Developing Professionals for the Lifting Equipment Industry

Offshore Container Examination

Advanced Programme

Training Course Study Materials

INSTRUCTOR LED TRAINING ONLY

LEEA Learning and Development Agreement

In the interests of all parties and to ensure the successful completion of the LEEA Offshore Container Examination Advanced Programme, you must confirm the following:

Student:

I agree to:

- Always follow the instructions of my LEEA trainer
- Follow all rules and procedures regarding health and safety matters whilst on site
- Respect the tidiness and cleanliness of training areas and rest area facilities
- Notify my LEEA trainer immediately if I have any concerns
- Inform my LEEA trainer of any learning difficulties at the soonest opportunity (this may be done privately between you and your LEEA trainer)
- Keep to agreed session times and return quickly from rest breaks and lunchtime periods
- Keep my mobile phone on 'silent' for the duration of all training sessions and to leave the class if I have to make or receive an urgent call, for the benefit of my fellow students
- Provide feedback to the LEEA trainer regarding the training I have received
- Respect the opinions of my fellow students and to actively engage in group discussion
- Follow the rules regarding LEEA Assessments

Signed _____ Date _____

LEEA Trainer

Your LEEA Trainer agrees to:

- Safeguard the health, safety and welfare of my students throughout the training programme
- Provide my students with quality training, maintaining the highest of professional standards throughout
- Always maintain confidentiality for all students
- Provide regular feedback to students on their progress, identifying areas which may need additional study
- Keep appropriate records of any assessments conducted
- Ensure that all students can discuss any issues or concerns which arise during the training course

Disclaimer

These Course Study Materials are a useful and authoritative source of information for the LEEA Offshore Container Examination Advanced Programme student.

Whilst every effort has been made to achieve the highest degree of accuracy in the generation of the data and information supplied, ultimate responsibility remains with the student and their employer to ensure that current legal requirements are followed.

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Operative training for all the equipment covered in these course study materials should always take the manufacturer's information and instructions for use into account.

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Digital Navigation

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1. LEGISLATION

Moral, Legal and Financial Reasons for Health and Safety Legislation

- Employers have a moral responsibility to ensure appropriate working conditions are provided
    - This is known as a common law duty of care

- Unsafe working conditions are likely to have an impact on production
    - Loss of output leading to lowering of morale and motivation
    - Loss of sales turnover and profitability

- Society and customer expectations of a company's approach to managing safety - health and safety culture
    - Negative public relations would have a damaging effect on any business

- Financial cost from loss of output
    - Fines, damages, legal costs, insurance etc.

The Legislative Framework

Health and Safety at Work etc. Act 1974 (UK)

- The Act is general in nature
- There is no reference to specific articles or substances
- The Act applies to all sectors

Specific duties of care for:

- Manufacturers/suppliers of articles or substances
- Employers
- Employees

The **Health and Safety at Work Act (HSWA)** is an enabling Act for specific regulations.

Status in UK: legal requirement.

International: adopted as best practise and requested by LEEA member companies.

Notes:

The Main Purpose of the HSWA

The Health and Safety at Work Act covers nearly all occupations. It is designed to protect people at work including staff, visitors, contractors and members of the public. The HSWA supersedes nearly all previous health and safety laws in the UK.

The main purposes of the Act are set out in section 1 as follows:

- To secure the health, safety and welfare of persons at work
- To protect other people from hazards arising from work
- To control the keeping and use of dangerous substances and materials, including explosives and highly flammable materials
- To control the emission of noxious substances from certain premises

It sets out a framework of general duties, primarily on employers, but also on employees and the controllers of premises, and on designers, manufacturers, importers and suppliers in relation to articles and substances used at work.

Regulations from the HSWA

Regulations are one form of delegated legislation made possible by Section 15 of HSWA which gives powers to the Secretary of State (UK) to make regulations for matters concerned with health and safety at work.

Regulations are not Acts of Parliament but do have the support of the law and therefore must be complied with.

Regulations are increasingly drafted by reference to European Directives (these will be discussed at a later stage in this module).

There are many sets of regulations applying to health and safety. Some apply to all places of work and others are specific to particular industries, operations, substances, materials or premises.

Here are some examples of such Regulations:

- The Manual Handling Operations Regulations
- The Control of Substances Hazardous to Health Regulations

Notes:

Health and Safety at Work Act Section 2

Duties of the Employer

"Duty to ensure so far as is reasonably practicable, the health, safety and welfare at work of all his/her employees"

- Safe plant and systems of work
- Safe use, handling, storage and transportation of articles and substances
- Information, instruction, training and adequate supervision
- Safe place of work and a safe means of access and egress
- Safe working environment and adequate welfare facilities

Health and Safety at Work Act Section 6

Duties of Designers, Manufacturers, Importers and Suppliers

- To ensure, so far as is reasonably practicable, that articles they design, construct, make, import, supply etc. are safe and without risk to health at all times e.g. when it is being set up, cleaned, used or maintained by someone at work
- To carry out or arrange such testing and examination necessary to perform the duties above
- To ensure that those supplying the item have adequate information about its designed and tested use. This includes essential conditions for dismantling and disposal
- Take steps to ensure, so far as is reasonably practicable, that those supplied are given updated information where it becomes known that the item gives rise to serious risk to health and safety

Health and Safety at Work Act Section 7

Duty of Employees

- States that employees must not endanger themselves, or others, by their acts or omissions
- Also, they must co-operate with their employers; as long as this does not lead to an increased risk to health and safety, or is an illegal act; so that employers can comply with their statutory duties

This makes responsibility for safety a joint employer/employee effort

Management of Health and Safety at Work Regulations 1992 (Revised 1999)

In addition to Section 2 (2) c of the HSWA, The Management of Health and Safety at Work Regulations 1999 require employers to ensure the effective planning, organisation, control, monitoring and review of preventive and protective measures. All these arrangements must be recorded and made known to employees. This is usually accomplished by the design of a company health and safety policy.

- MHSWR underlines the requirements for employers to provide instruction and training
- Employers must ensure that their personnel are properly trained to use any equipment necessary in the course of their work, but the regulations also place an obligation on employees to undergo such training and follow the instructions given by their employer
- Operatives are required to only use equipment for which they are trained and to use it in the manner and for the purpose for which they have been trained

LEEA Definition of a Competent Person

The term 'Competent Person' has long been used in legislation. Current legislation uses it for a variety of duties to describe a person with the necessary knowledge, experience, training, skill and ability to perform the specific duty to which the requirement refers. There can therefore be several 'Competent Persons', each with their own duties and responsibilities, i.e. competent for the purpose.

The term has never been fully defined in law but, for the purpose of thoroughly examining lifting equipment, the LEEA definition of a Competent Person is 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 which it is the purpose of the examination to discover and assess their importance to the safety of the equipment.

The Competent Person should have the maturity to seek such specialist advice and assistance as may be required to enable him/her to make necessary judgements and be a sound judge of the extent to which he/she can accept the supporting opinions of other specialists. He/she must be able to certify with confidence whether it is free from patent defect and suitable in every way for the duty for which the equipment is required. It is the view of LEEA that competency can be a corporate responsibility.

Notes:

Primary Elements of Competency

Information

Instruction

Training

Supervision

Note: LEEA training course certificates and Advanced Programme qualifications are not evidence, declaration or proof of competency.

What are the Required Elements of Competency?

Notes:

Risk Assessment

What is "Risk Assessment"?
Put simply, it is a careful examination of what, in your work, could cause harm to people, so that you can weigh up whether you have taken enough precautions or should do more to prevent harm.

What are the 3 main reasons to assess and manage risk?

- Human Harm
    - Injury and illness

- Legal Effects
    - Duty of care and consequences of unsuitable or insufficient risk management

- Economic Effects
    - Substantial financial costs are related to accidents at work

Although there are no fixed rules about how a risk assessment should be undertaken, it is important to take a structured approach which will allow all relevant risks or hazards to be addressed.

Firstly, we have to consider the factors that contribute to accidents/ill-health in the workplace:

HAZARD | DANGER | LIKELIHOOD | SEVERITY | RISK

Hazard
A hazard is something (object or situation) that has the potential to cause harm.

Danger
A liability or exposure to harm; something that causes peril.

Likelihood
How likely is it that someone could be harmed by the hazard?

Severity
If the potential for harm was to occur, how severe would the accident be?

Risk (a Combination of Likelihood and Severity)
Risk is the likelihood that the harm from the hazard is realised.

Definitions

Net Result (Risk) = Likelihood x Severity

i.e. how likely x how severe the consequence

5 Steps to Risk Assessment...

1. Identify the hazards
2. Decide who might be harmed and how
3. Evaluate the risks and decide on control measures
4. Record your findings and implement them
5. Review your assessment and update if necessary

Control Measures

Hierarchy of Control Measures (ERIC-PD)

Eliminate
Reduce
Isolate
Control
PPE
Discipline

Monitor and Review

Ensure control measure compliance (discipline)

Be vigilant - note changes:

- Additional hazards presented?
    - e.g. traffic, pedestrians etc., changes in production activity

Record your findings and change the risk assessment as necessary.

This may result in the requirement for additional control measures.

Are you Following a 'Safe System of Work'?

- ✓ You have evaluated the hazards
- ✓ You have identified who may be harmed
- ✓ You have decided upon and implemented control measures
- ✓ You have recorded your findings
- ✓ You will review and monitor the situation

If you have completed the above checklist, you are now following a "Safe System of Work"

The European Machinery Directive

A European directive is a directive to the member states of the European community, which has been adopted by the council of ministers, to introduce legislation with common requirements throughout the community. The directives are used to remove barriers to trade and introduce common safety requirements.

The Machinery Directive is largely based on risk assessment and use of European standards for critical features such as guards and emergency stops. Machinery directive provides the harmonisation of the Essential Health and Safety Requirements (EHSRs) for machinery.

It applies only to products that are intended to be placed on or put into service in the market for the first time.

Supply of Machinery (Safety) Regulations 2008 – SM(S)R

Machinery Directive is implemented in the United Kingdom under the Supply of Machinery (Safety) Regulations:

The Supply of Machinery (Safety) Regulations 2008, SI No 1597 implement the Machinery Directive and contain essential safety requirements which the machinery, including lifting machines and lifting accessories, must meet.

Manufacturers, importers (into the European Union) and suppliers placing such equipment on the market for service in the community have a duty to:

- Design, build and supply equipment that is safe and meets the Essential Safety Requirements
- To carry out such tests as may be necessary to ensure the requirements of above are met
- To maintain records of all calculations, tests and other relevant information that go to make up a **Technical File** which may be called upon by the enforcing authorities and which must demonstrate that the Essential Safety Requirements have been met
- Issue with each item of equipment information on the installation, maintenance, care and safe use, and:
    - Issue a Declaration of Conformity and affix the CE mark, or issue a Declaration of Incorporation depending on its nature and intended use. In this context, if you manufacture or import (from outside the European Union) an item for your own use, you assume the full responsibilities of the manufacturer and must therefore meet all of the requirements of the regulations

To support the Machinery Directive, the joint European Standards Organisation, CEN/CENELEC, has been producing Harmonised European Standards.

Most of these standards have been published but there are still some left in the pipeline. As and when they are published, they will supersede any existing British Standards or other European national standards covering the same products.

These Harmonised Standards have a special status in that products made to the standard are deemed to meet the essential health and safety requirements of the Relevant Directives, and therefore the UK Regulations, in so far as the standard addresses such essential requirements.

They therefore provide a relatively easy way for manufacturers to know that their products meet the legal requirements and equally a convenient way for purchasers to specify their needs.

Following the publication of the new Machinery Directive 2006/42/EC in 2006, all the relevant Harmonised Standards have been amended to make reference to it.

The Technical File

The Essential Health and Safety Requirements that apply to the lifting equipment:

- A description of the methods used to eliminate these hazards or reduce risks
- The standards used in the design; information from the user
- Design information (calculations, drawings, procedures, etc.)
- Material traceability; tests reports and instructions for use

What is a 'Machine'?

"An assembly, fitted with or intended to be fitted with a drive system other than directly applied human or animal effort, consisting of linked parts or components, at least one of which moves, and which are joined together for a specific application".

Note: As an example, a manual slew jib without hoist that could be fitted inside an offshore service container would not be within the scope of the Directive. The example below shows the hoist fitted to the slew jib so would be within the scope of the directive.

Notes:

Supply of Machinery (Safety) Regulations 2008

Aligned to the requirements of the Machinery Directive, the Supply of Machinery (Safety) Regulations state that lifting equipment must be designed and built to sustain a static overload of:

Manually operated machines	1.5	x WLL
Other machines	1.25	x WLL
Lifting accessories	1.5	x WLL

Machinery must be capable of sustaining a dynamic overload of: -

1.1 x WLL

Previous standards and directives have used different values therefore it is important to always consult manufacturers documentation for specific requirements.

Lifting machines must also be supplied with instructions for:

- Care and safe use
- Installation, commissioning and testing
- Maintenance and adjustments
- Limitations of use and possible misuse
- Noise and vibration emissions
- Training

PUWER and LOLER

PUWER: Provision and Use of Work Equipment Regulations 1998
Applies to all work equipment

LOLER: Lifting Operations and Lifting Equipment Regulations 1998
Applies to lifting equipment in addition to PUWER

Both LOLER and PUWER apply to all sectors of industry

Status of PUWER and LOLER

United Kingdom:	Legal requirement
International:	Good practice demanded by customers and local authorities, integral to the LEEA Code of Practice

The Essentials of PUWER

PUWER places duties on the employer to ensure that:

- It is the duty that the employer to ensure that work equipment coming into his undertaking meets with any EHSRs and in the case of lifting equipment this would be of directive 2006/42/EC.
- Work equipment is suitable for the purpose for which it is to be used

- The working conditions and risk to health and safety of personnel in which the work equipment is used is to be considered
- Equipment is suitably maintained and a log kept up to date
- Equipment is inspected on a regular basis (ref. LOLER)
- All inspection and maintenance records are kept and recorded
- All persons using work equipment have sufficient information pertaining to its use, e.g. operating manuals and guides to safe use

PUWER requires employer to address risks or hazards of equipment from all dates of manufacture and supply.

Equipment first provided for use after 31st December 1992 must comply with any 'essential requirements'

Equipment may still present a hazard or risk if:

- Application different from that originally envisaged
- Safety depends upon the way it is installed
- Technical mismatch between the supply side and user side legislation

Employers can ensure compliance by checking:
- CE Marking
- EC Declaration of Conformity

Note: Offshore container standards slightly differ and require a Certificate of Conformity

17 PUWER requires that, when providing equipment for use at work the purchaser obtains equipment complying with the relevant European Directives. E.g. With offshore containers, requesting the Certificate of Conformity which shows compliance with BS EN ISO 10855, will ensure that the offshore containers meet this requirement.

Provision and Use of Work Equipment Regulations (PUWER)

Regulation 4	Suitability of Work Equipment
Regulation 5	Maintenance
Regulation 6	Inspection
Regulation 7	Specific Risks
Regulation 8	Information and Instructions
Regulation 9	Training

Notes:

Summary of the Key Requirements of PUWER

PUWER requires employer to address risks or hazards of equipment from all dates of manufacture and supply.

Equipment first provided for use after 31st December 1992 must comply with any 'essential requirements'.

Equipment may still present a hazard or risk if:

- Application is different from that originally envisaged
- Safety depends upon the way it is installed
- Technical mismatch between the supply side and user side legislation

How does an employer check that equipment he has purchased complies with the requirements of PUWER?

