear identification on the nameplate
- No missing, damaged or broken fasteners or nuts
- No dents, cracks, twists or warping of parts
- No bends or twists
- No damage to rubber grip
- Rotates smoothly without binding



NOTES:

It is recommended to measure the distance between the deformation indicators prior to initial use.

Document this measurement in the inspection book so it can serve as reference for any future deformation.



Type	Load capacity [kg]	Standard lifting height* [m]	Weight [kg]
CB005	500	3.0	11.0
CB010	1 000	3.0	12.5
CB015	1 500	3.0	15.5
CB020	2 000	3.0	20.0
CB025	2 500	3.0	27.0
CB030	3 000	3.0	24.0
CB050	5 000	3.0	41.0

Check CB Hand Chain Blocks owner's manuals for more details and variants of the CB.
*Further standard lifting heights: 6.0 m
Additional lifting heights and capacities up to 50t available upon request.

PRE-USE INSPECTION CRITERIA

- Clear **identification** in place on the nameplate.
- **Body:** no missing, damaged, or broken fasteners or nuts. No dents, cracks, twists, warping of parts. Hook block anchored securely in body.
- **Top & bottom hook + latch:** smooth rotation and operation, no deformation, latch functioning properly.
- **Bottom hook & hook block securement bolts:** in place & secure.
- **Chain:** no stretched, worn, twisted, bent links. No weld spatter, nicks, or gouges. No pitting or excessive corrosion.

OPERATIONAL TEST

- Prior to initial usage, lift the load several centimetres, release the hand chain and observe that the hoist is holding the load in place.
- Pull on hand chain to move bottom hook up and down.
- Listen for a clear, smooth clicking sound when the hook is traveling upward.
- Ensure there are no abnormal sounds.



Kito Repair & Maintenance Training

We recommend that periodic repair and maintenance of Kito manual chain hoists and electrical hoists is performed by an authorized repair center.

KITO® Academy

Kito Crosby offers training to selected partners, these repair & maintenance courses are led by our technical specialists. In a combination of theory and interactive training modules and practice, we teach the basics for the proper repair and maintenance various types of manual and electrical Kito hoists.



Pre-use inspection

Capsized Hook (Double Fall Model)





KITO

Module 12 slide 59

NOTES:

It is not allowed to use load chain of manual chain & lever hoists in a choker or basket hitch.





A capsized hook can easily occur during transporting or handling the hoist.

As the hoist is moved from one installation to another, the hook can become capsized. Even when a new hoist is removed from the box, the hook can become capsized. It is important to check.

Pre-use inspection



Check the hoist body for signs of damage:

- Check for dents, cracks, warped/twisted frame, missing hardware.
- Whether the name plate and warning labels can be clearly read
- Whether the lever handle has become bent.



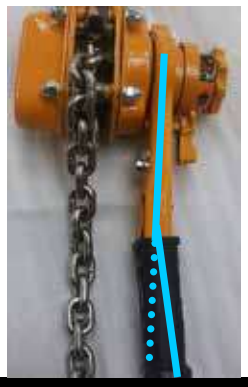
KITO

Module 12 slide 64

Prior to each use, manual chain & lever hoists need to be visually inspected by the user. An operational test verifying the proper functioning of the hoist is recommended before every lift.

Pre-use inspection





KITO

Module 12 slide 65

Check lever hoists for potential bending of the lever handle. When deformed, remove the lever hoist from service.

Don't confuse the shape of the handle for a bend.

Pre-use inspection





What is a chain stopper ?

Prevents load chain from coming out of the hoist



Check the dead-end stopper link (lever hoist) or dead-end anchor (manual chain hoist).

KITO

Module 12 slide 66

NOTES:

Check the dead-end stopper link (lever hoist) or dead-end anchor (manual chain hoist).

The dead end stopper link should be undamaged. It should not be a bolt or knotted section of chain.

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Pre-use inspection



Confirm the chain path through the hoist body is correct.

KITO

Module 12 slide 67

The correct path has the load side (hook side) chain and no-load side chain entering/exiting the hoist side-by-side. They can be comfortably grasped in the palm of your hand.

If the load/no-load chain sections are not side-by-side at the edge of the hoist body, remove the host from service.

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Pre-use inspection



Confirm the chain path through the hoist body is correct.



KITO

Module 12 slide 68

The correct path has the load side (hook side) chain and no-load side chain entering/exiting the hoist side-by-side and can be comfortably grasped in the palm of your hand.

If the load/no-load chain sections are not side-by-side at the edge of the hoist body, remove the hoist from service.

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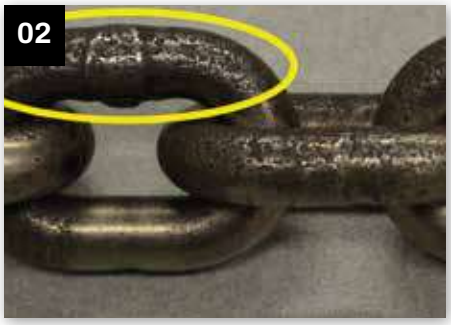
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Inspection of manual chain & lever hoists

01



02



03



04



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07



08



09



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11



12



How to book

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Kito Crosby is the global leader of the lifting and securement industry it pioneered, and for which it continues to set the quality standard. With global engineering, manufacturing, distribution, and operations, the company provides a broad range of products and solutions for the most demanding applications. Kito Crosby's people, products, solutions, and services have innovated the lifting and securement industry for more than 260 years.

Together we lift and secure the world today, for a safer, stronger, and more productive tomorrow. Our iconic brands include Kito, Crosby, Harrington, Gunnebo Industries, and Peerless.

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