- Locate the CE marking
- Obtain the EC declaration of conformity from the supplier

Lifting Operations and Lifting Equipment (LOLER)

Regulation 4	Strength and Stability
Regulation 5	Lifting Equipment for Lifting Persons
Regulation 6	Positioning and Installation
Regulation 7	Marking of Lifting Equipment
Regulation 8	Organisation of Lifting Operations
Regulation 9	Thorough Examination and Inspection
Regulation 10	Reports and Defects
Regulation 11	Keeping of Information

Regulation 4: Strength and Stability
Requires the employer to ensure that the load they are planning to lift does not exceed the limits for strength and stability of the lifting equipment.

Regulation 5: Lifting Equipment for Lifting Persons
Details the additional safeguards that must be considered when using lifting equipment to lift people.

Regulation 6: Positioning and Installation
Details the considerations on where lifting equipment, both fixed and mobile equipment, should be sited.

Regulation 7: Marking of Lifting Equipment
Requires all lifting equipment to be marked with its SWL and information that gives the items characteristics, e.g. grade, angle of use etc.

Regulation 8: Organisation of Lifting Operations
Clarifies that each lifting operation needs to be planned, supervised and carried out safely.

Regulation 9: Thorough Examination and Inspection
Before lifting equipment is put into service for the first time it is thoroughly examined for any defect unless the lifting equipment:

- Is less than 12 months old
- Owner holds the original DOC
- Equipment that has not been used before will require thorough examination when entering service if the DOC is older than 12 months. Equipment can be damaged during long periods within the supply chain

Maximum fixed periods for thorough examinations and inspection of lifting equipment as stated in regulation 9 of LOLER are: -

Lifting Accessories	6 months
Lifting Equipment	12 months
People Carrying Equipment	6 months

- Or in accordance with a written scheme of examination
- Or each time that exceptional circumstances which are liable to jeopardise the safety of the lifting equipment have occurred

The information to be contained in the report of thorough examination is given in **schedule 1 of LOLER.**

Minimum Requirements for a Report of Thorough Examination – Schedule 1 of LOLER

- The name and address of the employer for whom the thorough examination was made

- The address of the premises at which the thorough examination was made
- Information to identify the equipment, including its date of manufacture where known
- The date of the last thorough examination
- The safe working load of the lifting equipment or (where its safe working load depends on the configuration of the lifting equipment) its safe working load for the last configuration in which it was thoroughly examined
- In relation to the first thorough examination of lifting equipment after installation or after assembly at a new site or in a new location:
  - That it is such a thorough examination;
  - That it has been installed correctly and would be safe to operate

In relation to a thorough examination of lifting equipment other than a thorough examination to which paragraph 6 relates –

- Whether it is a thorough examination:
  - Within an interval of 6 months under regulation 9(3)(a)(i)
  - Within an interval of 12 months under regulation 9(3)(a)(ii)
  - In accordance with an examination scheme under regulation 9(3)(a)(iii)
  - After the occurrence of exceptional circumstances under regulation 9(3)(a)(iv)
- That the lifting equipment would be safe to operate

- In relation to every thorough examination of lifting equipment:
    - Identification and description of any part found to have a defect which is, or could become, a danger to persons
    - Details of repair, renewal or alteration required to remedy a defect found to be a danger to persons

- For a defect which is not yet, but could become, a danger to persons -
    - The time by which it could become a danger
    - Details of any repair, renewal or alteration required to remedy it

- The name, address and qualifications of the person making the report; that he/she is self-employed or, if employed, the name and address of his employer

- The latest date by which the next thorough examination must be carried out

- Details of any test included in the thorough examination

- The date of the thorough examination

- The name, address and qualifications of the person making the report; that he/she is self-employed or, if employed, the name and address of his employer

- The name and address of a person signing or authenticating the report on behalf of its author

- The date of the report

Model report of thorough examinations are available for LEEA members on the LEEA website.

Written Schemes of Examination

The Lifting Operations and Lifting Equipment Regulations 1998 permits a scheme of examination, drawn up by a competent person, as an alternative to the fixed maximum periods.

The benefit of an examination scheme is that, by focusing on the most safety critical areas, the examinations can be carried out the most cost effective way. This may provide a means of reducing examination costs, however, it may also provide a means of enhancing safety without increasing costs.

Notes:

Information for Written Schemes of Examination

The written scheme of examination should contain at least the following information:

- The name and address of the owner of the lifting equipment
- The name and contact details of the person responsible for the equipment.
    - If responsibility is divided, e.g. between maintenance and operations, there may be more than one name. However, it should be clear who should be notified in the event of a dangerous or potentially dangerous defect and to whom reports should be sent
- The name, qualifications and address of the person drawing up the scheme. If the competent person is not self-employed, give the name of their employing organisation and their position in that organisation
- The identity of the equipment, i.e. a description including the make, model and unique identity number
- The location of the equipment if it is a fixed installation, or the location where it is based for portable and mobile equipment
- Details of information or references used in drawing up the scheme. For example, the manufacturer's manual, expected component life, or specific information on the design life of the crane structure and mechanisms as detailed in clause 7 of ISO 12482-1

- The basis for the scheme. For example, is it based on hours of service, duty monitoring, examining certain parts or components at different intervals to other parts?
- Details of any data logging system fitted, including a list of the parameters monitored and the means of data retrieval, monitoring and storage
- What determines when the thorough examination shall take place and who is responsible for monitoring that and instigating the examination?
- Identification of the safety critical parts requiring thorough examination
- A risk assessment should take account of:
    - The condition of the equipment
    - The environment in which it is to be used
    - The number and nature of lifting operations and the loads lifted
    - The details of any assumptions about usage, expected component life
    - Etc.
- The frequency of thorough examination of safety critical parts, taking into account the degree of risk associated with each part. This may include time or loading or duty cycle limits and vary for different parts of the equipment. Where the scheme is based on such criteria, we recommend that a maximum period between thorough examinations is always specified as equipment can deteriorate whether used or not

- The method of examination of safety critical parts, which may include the degree of dismantling required and the techniques employed e.g. visual examination, measurement, NDT, operational test, load test

- The rejection criteria or a reference to where this information may be found

- An indication of the resources required to prepare the equipment and carry out the thorough examination. This may include qualified personnel, workshop facilities, specialist NDT and metallurgical facilities

- Any changes to equipment condition, operational or environmental parameters that will require a review of the scheme by the Competent Person. These may include damage to the equipment, change of use from general duty to heavy duty or moving from an inland location to a marine environment

- A requirement for the person responsible for the equipment to monitor its circumstances of use and inform the Competent Person who drafted the scheme of any changes

- The date of drawing up the scheme and the date at which any routine review is required

Further information on written schemes of examination can be found in the LEEA COPSULE Edition 8 Appendix 1.8.

Lifting Operations and Lifting Equipment Regulations (LOLER)

Regulation 10: Reports and Defects
A person making a thorough examination for an employer under regulation 9 shall:

- Notify the employer immediately of any defect in the lifting equipment which in his opinion is, or could become, a danger to persons
- As soon as is practicable, make a report of the thorough examination in writing authenticated by signature or equally secure means (by him or on his behalf) and containing the information specified in schedule 1 to the employer.

Where there is in his opinion a defect in the lifting equipment involving an existing or imminent risk of serious personal injury, the Competent Person will send a copy of the report as soon as is possible to the relevant enforcing authority. An employer who has been notified of an imminent risk shall ensure that the lifting equipment is not used before the defect is rectified.

Regulation 11: Keeping of Information
An employer obtaining lifting equipment shall:

- Keep the EC Declaration of Conformity for so long as they operate the lifting equipment
- Ensure that the information contained in every report is kept available for inspection

In the case of a thorough examination for lifting equipment:

- Until he ceases to use the lifting equipment

In the case of a thorough examination for lifting accessories:

- For two years after the report is made

LOLER and the Tester/Examiner
LOLER refers to 'Thorough Examination and Inspection', which may include testing.

A report of thorough examination is to include details of any tests carried out.

The duties of the Competent Person include ensuring that:

- Lifting equipment has been thoroughly examined before it enters service
- Second-hand, hired or borrowed equipment has a current examination report before it is used
- Where safety of equipment depends upon installation:
    - That it has a thorough examination after it has been installed
    - That it has a thorough examination after it has been assembled

Manual Handling Operations Regulations

- Refers directly to lifting operations and adds to the employer's duties in section 2 of the HSWA

- Requires an assessment to be made of any operation where loads are handled manually, or where manual effort is necessary, with a view to reducing the number of injuries that result from such operations:
    - Task
    - Individual
    - Load
    - Environment

- Requires the introduction of lifting appliances where the risks are high or if the operation can be made safer by their introduction

Notes:

Working at Height

The danger of people and materials falling affects not only those working at height, but also sometimes to a greater degree, those underneath.

Working at height is one of the biggest causes of fatalities and major injuries. Commonly, accidents are caused from falls from ladders and through fragile surfaces. Work at height means work in any place where, if there were no precautions in place, a person could fall a distance that could cause personal injury (for example a fall through a fragile roof).

Employers and those in control of work at height must first assess the risks.

Before working at height, you must follow these simple steps:

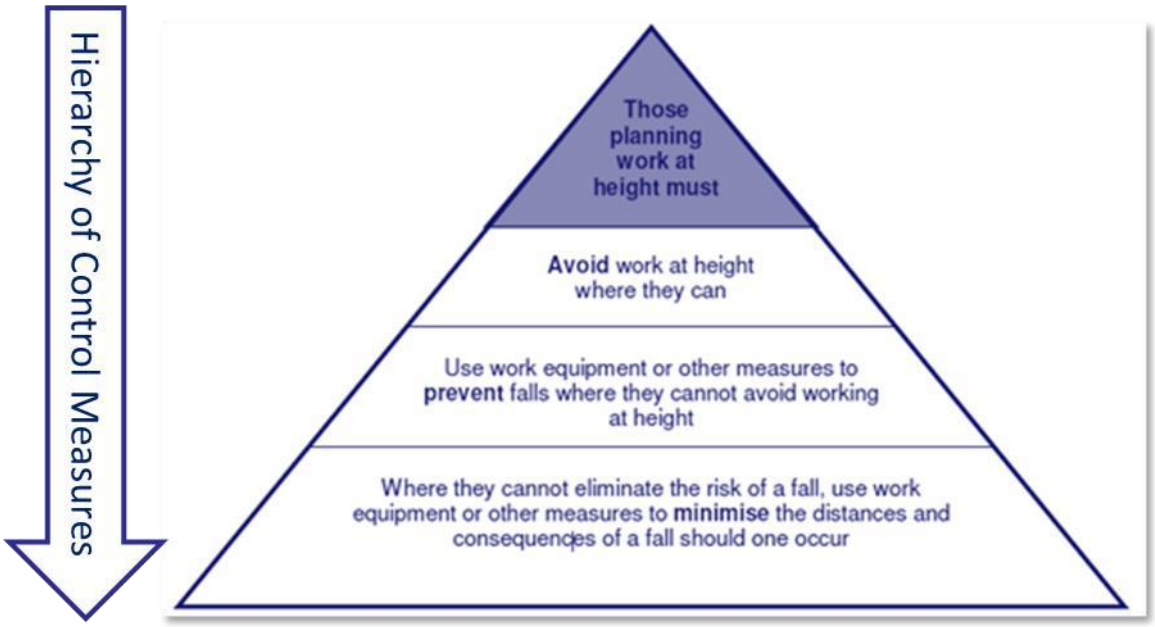
- **Avoid** work at height where it is reasonably practicable to do so
- Where work at height cannot be easily avoided, **prevent** falls using either an existing place of work that is already safe or the right type of equipment
- **Minimise** the distance and consequences of a fall, by using the right type of equipment where the risk cannot be eliminated

Working at Height Regulations (UK)

The Work at Height Regulations 2005 have an influence on lifting practice.

They emphasise the need to avoid working at height if possible but, where it is necessary, they require the most suitable means of reducing and controlling the risk.

Consequently, this has affected the choice of equipment for some lifting operations.



Do:

- As much work as possible from the ground
- Ensure workers can get safely to and from where they work at height
- Ensure equipment is suitable, stable and strong enough for the job, maintained and checked regularly
- Take precautions when working on or near fragile surfaces
- Provide protection from falling objects
- Consider emergency evacuation and rescue procedures

Do not:

- Overload ladders; consider the equipment or materials workers are carrying before working at height. Check the pictogram or label on the ladder for information
- Overreach on ladders or stepladders
- Rest a ladder against weak upper surfaces, e.g. glazing or plastic gutters
- Use ladders or stepladders for strenuous or heavy tasks, only use them for light work of short duration (a maximum of 30 minutes at a time)
- Let anyone who is not competent (who doesn't have the skills, knowledge and experience to do the job) to work at height

Working at Height – A Brief Guide

Please read the HSE document: "Working at Height – A Brief Guide", available at www.hse.gov.uk

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Revoked, Repealed and Amended Legislation

Prior to 5 December 1998, the Factories Act 1961 was the main legislation concerned with the use of lifting equipment and it was augmented several sets of industry specific regulations. The Provision and Use of Work Equipment Regulations 1998 and the Lifting Operations and Lifting Equipment Regulations 1998 together repeal, revoke or amend and replace the requirements for lifting equipment given in the following:

- The Factories Act 1961
- The Construction (Lifting Operations) Regulations 1961
- The Shipbuilding and Ship-repairing Regulations 1960
- The Docks Regulations 1988
- The Mines and Quarries Act 1954
- The Offshore Installations (Operational Safety, Health and Welfare) Regulations 1976
- The Lifting Plant and Equipment (Records of Test and Examination etc.) Regulations 1992

Notes:

Notes:

2. STANDARDS AND CODE OF PRACTICE

What are Standards?

Standards are a published specification that sets a common language, contains a technical specification or other precise criteria and is designed to be used consistently, as a rule, a guideline, or a definition.

Standards are applied to many materials, products, methods and services helping to make life simpler and increase the reliability and effectiveness of goods and services.

Standards are designed for voluntary use and do not impose any regulations, but laws may refer to a certain standard making compliance with them compulsory. Examples include:

- BS (British Standards, used mainly in the UK)
- EN (Euronorm, used throughout Europe)
- ISO Standards (International standard used globally)
- Det Norske Veritas (DNV, used globally in the Offshore Oil and Gas Industry)

Creating Standards

Standards are usually created by a collective of appropriately experienced and qualified people whom function together as a committee. Details of proposed standards are agreed and a draft of the standard is released for anyone who has an interest in the standard to make comments about the contents. When the reviews have finished, the standard may be published.

Notes:

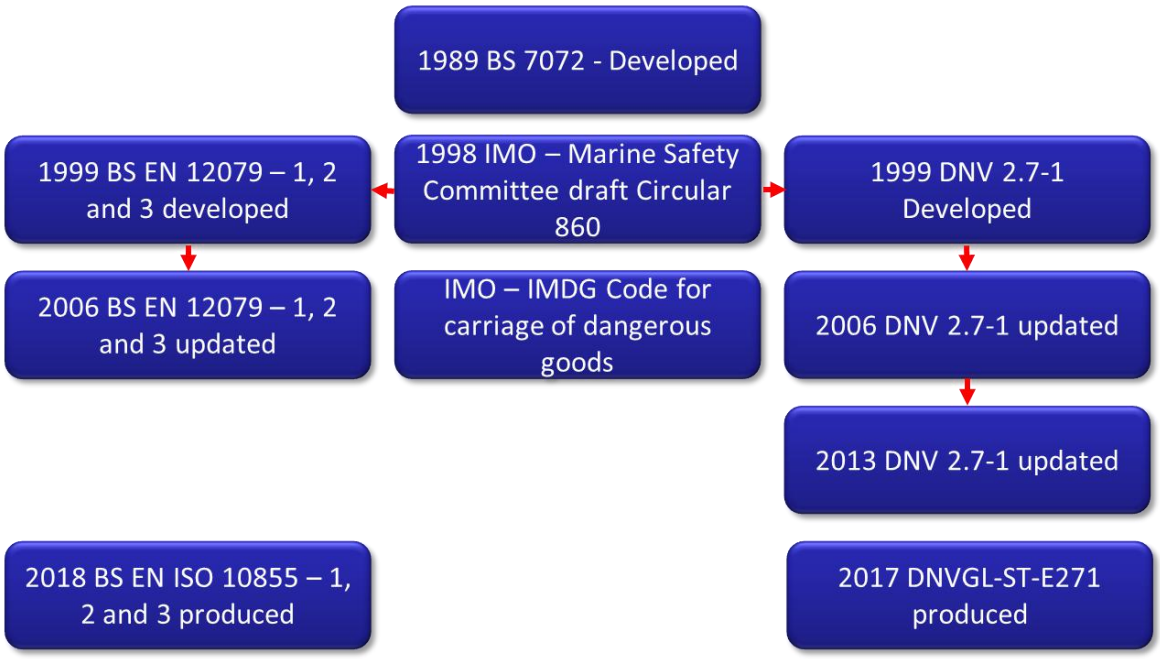
Harmonised European Standards (Transposed)

For lifting equipment, these standards are made through the European Standards body CEN. The standards bodies of the member states (BSI in the UK) are then required to withdraw any conflicting standards and publish the Harmonised Standard as their national standard. A manufacturer can demonstrate compliance with the requirements of a Directive by working to Harmonised Standards in so far as the standards address the requirements.

CEN standards carry the prefix EN. In practice the standards bodies of the member states publish the standards with the additional prefix used for their national standards, e.g. in the UK they are published with the prefix BS EN and in Germany as DIN EN. The number of the standard and its content is then identical throughout Europe. However not all EN standards are Harmonised and it is necessary to refer to the standard to establish its relationship with Directives.

Transposed Harmonised European Standards, which are intended to remove technical barriers to trade and to be recognised throughout Europe and beyond. They enjoy a quasi-legal status under the European Directives and working to them is the easiest way for a manufacturer to demonstrate compliance with the 'essential safety requirements' addressed by the standard.

Offshore Container Standards Development



Guidance Applicable for Offshore Containers

The guidance that led to the development of a European Harmonised Standard for Offshore Containers was from the International Maritime Organisation (IMO) Marine Safety Committee Circular 860 (MSC/Circular 860).

This Circular was intended to guide national authorities in developing approval and certification requirements for offshore containers. It recommends that new offshore containers be approved, prototype tested and certified by duly authorized bodies.

The Circular led to the development of BS EN 12079, which then caused BS 7072 to be withdrawn in 1999. The initial European Standard was superseded in 2006 by a newer version and more recently, by the BS EN ISO 10855 series of standards.

Due to the robustness of offshore containers, a large number of BS 7072 and BS EN 12079 units still exist in service. Consequently, the inspector should be familiar with these standards also.

Status of Standards

Since the advent of the first standard for offshore containers there has been various standards compiled for the design, manufacture, testing of offshore containers and their associated lifting set.

Below is an explanation of the current status of these standards as even though some of these have been withdrawn for a long time, there are still many of these units still in service around the globe.

Different regions may have local regulations relating to the older design of offshore containers and the inspector should be familiar with these local regulations.

Withdrawn Standards for Offshore Containers

Standard Number	Standard Name	Status
BS 7072: 1989	**British Standard Code of Practice for inspection and repair of offshore containers**	**Withdrawn**
BS EN 12079 – 1: 2006	**Offshore containers and associated lifting sets – Part 1: Offshore containers – Design, manufacture and marking**	**Withdrawn**
BS EN 12079 – 2: 2006	**Offshore containers and associated lifting sets – Part 2: Lifting sets – Design, manufacture and marking**	**Withdrawn**
BS EN 12079 – 3: 2006	**Offshore containers and associated lifting sets – Part 3: Periodic inspection, examination and testing**	**Withdrawn**

Notes:

Current Standards for Offshore Containers

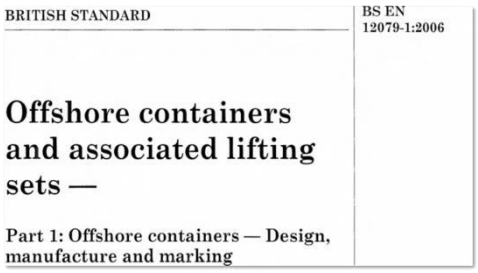
Standard Number	Standard Name
Det Norske Veritas Germanischer Lloyd (DNVGL) DNVGL-ST-E271	2.7-1 - Offshore Containers – August 2017 (supercedes June 2013 edition)
BS EN ISO 10855 – 1: 2018	Offshore containers and associated lifting sets – Part 1: Offshore containers – Design, manufacture and marking of offshore containers
BS EN ISO 10855 – 2: 2018	Offshore containers and associated lifting sets – Part 2: Lifting sets – Design, manufacture and marking of lifting sets
BS EN ISO 10855 – 3: 2018	Offshore containers and associated lifting sets – Part 3: Periodic inspection, examination and testing

BS 7072: 1989 – British Standard

Code of Practice for Inspection and Repair of Offshore Containers
This British Standard was withdrawn on the 15th October 1999 with the advent of BS EN 12079. However, all inspection bodies and inspection personnel should be aware that there is still a large number of these containers being operated. When requested to inspect and test containers built to BS 7072, all personnel involved should make themselves aware of the requirements of this standard.

Note: Oil and Gas UK following the recommendation of Maritime and Coastguard Agency (Marine Guidance Note 282), prohibited the use of BS 7072 containers being used in UK waters for the purpose of carrying dangerous goods from the 1st January 2015. This is not a global prohibition so inspection personnel should make themselves aware of the regulations required by the national government local to them.

BS EN 12079 – 1: 2006 Offshore Containers and Associated Lifting Sets


BRITISH STANDARD

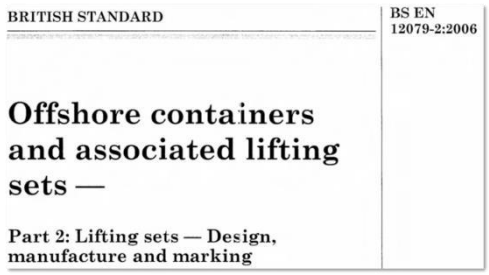
BS EN 12079-1:2006

Offshore containers and associated lifting sets —

Part 1: Offshore containers — Design, manufacture and marking

Part 1: Offshore containers – Design, manufacture and marking
This European Standard sets down the requirements for the design, manufacture and markings for the offshore container.

BS EN 12079 – 2: 2006 Offshore Containers and Associated Lifting Sets

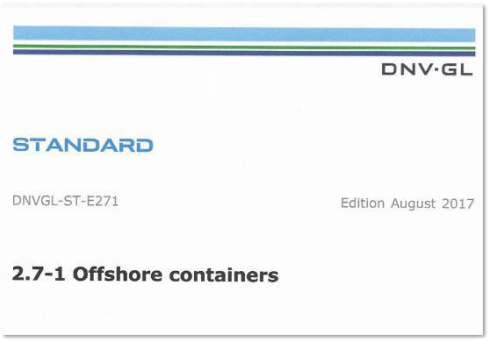


Part 2: Lifting sets – Design, manufacture and marking
This European Standard sets down the requirements for the design, manufacture and markings for the lifting set.

BS EN 12079 – 3: 2006 Offshore Containers and Associated Lifting Sets

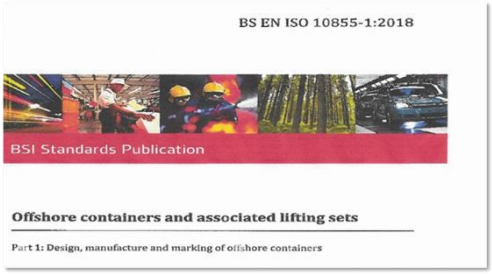
Part 3: Periodic inspection, examination and testing
This European Standard sets down the requirements for the periodic inspections, examinations and tests for both the offshore container and the lifting set. Now superseded by BS EN ISO 10855-3 2018.

DNV GL-ST-E271



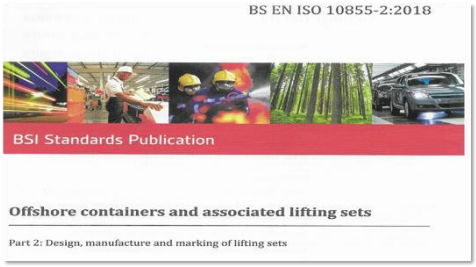
Det Norske Veritas Germanischer Lloyd (DNV GL) is an independent organisation with dedicated risk professionals with the purpose of safeguarding life, property and the environment. The DNV GL Standards for Certification are used globally and the Standard No 2.7-1 for offshore containers is used extensively worldwide.

BS EN ISO 10855-1: 2018 Offshore Containers and Associated Lifting Sets



Part 1: Design, manufacture and marking of offshore containers
ISO 10855 (all parts) meets the requirements of IMO MSC/ Circ.860 for the design, construction, inspection, testing and in-service examination of offshore containers and associated lifting sets which are handled in open seas.

BS EN ISO 10855-2: 2018 Offshore Containers and Associated Lifting Sets



Part 2: Design, manufacture and marking of lifting sets

BS EN ISO 10855-3: 2018 Offshore Containers and Associated Lifting Sets

Part 3: Periodic inspection, examination and testing

Codes of Practice

The International Maritime Organisation (IMO) is the United Nations' specialized agency responsible for improving maritime safety and preventing pollution from ships.

The **International Maritime Dangerous Goods Code**, written by the IMO and first published in 1965, has become the standard guide to all aspects of handling dangerous goods and marine pollutants in sea transport.

The Code lays down basic principles: detailed recommendations for individual substances, materials and articles, and a number of recommendations for good operational practice, including advice on terminology, packing, labelling, stowage, segregation and handling, and emergency response action.

Various offshore containers are utilised to carry dangerous loads so will come within the scope of the International Maritime Dangerous Goods Code.

Notes:

3. TERMS, DEFINITIONS AND SYMBOLS

Terms and Definitions

This module offers essential terms, definitions and symbols used for offshore containers.

Offshore Container

Portable unit for repeated use in the transport of goods or equipment handled in open seas, to from and between fixed and/or floating installations and ships.

Both BS EN ISO 10855 and DNVGL-ST-E271 containers have a maximum gross mass of 25,000kg.

Offshore containers are subdivided into 3 categories:

1. Offshore freight container built for the transport of goods
2. Offshore service container built and equipped for a special service task usually as a temporary installation such as laboratories, workshops, stores or power plants
3. Offshore waste skips which can be open or closed for the storage or removal of waste

Offshore Freight Container

Examples of offshore freight containers can include:

Tank Container

General Cargo

Cargo Basket

Gas Cylinder Rack

Special Containers

Offshore Service Containers

Examples of offshore service containers can include:

Swing Jib

Lubrication Pump

Stores

Offshore Waste Skip

Open or closed offshore container used for the storage and removal of waste.

In addition to the pad eyes for the lifting set, the boat shaped containers may also have side mounted lifting lugs suitable for use with the lifting equipment mounted on a skip lift vehicle.

Permanent Equipment

Permanent Equipment is equipment which is attached to the container which is not cargo.

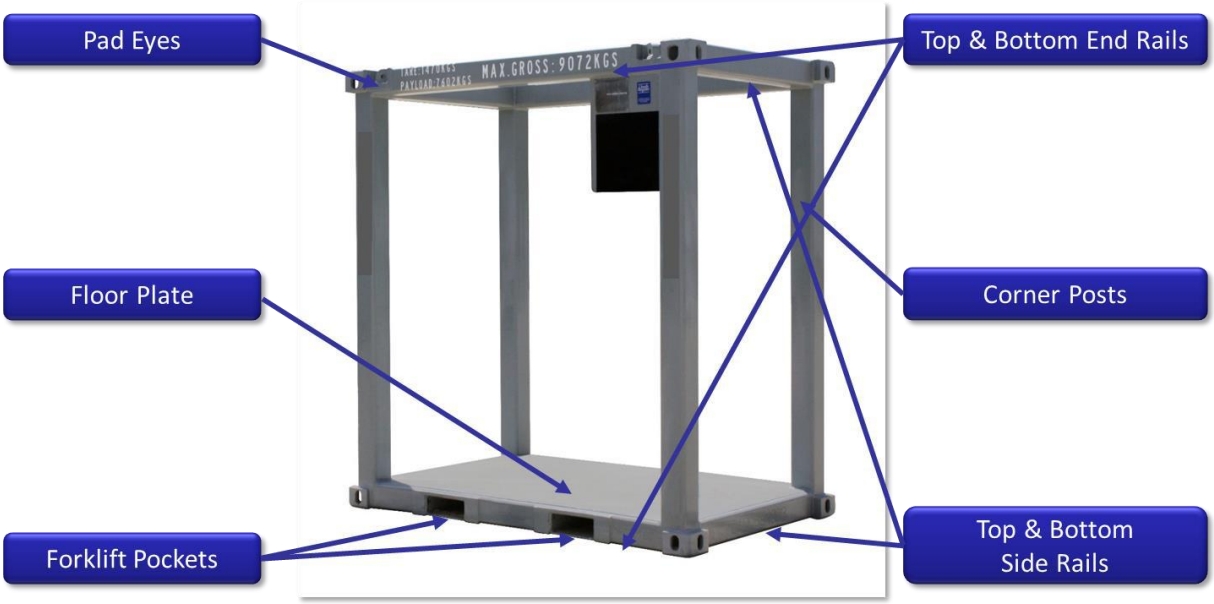
This may include lifting sets, refrigeration units, securing points and shelves.

Primary Structure

Load carrying, supporting frames and load carrying panels. The primary structure can be subdivided into 2 groups:

- **Essential** primary structure which transfers the cargo load to the crane hook. Forms the load path from the payload to the lifting set and will include at least:
  - Top and bottom side rails
  - Top and bottom end rails
  - Corner posts
  - Pad eyes

- **Non-essential** primary structure which are parts of the container such as the floor plates and protective frame members on tank containers



Notes:

Secondary Structure

Secondary structure is defined as parts which are not considered as load carrying for the purpose of design calculations.

Secondary structure items include:

- Doors, walls and roof panels
- Panel stiffeners
- Structural components used for tank protection only
- Internal securing points

Other Definitions

Prototype
Equipment item used for type testing, considered to be representative of the product for which conformity is being claimed. It may be either fabricated especially for type testing or selected at random from a production series.

Owner
The legal owner of the offshore container or the delegated nominee of that body.

Lifting Set
The items of integrated lifting equipment used to connect the offshore container to the lifting appliance.

Symbols

T – **Tare mass** or the mass of the empty container including any permanent equipment (but excluding the lifting set and the cargo) in kg.

P – **Payload** or the maximum permissible mass of cargo that may be safely transported by the container in kg.

R – **Rating** or the 'maximum gross mass' (MGM) of the container including permanent equipment and the cargo (but excluding the lifting set) in kg.

The mass of the lifting set is not included in the rating or the tare mass as this is often added later to the container and there is often the case where the lifting set will be changed out. In some cases, this lifting set media may be changed from steel wire rope to chain resulting in an heavier lifting set.

S – **Mass of the lifting set** in kg.

Examples

T – Tare mass or the mass of the empty container including any permanent equipment but excluding the lifting set and the cargo in kg.

The example below is for a container with a tare mass of 725kg.

P – Payload or the maximum permissible mass of cargo that may be safely transported by the container in kg.

The example below is for of a container with a payload of 5275kg.

R – Rating or the 'maximum gross mass' (MGM) of the container including permanent equipment and the cargo (but excluding the lifting set) in kg.

The example below is for a container with a rating (MGM) of 6000kg. This example also shows the design angle.

The MGM or rating is the tare mass and payload added together.

Notes:

4. DESIGN AND CONSTRUCTION

General Design

An offshore container shall have sufficient strength to allow unloading and loading from supply vessels offshore operating in sea states with significant wave heights of 6 metres and to withstand impact from heavy seas.

Impacts can also occur when the container hits the deck, rigid parts of the structure or other containers; this often happens when the crane is loading and unloading containers from the supply vessel.

To prevent the containers from overturning on a moving deck, they are designed to withstand tilting in any direction of 30° without overturning when loaded at its Maximum Gross Mass, when empty or any intermediate condition.

The centre of gravity would be considered by the designer to be at half height of the container, unless the container is designed for a specific load like bottle racks. This is because the actual centre of gravity will be below half height and the actual centre of gravity would be required to be used for design purposes. DNVGL-ST-E271 requires a tilt test where the container's ability to tilt cannot be verified through calculations.

Protruding parts of the container that may catch other containers or structures shall be avoided.

Protruding parts that may snag (catch) on the lifting set shall be placed or protected so this is avoided.

Stacking fittings and guides, and other structures that protrude above the top of the container frame shall be designed and located to minimise the potential to catch on structures on the ship or on other deck cargoes during lifting operations. They shall also be designed to minimise the risk of damage to other containers or cargoes from these.

41 Containers that are designed for stacking with the lifting set hanging over the side of the top frame shall be fitted with a method of protection for those exposed parts. The example below has the corners raised to a sufficient height above the frame and roof to prevent unintentional contact with, and damage to, the lifting set.

Notes:

Containers shall be designed as structural frames (primary structure), with non-load bearing cladding where necessary (secondary structure).

On certain types of containers, e.g. waste skips with trapezium shaped sides, with only a non-stressed cover above the bracing where the pad eyes are attached, the whole structure may be considered as a primary structure, and the design calculations may treat such a container as a monocoque construction.

Trapezium Shaped Waste Skip

The design temperature for the containers shall not be higher than the lowest daily mean (average) temperature where the offshore container is to operate and in no case shall be higher than -20°C.

Impact loads are dynamic loads of very short duration. Ideally, dynamic calculations or tests should be carried out to verify the ability of a container to withstand such loads.

Horizontal Impact
The main frame structure dimensions shall withstand a local horizontal impact force acting at any point. This force may act in any horizontal direction on the corner post. On all other frame members in the sides, the load may be considered as acting at right angles to the side. To protect against these horizontal impact loads acting on the corner posts, there will often be protective non- load bearing cladding welded over the corner posts.

Internal Forces on Container Walls
Each container wall, including the doors, shall be designed to withstand an internal force evenly distributed over the whole surface, without suffering any permanent deformation.

Vertical Impact
A vertical impact test shall be carried out in accordance the standard being worked to.

Maximum vertical impact forces are likely to occur when a container is lowered onto the deck of a heaving supply vessel. If the deck is at an angle, the first impact will be on a corner.

Minimum Material Thickness
The following minimum material thickness (t) requirements shall apply:

- For external parts of corner posts and bottom rails i.e. parts forming the outside of the container:
  - For R≥ 1000 kg, thickness = 6 mm
  - For R≤ 1000 kg, thickness = 4 mm

- For all other parts of the primary structure: thickness = 4 mm

- For secondary structure made from metallic materials: thickness = 2 mm

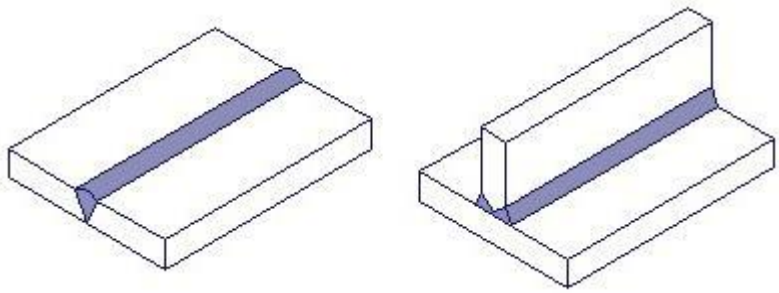
- For waste skips of monocoque design, within an area of 100mm from the side edges a minimum thickness of metallic material of 6mm and for the remaining side structures a minimum thickness of 4mm

These thicknesses may have to be increased beyond these values to take account of special considerations such as rating, design, corrosion allowances etc.

Note: R = Rating (see module 3 – Terms Definitions and Symbols)

Welding

Welding of Primary Structure
Essential and non-redundant primary structural members shall be welded with full penetration welds. Examples of full penetration butt welds are shown below.

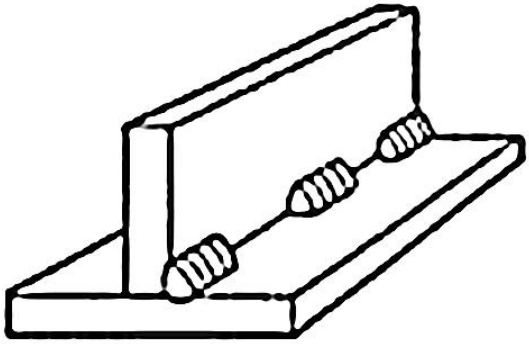


For other primary structure, the use of fillet welds shall be justified by design appraisal.

Welding of Pad Eye
All main welds between pad eyes and the primary frame structure shall always be full penetration welds.

Welding of Secondary Structure

Intermittent fillet welding of secondary structure is acceptable, but measures shall be taken to avoid corrosion if water intrusion could cause problems. An example of fillet welding is shown below.



Additional Design Details

Floor

Containers liable to fill with water, e.g. open topped, shall have a suitable drainage facility.

Notes:

Doors and Hatches

Doors and hatches, including hinges and locking devices, shall be designed for at least the same horizontal forces as the primary structure. Locking devices shall be secure against opening of the doors during transport and lifting.

Double doors shall have at least one such locking device on each door, locking directly to the top and bottom frame. Locking arrangements shall be protected to prevent dislodgement by impact.

Hinges shall be protected against damage from impact loads. Doors shall be capable of being secured in the open position. If weather tightness is required, the doors shall be equipped with seals.

Door Securing Device and Seal

Door Locking Lever

Intermediate Cargo Decks

When intermediate cargo decks, are fitted they shall be designed to withstand a uniformly distributed force.

Driving Ramps

Offshore containers may be fitted with driving ramps. The strength of driving ramps shall be verified by test loading. The test shall be performed with a test vehicle, with the axle load evenly distributed between two tyres.

The test load shall be 1.25 x the payload (P) but no more than 7260 kg.

Driving ramps are to be marked with the maximum allowable load, which shall be 0.8 x the test load.

Note: These requirements only apply to ramps used for driving into containers, not to smaller ramps used for hand loading trolleys.

Internal Lashing Points
General cargo containers will have internal securing lashing points (recommended at least 12) and each will be designed to withstand a force of at least 10 kN. The foldable/hinged type are preferred.

Fork Lift Pockets
Forklift pockets shall:

- Be installed in the bottom structure and have a closed top
- Pass all the way through the base
- Have means to prevent the container falling off the forks
- Minimum internal dimensions of the forklift pockets shall be 200 mm x 90 mm
- Located so that the container is stable during handling and driving, taking into account the dimensions (container length, height, width) and rating
- Located as far apart as practicable but need not be more than 2050mm apart from the centre of pocket to centre of pocket
- The bottom of the pocket may be fully closed but it is recommended that openings are provided to facilitate maintenance and to minimise the risk of loose items being retained in the pockets.

Notes:

Fork Lift Pockets Recommended Distances: DNVGL–ST-E271

Recommended Fork Pocket Distance and Operational Limitations		
Container length L (mm)	**Min distance between centres of pockets (mm)**	**Limitations**
Length under 6000	900 but no more than 2050	Between 3000 and 6000 the fork pockets should be spaced at least 1500mm apart
Length between 6000 and 12000	2050	Pockets for loaded handling
Length between 6000 and 12000	900	Pockets for empty handling
Length between 12000 and 18000	2050	Empty handling only
Length over 18000	-	No Pockets

Top Protection

The top of all open frame containers and of all open top containers with permanent internal fittings, machinery or other installations where crane hooks or forerunners may snag, shall be protected with grating or plates.

This may be fixed, hinged or removable. Top protection shall be capable of being secured.

ISO Corner Fittings

Where ISO corner fittings are mounted to offshore containers, they shall conform to ISO 1161.

Note: Lifting offshore with shackles in these corner fittings is not acceptable.

Coating and Corrosion Protection

Offshore containers shall be suitable for the offshore environment by means of construction, use of suitable material and/or corrosion and paint protection.

All offshore container roofs, including those constructed from chequer plate, shall be coated with a permanent non-slip medium.

Tank Containers

General
In addition to complying with other relevant design codes and requirements, tank containers shall be suitable for offshore service.

Frame
The frame shall be designed to protect the tank and equipment (valves, man-holes, etc.).

Tanks for Fluids
Tanks for dangerous cargoes shall fulfil the requirements of the IMDG code and be designed according to a recognized code for pressure vessels. A tank and its support shall be able to withstand lifting and impact loads.

Impact Protection on Tank Containers for Dangerous Cargoes
On tank containers for dangerous cargoes, all parts of the tank and fittings shall be suitably protected from impact damage.

The top of the tank and its fittings shall be protected by beams, plates or grating. No part of the tank or its fittings shall extend to within 100 mm of the top of the framework.

Top: Not be possible for any part of the lifting set to foul fittings, manhole cleats or other protrusions on the tank.

Sides: Protective beams shall be placed at or near the location where the tank shell is nearest to the outer plane of the sides.

Bottom: No part of the underside of the tank shall extend below a level 150 mm above the bottom of the framework. Any part that extends to within 300 mm of the bottom of the framework, shall be protected by beams or plating.

Tank containers designed with direct connection between the tank and the side or top frame elements shall be subject to special consideration.

Notes:

5. PAD EYES

Offshore containers use pad eyes at the top corner of the containers to attach the lifting set via a shackle.

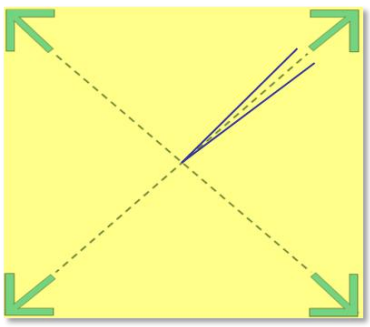
The pad eyes are more secure than an ISO corner on an offshore container and even when ISO corner fittings are provided on an offshore container, these should never be used for lifting offshore. This is due to the shackles being twisted in the ISO corner fitting.

Only connect slings to the pad eye using nut, bolt and pin type shackle (preferred).

Pad Eye Design

To prevent lateral bending moments on pad eyes, they shall be aligned with the sling to the centre of lift, with a maximum manufacturing tolerance of ±2.5°.

Any difference in the diagonal measurements between lifting point centres shall not exceed 0.2% of the length of the diagonal, or 5mm, whichever is the greater.



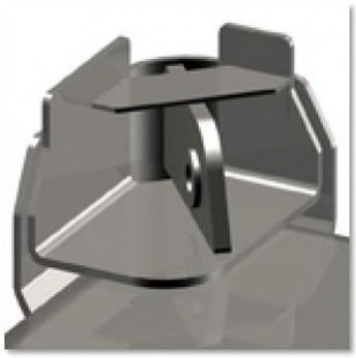
The diameter of holes in pad eyes shall match the shackle used. Clearance between shackle pin and pad eye hole shall not exceed 6% of the nominal shackle pin diameter.

To minimize the shackle pin seizing in the hole, it is recommended to select nominal shackle size and bore in pad eye as close as possible to 6% limit.

Pad eyes shall not protrude outside the boundaries of the container other than vertically upward and shall, as far as possible, be designed to avoid damage from other containers.

Lifting points shall be positioned on the container to preclude, as far as practicable, the risk of slings fouling against the container or its cargo during normal use.

Pad eyes shall be welded to the frame with full penetration welds.



Pad eyes that are placed vertically and aligned towards a central point can normally accommodate variations in sling angles, i.e. a lifting set with the legs 45° from vertical can be replaced with a longer lifting set, giving a smaller angle to the vertical without any adverse effect on the pad eyes or the container.

Containers that are designed to have the centre of gravity offset from the geometric centre may be fitted with lifting sets of asymmetric length. This will ensure that the container will hang horizontally when lifted. If the lifting set is asymmetric, the pad eyes must be aligned towards the lifting centre.

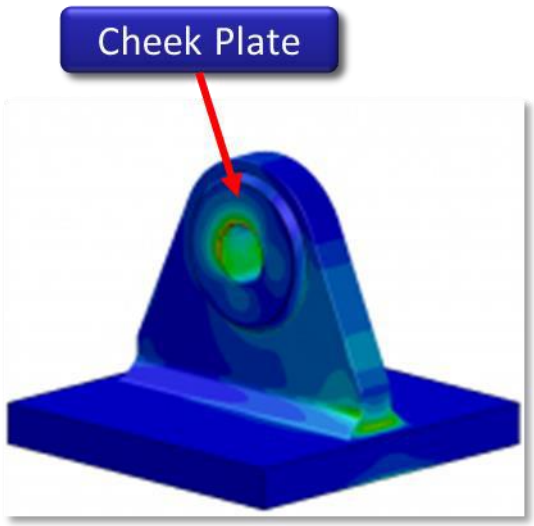
- Pad eyes partly slotted into primary structure members are generally considered to be preferable
- Pad eye design must take into account the size and shape of the shackles that are going to be used
- When the pad eye has been designed, only one size of shackle will fit
- Shackles come in standard sizes therefore the designer should determine the size of the shackles to be used before designing the pad eyes
- The diameter of the shackle pin (pad eye hole diameter to be a maximum of 6% larger than the nominal diameter of the shackle pin). The inside (jaw) width (pad eye thickness to be a minimum of 75% of the shackle jaw width) and length of the shackle and the free space needed to fit the shackle must all be taken into account

BS EN ISO 10855-1 requires the tolerance between pad eye thickness and inside width of shackle not to exceed 25% of the inside width of the shackle.

DNVGL-ST-E271 requires that the thickness of the pad eye at the hole shall not be less than 75% of the inside width of the shackle.

The requirements for the pad eye are actually the same although different terminology is used.

If the requirement above cannot be met the thickness can be increased by welding on cheek plates.



Standard Shackle Dimensions

Standard Shackles in Accordance with BS EN 13889				
Nominal WLL (tonnes)	**Pin Diameter (mm)**	**Jaw Width (mm)**	**Inside Length of Dee Shackles (mm)**	**Inside Length of Bow Shackles (mm)**
3.25	**19**	**27**	**47**	**57**
4.75	**22**	**31**	**52**	**65**
6.5	**25**	**36**	**65**	**76**
8.5	**28**	**43**	**74**	**88**
9.5	**32**	**46.5**	**83**	**101**
12	**35**	**51.5**	**87**	**108**
13.5	**38**	**57**	**104**	**126**
17	**42**	**60**	**115**	**139**
25	**50**	**74**	**139**	**168**

Pad Eye Design

One restriction in the requirements of BS EN 12079-2 that the designers need to be aware of is the preference for shackles with bolt type pin with hexagon head, hexagon nut and safety cotter pin to be fitted. Therefore, sufficient space is required surrounding the pad eye to enable this type of pin to be fitted and removed.

More information reference pad eye design can be found in the LEEA Guidance Document 048.

Non-Standard Pad Eye

The picture below illustrates a non-standard pad eye fitted to a ISO container. This container would not have sufficient strength to withstand the dynamic forces that can be experienced when lifting the container offshore.

Notes:

Notes:

6. MARKING REQUIREMENTS AND DATA PLATES

Container Safety Markings

The tops of closed containers and the top rails of open and framed containers shall be marked as follows:

Closed containers markings
A band of solid contrasting colour not less than 100 mm wide around roof perimeter.

On a recessed roof which is below the top perimeter rail, the top surface of the top rail shall be marked.

Open and Framed Containers
Marked on the top surface of the top rails with hatching in a contrasting colour or a solid light colour.

Fork Lift Pocket Markings
Container fork pockets (handling empty container only) will have the words “empty lift only" clearly displayed near each set of fork pockets.

The characters must not be smaller than 50mm high.

A fully laden container must not be lifted using the fork pockets, instead the correct lifting set will be used.

Identification Markings

Containers shall have the fabricator's serial number welded on in characters at least 50mm high so that if stencilled markings becoming illegible, the container can be traced.

In addition, each container shall be marked with a unique container number, issued by the owner, as a prime identifier for use as the common cross-reference on all in-service certification and shipping documentation.

The container number shall be prominently and indelibly displayed on all sides of the container as viewed from ground level in characters of a contrasting colour of not less than 75mm high.

Characters will be at least 300mm displaying the container number on the roof of the container. This is to assist the crane driver in placing the loads in the correct area.

If space is an issue, then characters should be as large as possible.

Marking shall be carried out in such a way as to avoid incorrect interpretation (e.g. by underlining).

Position the lower edge of the marking on the container near the door where applicable, so the crane driver can put the doors facing outwards.

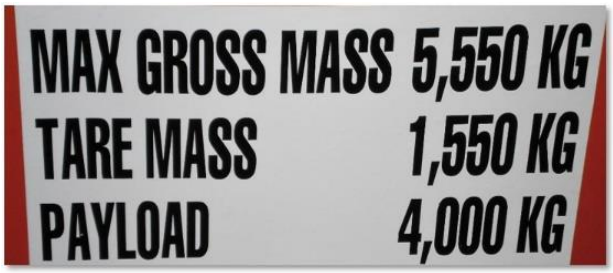
Information Markings

Each container shall be clearly and indelibly marked with:

- Maximum gross mass (kg)
- Tare mass (kg)
- Payload (kg)

The maximum gross mass, tare mass and payload shall be displayed in characters of a contrasting colour not less than 50mm high.

A matt black panel of appropriate size may be provided for the application of temporary information. It is recommended that this panel be located on a door, where fitted.



Other Markings

Intermediate deck
If an intermediate deck is fitted:

- Payload of the deck displayed on the inside of the container in contrasting colour characters and the characters shall be a minimum of 50 mm high.

Notes:

BS EN ISO 10855–1 Container Data Plate Markings

Offshore containers shall be fitted with a plate carrying the following information:

- Manufacturer's serial number
- Month and year of manufacture
- Maximum gross mass in kilogrammes (excluding lifting set) at the design sling angle
- Tare mass in kilogrammes
- Payload in kilogrammes and intermediate deck payload if applicable
- Certificate of conformity number
- Design temperature
- Identification of body issuing the certificate of conformity

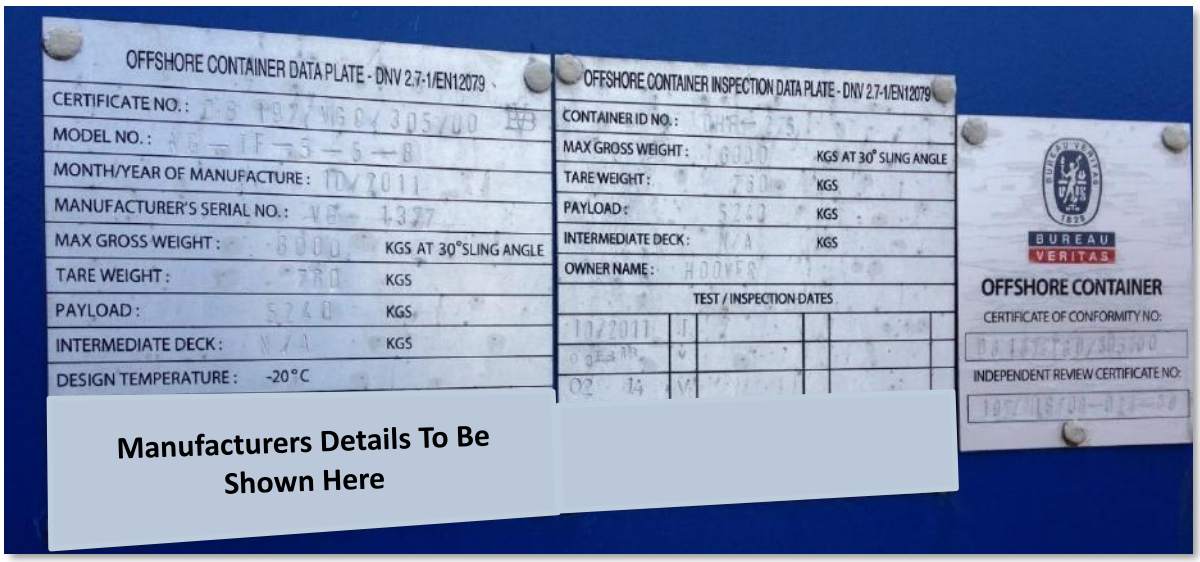
The plate shall be headed "OFFSHORE CONTAINER DATA PLATE – ISO 10855-1"

The plate shall be made of corrosion resistant material securely attached in a prominent position- on a container with doors, on the door.

The information on the plate shall be in English primarily, but provisions for a second language may be made. The text shall be in characters of not less than 4mm high.

DNVGL-ST-E271 Container Data Plate Markings

Det Norske Veritas offshore containers will also have "OFFSHORE CONTAINER DATA PLATE DNVGL-ST-E271 / BS EN ISO 10855 – 1" marked, similar to the image below.



Users and inspectors of DNVGL-ST-E271 containers can regard the data plate as prima facie evidence (sufficient evidence) of certification status.

BS EN ISO 10855–3 Container Inspection Plate

The plate shall be headed “OFFSHORE CONTAINER INSPECTION PLATE – ISO 10855-3”

The plate shall be made of corrosion resistant material securely attached in a prominent position, on a container with doors, on the door. The information on the plate shall be in the English language primarily, but provisions for a second language may be made. The text shall be in characters of not less than 4mm high.

The plate shall contain the following information:

- Owner’s container number
- Owner’s name
- Date of last inspection

Provisions shall be made on the inspection plate for at least 9 inspections.

The inspection plate is very often combined with the original data plate

DNVGL-ST-E271 Container Inspection Plate

When certified by DNV, the plate shall be headed “OFFSHORE CONTAINER INSPECTION PLATE – DNVGL-ST-E271”

The plate shall be made of corrosion resistant material securely attached in a prominent position- on a container with doors, on the door. The information on the plate shall be in English primarily, but provisions for a second language may be made. The text shall be in characters of not less than 4mm high.

The plate shall contain the following information:

- Owner’s container number
- Owner’s name
- Date of last inspection

Provisions shall be made on the inspection plate for at least 9 inspections.

This inspection plate is very often combined with the original data plate.

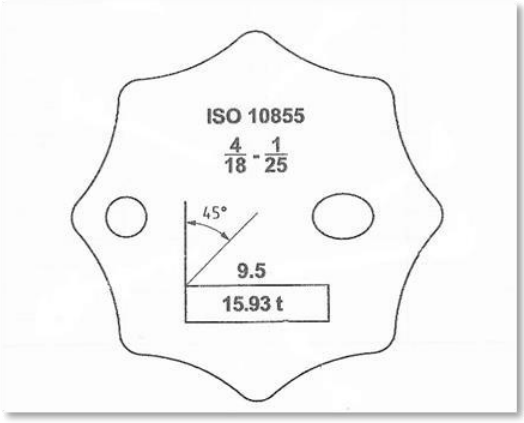
Lifting Set Markings

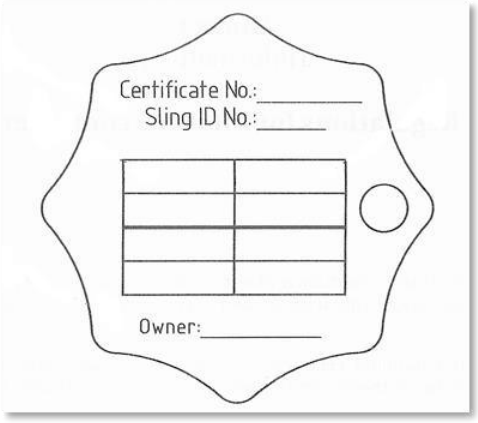
In addition to the marking requirements of the individual component standards, BS EN ISO 10855-2 also requires the individual shackles that are not assembly secured are marked with an individual unique identification.

A common method of marking the individual shackles is to relate them to the container and the lifting set. For example, a container with the serial number 52419089 will have a lifting set serial number of 52419089/A and each of the shackles have the unique number 52419089/B/C/D/E. The unique identification number should be applied using low stress stamps, with a minimum height of 5mm and applied in areas of low stress.

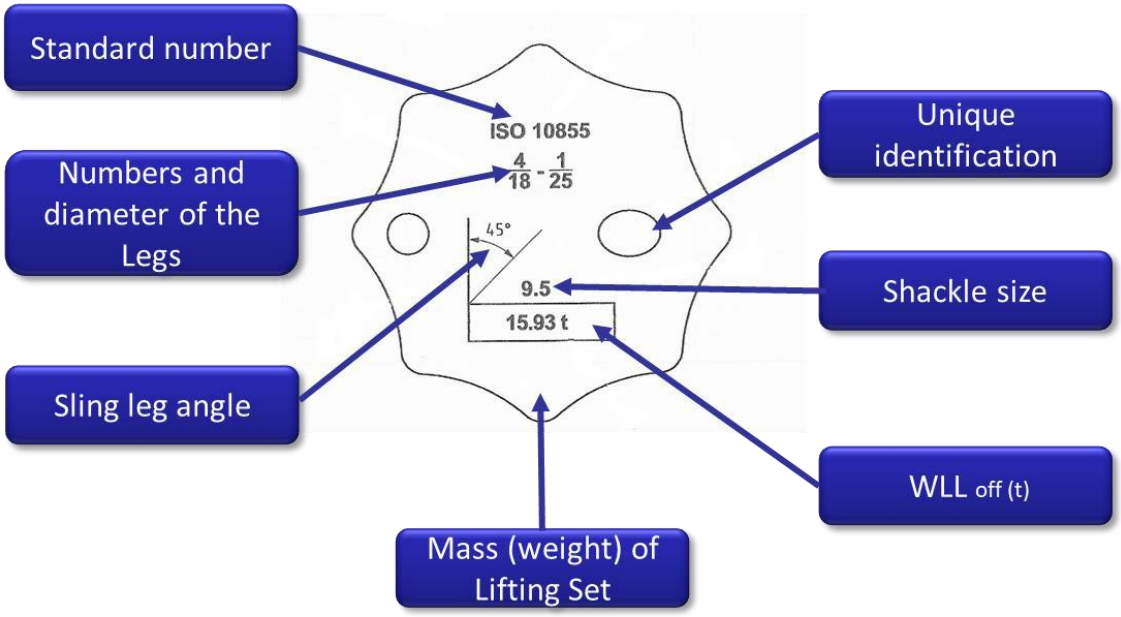
Slings shall be marked with an identification tag permanently attached to the top assembly of the sling. The tag shall be made of metal with the marking permanently embossed or stamped. The tag shall be 8 sided for chain and round for wire rope slings.

Where 2 x 2 leg slings function on a container as a 4 leg sling, both shall be marked as a 4 leg sling. This is often the case in long baskets and open top waste skips, where if it was a standard 4 leg sling this would obstruct the loading as the sling would lay in the container. If 2 x 2 leg slings are fitted, these can be hung over the ends therefore not obstructing the loading area.





The example below is for a chain sling but these markings are also required on wire rope slings by BS EN ISO 10855-2. On this tag, the 9.5 indicates the size of the shackles.



Notes:

Notes:

7. CERTIFICATION

Type Testing

Any change of design, specification of material and method of manufacture outside normal manufacturing tolerances, which may lead to a modification of the mechanical properties defined in BS EN ISO 10855-1, shall require that the relevant type tests are carried out on the modified container.

The purpose of type testing is to confirm they possess the mechanical properties specified.

Type testing may not replace design review. Non-destructive examination (NDE) in accordance with the relevant ISO will be required after testing.

When type testing is being carried out, follow these guidelines where possible:

- Evenly distribute the test masses inside the container
- Where this is not possible, some of the test mass can be placed outside or under the container, providing that the loading on the structure is similar to the distribution of the container loading in operating condition
- If the container has an additional cargo deck, distribute the test mass evenly between the floor and the removable deck
- The test must also be carried out with all the test mass on the floor when the deck has been removed

The test mass or test load shall be verified using calibrated weights or a calibrated load cell and handset.

Examples of suitable means of applications are:

- Calibrated test blocks
- Water bags
- Free weights
- Suitable test rig

Notes:

Load cells and hand sets when used are required by ISO 7500-1 to have an accuracy of ± 2% and be calibrated annually.

If a load cell is shock loaded from being dropped or overloaded, it is recommended that it is re-calibrated before further use.

Where test blocks are used, these shall be calibrated every second year as a minimum, and the measured mass in kilogrammes be legibly and durably marked on each block.

Concrete blocks can absorb water, which may affect the actual block mass - take care to avoid this when storing them.

Lifting Test

The container shall be lifted by a lifting set with an angle to the vertical equal to the design angle.

The container shall be clear of the ground during the test.

The container shall be carefully lifted so that no significant acceleration forces occur. It shall be held for 5 minutes before measurements are taken.

All-Point Lifting Test

The container shall be loaded to a total mass of 2.5 x maximum gross mass (R-Rating) and lifted clear of the ground using all pad eyes. The total mass can be obtained by loading an internal test mass of 2.5 x R – T.

No deflections during testing shall be greater than 1/300 of the span of the member. There shall be no permanent deformation or other damage shown after the test.

If the container lifting set is used for this test, there will have been damage caused by the overloading. Avoid this by using specially designed test slings.

Two-Point Lifting Test

An offshore container fitted with 4 pad eyes shall also be lifted using 2 diagonally situated pad eyes.

The total test mass for the 2 point lifting test shall be 1.5 R.

The offshore container shall show no permanent deformation or other damage after testing.

Post Lifting Test Inspection and Examination

On completion of the lifting test, carry out a non-destructive examination and visual inspection of the pad eyes.

Vertical Impact Test

The container, with its internal test mass corresponding to payload P, shall be either lowered or dropped on to a workshop floor of concrete or other rigid structure.

Note 1: This floor may be covered with a sheathing of wooden planks with a thickness not exceeding 50 mm.

Note 2: If the container is lowered from a crane, the suspending wire and hook may dampen the impact compared to a free-fall drop test. Therefore, the impact speed should be greater if a lowering test is used.

In both cases, the container shall be inclined so that each of the bottom side and end rails connected to the lowest corner forms an angle of not less than 5° with the floor.

However, the greatest height difference between the highest and lowest point of the underside of the container corners need not be more than 400 mm.

The impacting corner shall be the one expected to have the lowest rigidity. On closed dry cargo containers, this will normally be at the door end.

No significant permanent damage shall occur.

Note 3: Cracks in welds and minor deformations may be repaired.

One of the following procedures shall be carried out:

- Drop test
    - An internal load equal to the payload (P) shall be safely secured and the container shall be inclined as described previously
    - The container shall be suspended from a quick release hook. When released, the container shall drop freely for at least 50 mm to give it a speed at initial impact of at least 1m/second

- Lowering test
    - An internal load equal to the payload (P) shall be safely secured and the container shall be inclined as described previously
    - The container shall be lowered to the floor at a constant speed of not less than 1.5 m/second

Note 4: Warning, these tests may cause considerable tremors in the building!

Other Tests

Open top containers with an overall length of 6.5m or more and with fork pockets designed for loaded lifting shall be loaded to a total uniformly distributed gross mass of 1.6 (R+S) and lifted clear of the ground using the fork pockets. No deflections during testing shall be greater than 1/300 of the span of the member. The offshore container shall show no permanent deformation or other damage after testing.

Tanks for dangerous cargoes shall be tested according to the requirements of the IMDG Code.

Certification

General
All containers shall be issued with a certificate of conformity to show compliance with the relevant standard the container has been constructed to.

67 The certificate shall be kept by the owner for as long as he is in possession of the container.

All certificates relating to design, materials, welding, fabrication, NDE, testing and final inspections shall be kept in the “as built” dossier held by the manufacturer of the container.

This documentation must be retained for a minimum of 10 years by the manufacturer.

Information which is not commercially sensitive from the “as built” dossier shall be copied to the owner.

For dangerous goods containers, these shall be certified in accordance with the IMDG code.

Each container shall have its own serial number as specified in the marking requirements.

Notes:

Certificate of Conformity

Certificate of conformity shall contain the following information:

- Manufacturer's serial number
- Unique identification number
- Description of the container including:
    - External dimensions
    - Number of lifting points
    - Name of manufacturer
    - Month/year of manufacture
    - Maximum gross mass excluding lifting set (kg)
    - Tare mass excluding lifting set (kg)
    - Payload (kg)
    - Reference to the as built dossier
    - Total loading in kN applicable to the all-points lifting test for the batch of containers tested
    - Angle of lifting set legs (from vertical)
    - Minimum nominal shackle bolt diameter
- Conformity to other requirements and/ or codes
- Statement that the container described has been designed, fabricated and tested in accordance with ISO 10855-1
- Manufacturer's serial numbers of those containers from the production batch subject to testing
- Remarks
- Signature on behalf of the body issuing the certificate of conformity

Notes:

Notes:

8. CHAIN SLINGS

Applicable Standards and References

BS EN 818 – 1: General conditions of acceptance

BS EN 818 – 2: Medium tolerance chain for chain slings – Grade 8

BS EN 818 – 3: Medium tolerance chain for chain slings – Grade 4

BS EN 818 – 4: Chain slings – Grade 8

BS EN 818 – 5: Chain slings – Grade 4

BS EN 818 – 6: Chain slings instructions for use and maintenance

LEEA Code of Practice for the Safe Use of Lifting Equipment – Section 14

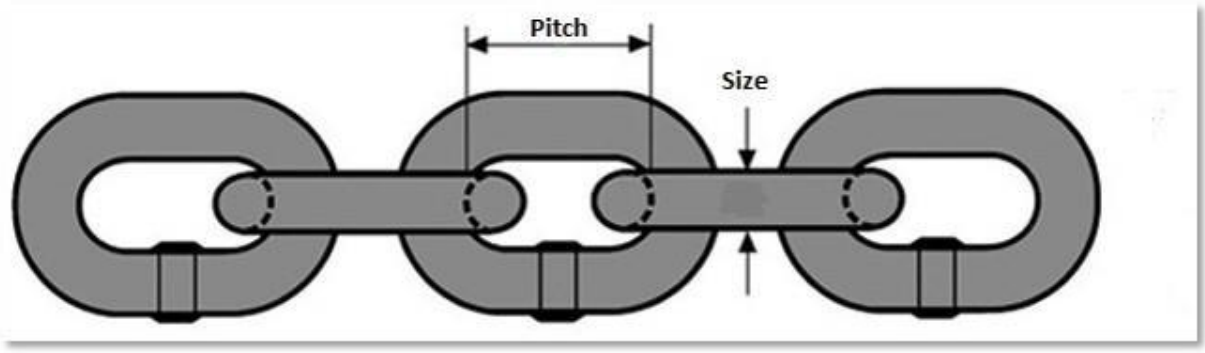
Definitions

Short Link Chain
The Machinery Directive states that where chain with welded link is used for lifting purposes, the chain used shall be short link chain. For the purposes of the standard BS EN 818, this means a nominal pitch to size ratio of 3:1.

Nominal Size
Nominal size of the round section of steel wire or bar from which the chain is made.

Material Diameter
Diameter of the material in the chain link as measured.

Pitch
Internal length of a chain link as measured.



Weld Diameter
Diameter at the weld as measured.

Length Dimensionally Affected by Welding
Length on either side of the centre of the link, affected by welding.

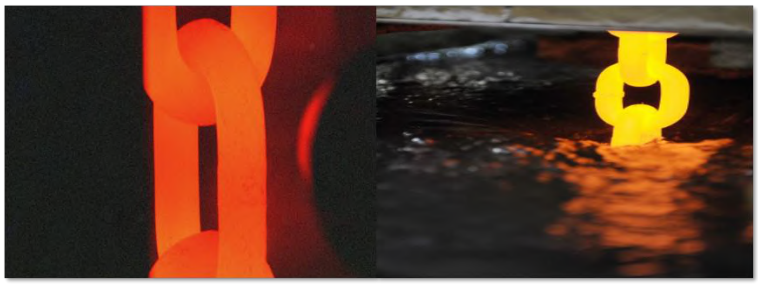
Manufacturing Proof Force (MPF) of Chain
Force to which during manufacture the whole of the chain is subjected.

Breaking Force (BF)
Maximum force which the chain withstands during a static tensile test to destruction.

Short link Chain
Various grades of short link chain are used when manufacturing chain slings. Generally, capacity for capacity, short link chain is the heaviest of the lifting media. As the links are free to articulate fully with one another, short link chain provides the most flexible lifting media.

Heat Treatment

All the chain shall be subjected to the appropriate heat treatment specified in the Part of BS EN 818 for the particular type and grade of chain, before the application of the manufacturing proof force.



Surface Finish

The 'finished' condition for chain shall include any surface finish.

Note: Chains are supplied in various surface finishes e.g. natural black (i.e. furnace scaled), de-scaled, electroplated or painted.

Grades of Link Chain

Grades		Mean Stress at the Specified Minimum Breaking Force N/mm²
Fine Tolerance	Medium Tolerance	
M	4	400
P	5	500
S	6	630
T	8	800
V	10	1000
	12	1200
Note: Chains in all of these grades may not be covered by European Standards. Grade T/8 is currently the highest standardised grade of chain in Europe.		
This grading system has also been applied to hooks, links, shackles and other accessories, indicating their strength compatibility with the appropriate grade of chain.		

Grade Marks

The grade mark is the number for medium tolerance chain that designates the grade of chain. It shall be legibly stamped or embossed on every 20th link, or links at intervals of 1 metre, whichever is the lesser distance.

If stamps are used, they shall have a concave surface and the indentation shall not impair the mechanical properties of the chain link.

Manufacturer's Certificate

The manufacturer shall supply a certificate of test and examination stating conformance with the appropriate part(s) of BS EN 818 with every supply of chain.

The certificate of test and examination shall give at least the following information:

- The name and address of the manufacturer or his authorised representative, including date of issue of the certificate and authentication
- Number and part(s) of BS EN 818
- Quantity and description of the chain of which the test sample is representative
- Identification of the chain of which the test sample is representative
- Nominal size of chain, in millimetres
- Manufacturing proof force, in kilonewtons
- Breaking force, in kilonewtons (i.e. confirmation that the specified minimum breaking force was met or exceeded)
- Total ultimate elongation at fracture, as a percentage (i.e. confirmation that the specified minimum total ultimate elongation has been met or exceeded)

Notes:

BS EN 818-2

Short link chain for lifting purposes – Safety Part 2: Medium tolerance chain for chain slings – Grade 8.

This European Standard has been prepared to be a Harmonised Standard to provide one means of complying with the essential safety requirements of the Machinery Directive.

This Part of BS EN 818 specifies the requirements related to safety for short link lifting chains, grade 8, of medium tolerance for use in chain slings and for general lifting purposes. They are electrically welded round steel short link chains, heat treated and tested and conforming to the general conditions of acceptance in BS EN 818-1.

The range of nominal sizes of chain covered by this part of BS EN 818 is from 4mm to 45mm.

Dimensions (mm)							
1	2	3	4	5	6	7	8
Nominal Size (dN)	Material Diameter Tolerance	Weld Diameter ds Maximum	Pitch			Internal Width Away from Weld w1 Minimum	External Width Over the Weld w2 Maximum
			pn	P Maximum	P Minimum		
4	+/-0.16	4.4	12	12.4	11.6	5.2	14.8
5	+/-0.2	5.5	15	15.5	14.6	6.5	18.5
6	+/-0.24	6.6	18	18.5	17.5	7.8	22.2
7	+/-0.28	7.7	21	21.6	20.4	9.1	25.9
8	+/-0.32	8.8	24	24.7	23.3	10.4	29.6
10	+/-0.4	11	30	30.9	29.1	13	37
13	+/-0.52	14.3	39	40.2	37.8	16.9	48.1
16	+/-0.64	17.6	48	49.4	46.6	20.8	59.2
18	+/-0.9	19.8	54	55.6	52.4	23.4	66.6
19	+/-1	20.9	57	58.7	55.3	24.7	70.3
20	+/-1	22	60	61.8	58.2	26	74
22	+/-1.1	24.2	66	68	64	28.6	81.4
23	+/-1.2	25.3	69	71.1	66.9	29.9	85.1
25	+/-1.3	27.5	75	77.3	72.8	32.5	92.5
26	+/-1.3	28.6	78	80.3	75.7	33.8	96.2
28	+/-1.4	30.8	84	86.5	81.5	36.4	104
32	+/-1.6	35.2	96	98.9	93.1	41.6	118
36	+/-1.8	39.6	108	111	105	46.8	133
40	+/-2	44	120	124	116	52	148
45	+/-2.3	49.5	135	139	131	58.5	167

Heat Treatment

All the chain shall be hardened from a temperature above the AC3 point and tempered before being subjected to the manufacturing proof force. The tempering temperature shall be at least 400°C.

The tempering conditions shall be at least as effective as a temperature of 400°C maintained for a period of 1 hour. This requirement is the responsibility of the chain manufacturer.

When proposed for verification, sample chains shall be tested after they have been reheated to and maintained at 400°C for 1 hour and then cooled to room temperature.

Manufacturing Proof Force

All the chain shall be subjected to the manufacturing proof force specified in column 3 of the table below, for the appropriate nominal size of chain.

This is equal to 2.5 x the WLL.

Note: This is the manufacturers proof force.

Manufacturers Proof Force and Breaking Force				
1	2	3	4	5
Nominal Size (dN)	**Working Load Limit WLL t**	**Manufacturing Proof Force MPF kN**	**Breaking Force BF kN min**	**Bend Deflection f mm min**
4	0.5	12.6	20.1	3.2
5	0.8	19.6	31.4	4
6	1.12	28.3	45.2	4.8
7	1.5	38.5	61.6	5.6
8	2	50.3	80.4	6.4
10	3.15	78.5	126	8
13	5.3	133	212	10
16	8	201	322	13
18	10	254	407	14
19	11.2	284	454	15
20	12.5	314	503	16
22	15	380	608	18
23	16	415	665	18
25	20	491	785	20
26	21.2	531	849	21
28	25	616	985	22
32	31.5	804	1290	26
36	40	1020	1630	29
40	50	1260	2010	32
45	63	1590	2540	36

Notes:

BS EN 818-4

Short link chain for lifting purposes – Safety – Part 4: Chain slings – Grade 8

This European Standard specifies the requirements related to safety methods of rating and testing of single, 2, 3, 4 and endless chain slings assembled by:

- Mechanical joining devices
- Welding
- Using short link grade 8 medium tolerance lifting chain conforming to BS EN 818–2 together with the appropriate range of components of the same grade

Definitions

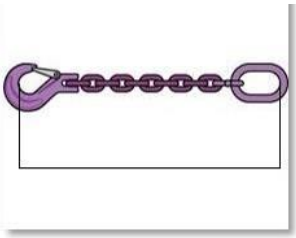
Chain Sling
Assembly consisting of a chain leg or chain legs, joined to upper and lower terminals for attaching loads to the hook of a crane or other lifting machine.

Nominal Size of Chain Sling
The nominal size of short link chain, in millimetres, used in the manufacture of the chain sling.

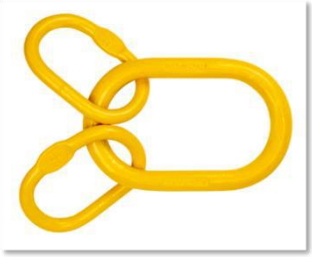
Nominal Grade of Chain Sling
The grade of short link chain used in the manufacture of the chain sling.

Master Link
A link forming the upper terminal of a chain by means of which the chain is attached to the hook of a crane or other lifting machine.

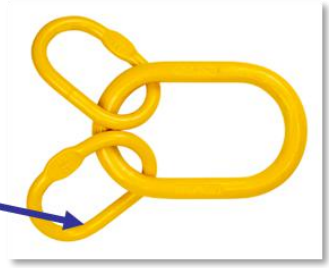
Length of a Leg
For a finished chain sling is the length from the lower bearing point of the lower terminal to the upper bearing point of the upper terminal.



Master Link Assembly
Assembly consisting of a master link together with 2 intermediate master links.



Intermediate Master Link
A link used to connect 1 or 2 legs of a sling to the master link.



Lower Terminal
A link, hook or other device fitted at the end of a leg of a sling, remote from the master link or upper terminal.

Mechanical Joining Device
A means of connection which does not depend on welding. It may be integral with a component or be a separate component. These types of mechanical joining devices are not allowed on lifting sets for offshore containers to BS EN ISO 10855.

Joining Link
A welded link, fitted to the end of a chain to connect it either directly or through an intermediate link to an upper or lower terminal or intermediate master link. In the case of an endless chain sling, to the other end of the chain.

Manufacturing Proof Force
A force applied during manufacture as a test to the whole chain sling or a force applied as a test to a section of chain sling.

Working Load Limit (WLL)
The maximum mass which a sling is authorized to sustain in general lifting service.

Safety Requirements

- The chain shall comply with BS EN 818-2
- Forged steel components, including mechanical joining devices, for use with grade 8 chain in the manufacture of chain slings shall comply with BS EN 1677-1
- Master links and intermediate master links shall comply with BS EN 1677-4
- Lower terminal links shall comply with BS EN 1677-4 except for those clauses relating to link dimensions
- Joining links and intermediate links shall comply with BS EN 1677-4 except for those clauses relating to link dimensions
- Lower terminal links, joining links and intermediate links shall satisfy the appropriate requirements
- Forged steel hooks with latch shall comply with BS EN 1677-2
- Forged steel hooks with self-locking latches shall comply with BS EN 1677-3

Design and construction – Chain slings assembled with mechanical joining devices

The assembly of the chain sling shall be undertaken in accordance with the chain manufacturer's instructions.

Chain slings shall be designed and manufactured so that when assembled in accordance with the manufacturer's instructions, the unintentional disconnection of any component cannot occur.

Pear shaped links shall only be used if they have an integral joining device.

Assembled mechanical joining devices shall have a working load limit not less than that of the chain to which they are connected in a chain sling.

Design and construction – Chain slings assembled by welding

Pear shaped links shall not be used as terminals.

Joining links and intermediate links shall have a working load limit not less than that of the chain to which they are connected in a chain sling.

The dimensions of joining links and intermediate links shall ensure adequate articulation with parts of the chain sling which they connect with.

Tolerance on Length

When constructing a chain sling, the actual length of each leg shall be the nominal length with a tolerance of + 2/- 0 chain link pitches.

When constructing a multi-leg chain sling, the difference in length between the longest and shortest legs which are nominally the same length when measured under equivalent tension comply with the values given in the table below.

Multiple Leg Chain Slings		
Type of Chain Sling	**Difference in Length between the Longest and Shortest Legs**	
	Nominal Lengths up to and including 2m	**Nominal Lengths over 2m**
Joining by Mechanical Devices	10mm Maximum	5mm/m
Assembled by Welding	6mm Maximum	3mm/m

Notes:

Working Load Rating

Single leg chain slings shall be rated at a working load limit in accordance with the table below.

Nominal Size of Chain Sling (mm)	Working Load Limits for Single Leg Chain Slings (t)
4	0.5
5	0.8
6	1.12
7	1.5
8	2
10	3.15
13	5.3
16	8
18	10
19	11.2
20	12.5
22	15
23	16
25	20
26	21.2
28	25
32	31.5
36	40
40	50
45	63

Single Leg Slings

Marking Requirements

The information specified shall be either marked on a metal tag attached to the master link or to a link immediately adjacent to it or all or part of the information marked on the master link provided that the mechanical properties of the link are not impaired.

- The working load limit (tonnes)
- The individual identification mark (related to the manufacturers certificate)
- The manufacturers mark or symbol
- The grade of the chain sling
- The number of legs
- (The nominal size of the chain may be marked if required as an option)

Working Load Rating
Multi-leg chain slings shall be rated for symmetrically distributed loads only and in accordance with the table below.

Each chain sling shall have a single working load limit for the range of angles from 0 up to and including 45° to the vertical or, additionally, a working load limit for the range of angles from 45° up to and including 60° to the vertical.

Note: The maximum design angle for offshore container lifting sets is 45°.

Nominal Size of Chain Sling (mm)	Working Load Limits (t)				
	2 Leg Chain Slings		3 and 4 Leg Chain Slings		Endless Chain Sling in Choke Hitch
	0°-45°	45°-60°	0°-45°	45°-60°	
4	0.71	0.5	1.06	0.75	0.8
5	1.12	0.8	1.6	1.18	1.25
6	1.6	1.12	2.36	1.7	1.8
7	2.12	1.5	3.15	2.24	2.5
8	2.8	2	4.25	3	3.15
10	4.25	3.15	6.7	4.75	5
13	7.5	5.3	11.2	8	8.5
16	11.2	8	17	11.8	12.5
18	14	10	21.2	15	16
19	16	11.2	23.6	17	18
20	17	12.5	26.5	19	20
22	21.2	15	31.5	22.4	23.6
23	23.6	16	35.5	25	26.5
25	28	20	40	30	31.5
26	30	21.2	45	31.5	33.5
28	33.5	25	50	37.5	40
32	45	31.5	67	47.5	50
36	56	40	85	60	63
40	71	50	106	75	80
45	90	63	132	95	100

Notes:

Uniform Load Method – Multi-Leg Slings

Marking Requirements
The information specified shall be marked on a metal tag attached to the master link. or to a link immediately adjacent to it, or all or part of the information marked on the master link provided that the mechanical properties of the link are not impaired.

- The working load limit and the range of angles
- The individual identification mark (related to the manufacturers certificate)
- The manufacturers mark or symbol
- The grade of the chain sling
- The number of legs
- (The nominal size of the chain may be marked if required as an option)

Alternative Method of Rating

Warning: **A master link designed for use in a chain sling rated by the uniform load method may not be suitable for a chain sling rated by the alternative method.**

For 2 leg chain slings used at an angle to the vertical, the working load limit shall be given by the formula:

$$WLL = 2 \times WLL \text{ for a single leg} \times \cos\beta$$

(β = angle to the vertical/beta angle)

EXAMPLE:

16mm chain sling with 2 legs to be rated at 30° using the alternative method of rating

WLL = 2 x WLL of 16mm Chain x cosine 30°

WLL = 2 x 8 x 0.866 = 13.85t

As you can see from this example, a master link fitted to a uniform load rated sling may only be rated at 11.2t, which would not be strong enough for the alternative method of rating.

For 3 and 4 leg chain slings used at an angle β to the vertical, the working load limit shall be given by the formula:

$$WLL = 3 \times WLL \text{ for a single leg} \times \cos\beta$$

EXAMPLE:

16mm chain sling with 3 legs to be rated at 30° utilising the alternative method of rating

WLL = 3 x WLL of 16mm Chain x cosine 30°

WLL = 3 x 8 x 0.866 = 20.78t

As you can see from this example, a master link fitted to a uniform load rated sling may only be rated at 17t which would not be strong enough for the alternative method of rating.

Warning: For a 4 leg sling, if proper measures are taken to achieve the equal distribution of the load between each leg, all 4 legs can be considered as supporting the load. The rating of a 4 leg chain sling may, in such circumstances, be based on the formula:

$$WLL = 4 \times WLL \text{ of a single leg} \times \cos\text{ine}_{\beta}$$

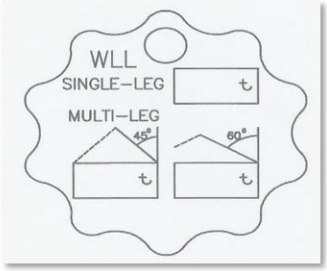
This would be a very dangerous practice to carry out as the equal sharing of the load cannot always be guaranteed.

Marking Requirements

The information specified shall be either marked on a metal tag attached to the master link or to a link immediately adjacent to it or all or part of the information marked on the master link provided that the mechanical properties of the link are not impaired.

- The working load limit and the angle at which rated
- The individual identification mark (related to the manufacturers certificate)
- The manufacturers mark or symbol
- The grade of the chain sling
- The number of legs
- (The nominal size of the chain may be marked if required as an option)

For the purposes of identification of chain slings, tags shall be affixed to the slings having the information legibly and permanently embossed or stamped.



Notes:

BS EN 818-6

This part of BS EN 818 specifies the information on use and maintenance to be provided by the manufacturer with chain slings conforming to BS EN 818-4 and BS EN 818–5.

Definitions

Inspection
A visual check on the condition of the chain sling to identify obvious damage or deterioration which might affect its fitness for use.

Thorough Examination
A visual examination carried out by a Competent Person, and where necessary, supplemented by other means, such as non-destructive testing, in order to detect damage or deterioration which might affect the fitness for use of the chain sling.

High and Low Temperature Conditions

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

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

Grade	Working Load Expressed as a Percentage of WLL				
	Temperature (°C)				
	-40 to 200	200 to 300	300 to 400	400 to 475	Above 475
4	100	100	75	50	Not Allowed
8	100	90	75	Not Allowed	

Acidic Conditions

Chain slings of grade 8 should not be used either immersed in acid solutions or exposed to acid fumes. This is due to the possibility of the chain sling suffering from hydrogen embrittlement. Where production processes involve acidic solutions and fumes, seek the manufacturer's advice.

For further information about this, refer to Hydrogen Cracking of Grade T and Grate 8 Chain and Components found on www.hse.gov.uk.

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

Chain slings of grade 4 may be used in acidic conditions.

The following precautions should be adopted:

- The working load of such a chain should not be greater than 50% of the working load limit
- The chain sling should be thoroughly washed in clean water immediately after use
- The chain sling should be given an inspection by a competent person each day before use

Consult the manufacturer of the chain sling if the chain sling is to be exposed to highly concentrated chemicals combined with high temperatures.

Use in Exceptionally Hazardous Conditions

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

Pre-Use Inspection

Before first use of the chain sling ensure that:

- The chain sling is precisely as ordered
- The manufacturers certificate is to hand
- The identification and WLL marking on the chain sling correspond to the information on the certificate
- Full details of the sling are recorded

Inspect the chain sling before each use for obvious damage or deterioration. If this is found, withdraw the chain sling from service and refer to a Competent Person for a more thorough examination.

Notes:

9. STEEL WIRE ROPE SLINGS

Applicable Standards and References

BS EN 12385 Parts 1 - 4 – Steel Wire ropes – General Requirements, Definitions, Information for use and Maintenance and Stranded ropes for General Lifting Application

BS EN 13411 – Terminations for steel wire rope and ferrule secured eyes

BS EN 13414 Parts 1 and 2 – Steel wire rope slings and information for use and maintenance

BS EN 1677 – Components for slings

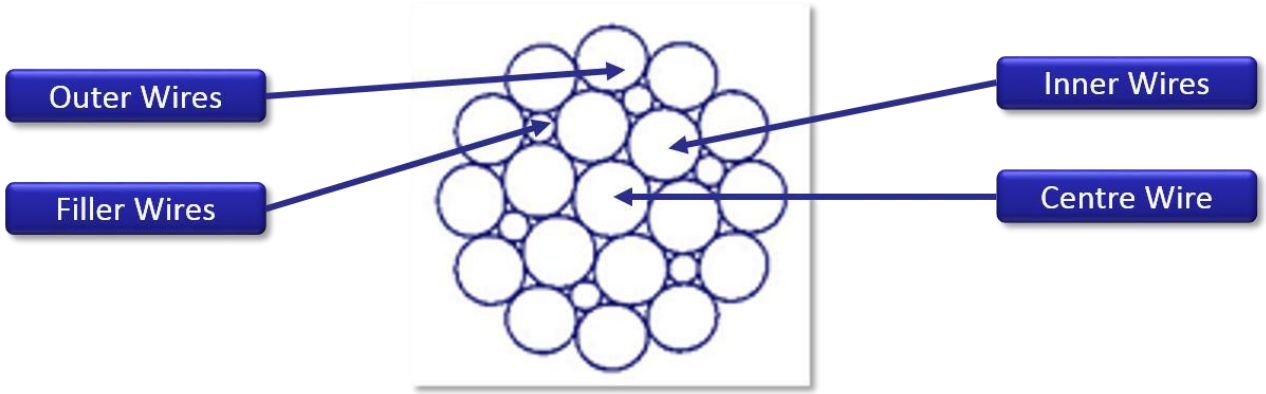
Definitions

Outer wires: all wires positioned in the outer layer of a spiral rope or in the outer layer of wires in the outer strands of a stranded rope.

Inner wires: all wires of intermediate layers positioned between the centre wire and outer layer of wires in a spiral rope or all other wires except centre, filler and outer wires in a stranded rope.

Filler wires: wires used in filler construction to fill up the gaps in between the layers.

Centre wires: wires positioned at the centre of a spiral rope or the centres of strands of a stranded rope.



Notes:

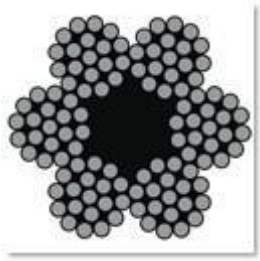
Diameter and Constructions

The nominal diameter of round ropes shall be given in millimetres.

The construction of a rope shall be given as:

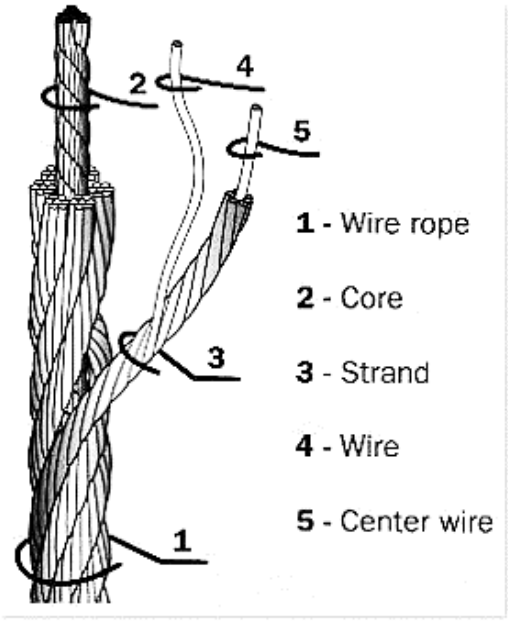
Number of outer strands x Number of wires

e.g. 6 x 19 construction –



This shows that the wire rope construction is of 6 outer strands with each outer strand made up of 19 wires.

Elements of a Wire Rope

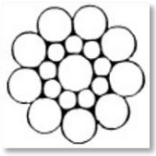


Notes:

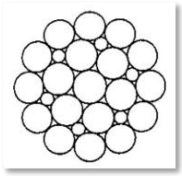
Strand Construction

The three basic methods of laying up a strand:-

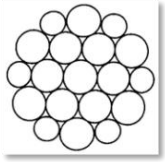
Seale Construction



Filler Construction



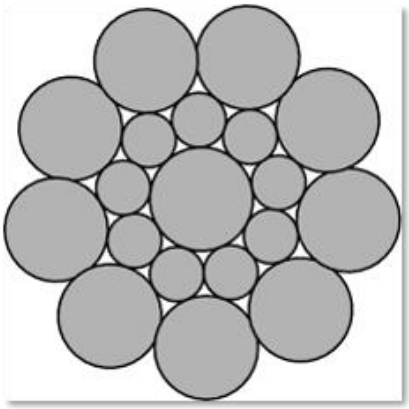
Warrington Construction



Seale Construction

This is a parallel lay strand with the same number of wires in both layers. In the example shown below, the construction consists of:

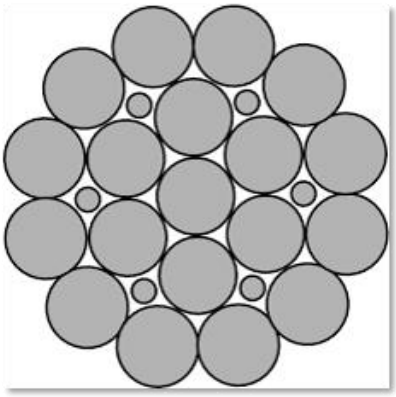
- 1 x centre wire
- 9 x inner wires
- 9 x outer wires



Filler Construction

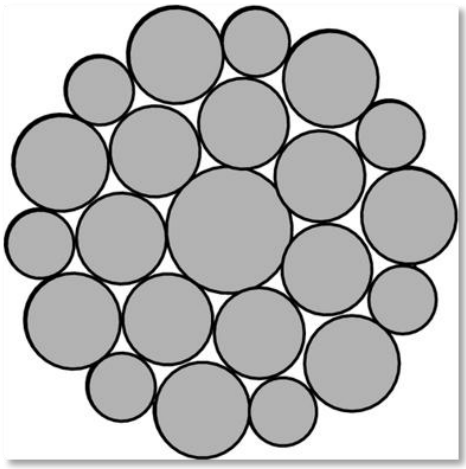
A parallel lay strand having an outer layer containing twice the number of wires than the inner layers with filler wires in the valleys between the layers. In the example shown below, the construction consists of:

- 1 x centre wire
- 6 x inner wires
- 6 x filler wires
- 12 x outer wires



Warrington Construction
A parallel lay strand having an outer layer containing alternately large and small wires. In the example shown below, the construction consists of:

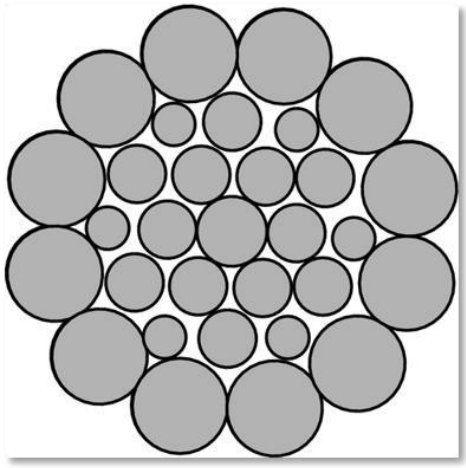
- 1 x centre wire
- 7 x inner wires
- 14 (7 large and 7 small) x outer wires



Combined Construction
A parallel lay strand having three or more layers laid in one operation and formed from a combination of the previous strand types.

In the example shown below, the Warrington Seale construction consists of:

- 1 x centre wire
- 6 x inner wires
- 12 warrington wires
- 12 x outer wires

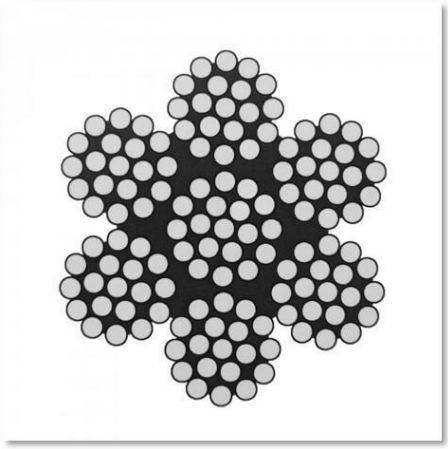


Notes:

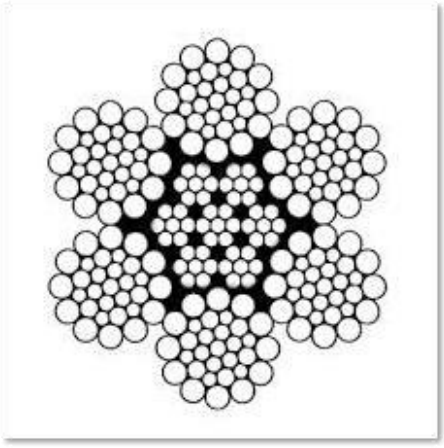
Core Types

Fibre core (FC)
This type of core is made from either natural fibres or synthetic fibres.

Wire Stranded Core (WSC)
This type of core can be either one single wire as the core or more typically the core construction the same as the outer strands.



Independent Wire Rope Core (IWRC)
This type of core is actually made up of a core and strands so is actually a rope that is utilised as the core. (Ropes over 12mm diameter shall have IWRC).



Grades of Rope

Wire Tensile Strength/Grade

The grade of the wire rope based upon the tensile strength of the wires in N/mm².

Rope Grade	Wire Tensile Strength Grade	
	Minimum	Maximum
1770	1570	1960
1960	1770	2160
2160	1960	2160

Note: Rope Grade 2160 is not covered by European Standards.

Rope Finish

Coatings and plating are added to wire to provide protection such as galvanising (a surface coat of zinc is given to the wire).

This coating will resist oxidisation which will improve the corrosion resistance of the wire rope. It is also softer than the steel from which the wire is made which can act as a bearing surface and increase the ropes wear resistance.

BS EN 12385 uses the symbol 'U' to denote uncoated or bright finish.

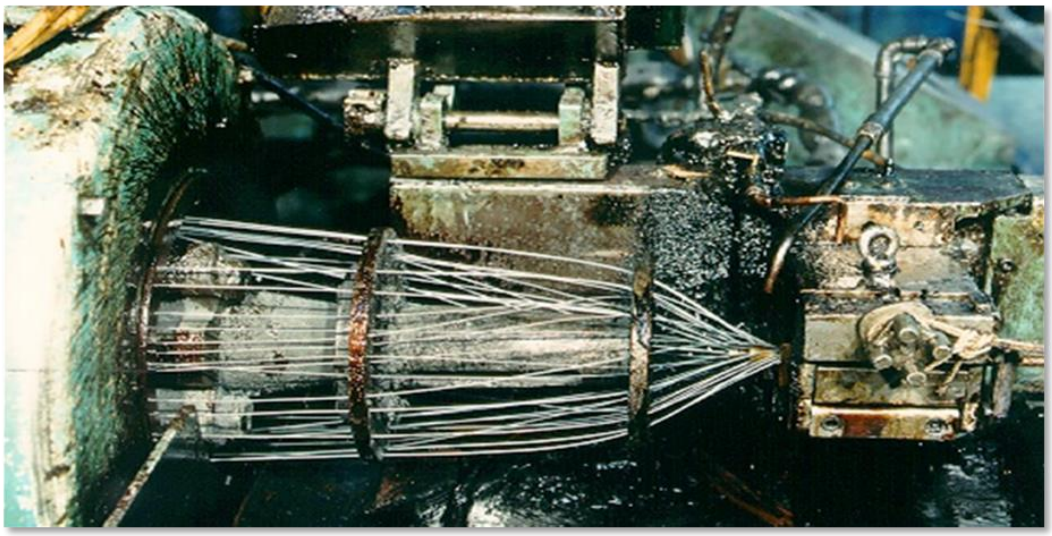
For zinc coating the symbol will depend on the class of the coated finish:

- Class B zinc coating is designated 'B'
- Class A zinc coating is designated 'A'

Notes:

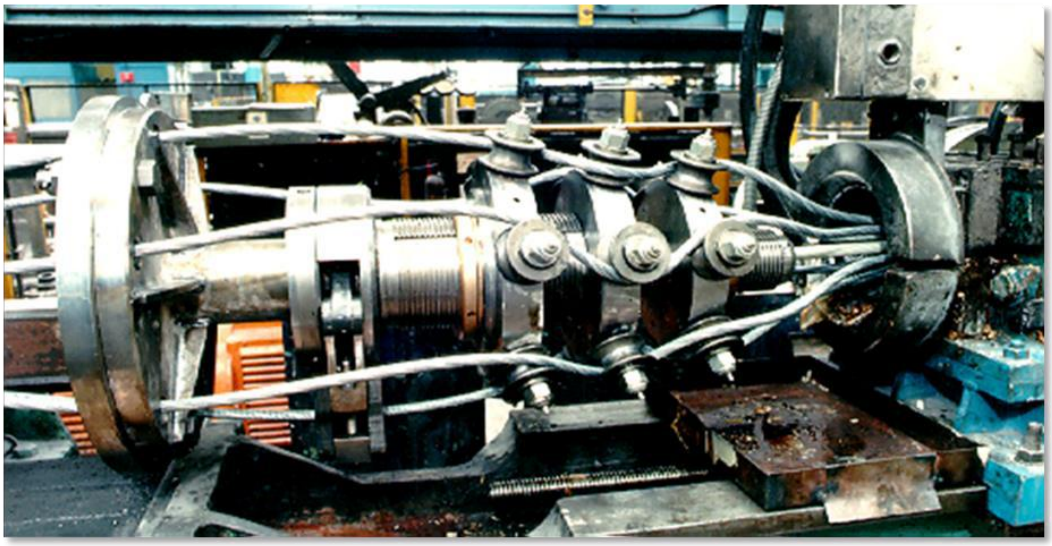
Stranding

The stranding operation takes place when all the wires are brought together at the forming point. The wires during this and the closing operation are spun into the correct helical shape; this process is called preforming. Preforming reduces the internal stresses in the strands and the rope so that if the wires and strands are cut, they do not spring out of the rope formation.



Pre-Forming and Closing

During this operation, the strands are now brought together at the forming point around the specified core to make the rope.



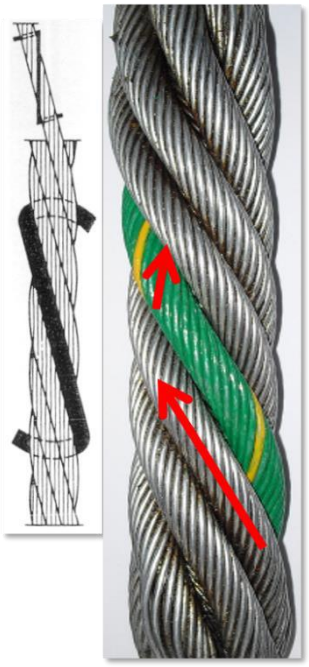
Rope Lay

Rope lay refers to the way in which the wires are laid when forming the strands and the way in which the strands are laid when forming the rope.

There are 2 types of lay- ordinary (regular) lay and lang's lay.

Ordinary lay: the wires that make up the strand and the strands that make up the rope are laid in opposite directions. When formed, this gives the impression that the wires are running the length of the wire rope.

Lang's lay: the wires that make up the strand are laid in the same direction as the strands in the rope. When formed the wires quite clearly run across the diameter of the rope. Due to the tendency of the rope to unwind, Lang's lay ropes are not suitable for wire rope slings.

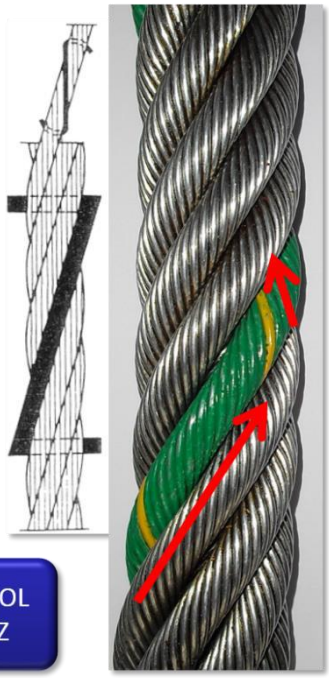


Ordinary Lay

Wires in the strands are laid in the opposite direction of lay to the strands in the rope.

The lower case letter indicates the direction of the wires and the capital letter, the direction of the strands.

Note: Ordinary Lay ropes will be letter designated with different letters.



LHOL
zS

RHOL
sZ

Rope Details and Designation

BS EN 12385-2 requires the designation to be made up of the six pieces* of information indicated below:

- Nominal diameter of rope*
- Construction of rope*
- Type of core*
- Grade of rope*
- Wire finish*
- Direction of lay and type of lay*

A typical rope designation would read:
22 6x36 – FC 1770 U sZ

Rather than:
22mm Diameter rope with a 6 strand of 36 wire construction with a fibre core having a tensile strength of 1770N/mm² with no galvanising and right hand ordinary lay.

Sling Terminations

Protective thimbles are very often inserted into a sling termination during manufacture to protect the eye from the effects of abrasion and point loading.

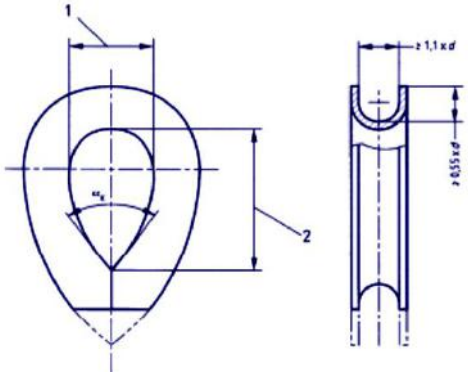
The heart (teardrop) shaped thimble is used to attach to other fitting such as master links and hooks.

The reeving thimble is used to allow the passage of one eye through the other so that the sling may be used in choke hitch.

Thimbles of any size shall comply with the following dimensions:

- 2.5 – 3.5 x nominal rope diameter
- 1.5 – 2 x dimension 1

Thimbles shall be visually inspected for surface defects liable to damage the rope or injure the user.



The ferrule is to be positioned so that after pressing, the rope protrudes from the base of the ferrule. In the case of ropes cut by a heat process this protrusion can be up to a maximum of 1x ropes diameter and in the case of all other methods of cutting ropes a maximum of ½ x rope diameter.

Ferrules are made from different materials for different types of rope.

There are different shapes of ferrules for the different types of termination.

The standard, BS EN 13414-1 recognises the differing methods of terminating a wire rope, but gives the same termination efficiency for all ferrule secured terminations of 90%.

Notes:

Turned Back Eye

When a thimble is fitted, the size and shape of the correctly sized thimble will dictate the length and width of the eye.

Typically after pressing the clearance between the base of the thimble and the ferrule should be approximately 1.5 times the nominal rope diameter for a thimble without a point, and 1 times the nominal diameter for a thimble with a point unless specified otherwise by a Competent Person.

Note: Upper eyes shall always be fitted with thimbles, and if lower terminal fittings are used, the eyes shall always be fitted with thimbles.

Flemish Eye

The outer strands of the rope shall be divided into two equal groups. The core shall be assigned to one of these groups. The length of rope divided shall depend on the size of eye to be formed. Both groups of strands shall then be re-laid together in opposing directions.

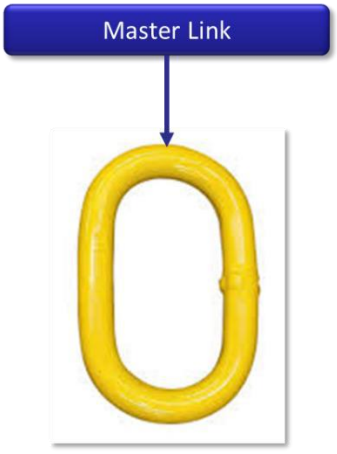
Notes:

Wire Rope Sling Definitions

Steel Wire Rope Sling for General Lifting Service
Assembly of components which includes one or more single part legs or an endless sling which is intended for a variety of lifting operations and not designed for one specific lifting application.

Terminal Fittings
Link, link assembly, hook or other device permanently fitted at the upper or lower end of a sling and intended to connect the sling to the load or the lifting machine.

Master Link/Intermediate Assembly
Link forming the upper terminal of a sling by means of which the sling is attached to the hook of a crane or other lifting machine.



Intermediate Master Link
Link used to connect one or two legs of a sling to a master link.

Note: Intermediate links can be assembled with a master link to form a permanent master link assembly.

BS EN 13414-1 states that in a three-leg sling, two of the legs shall be joined by a single intermediate master link to the master link, the third leg shall be connected via a second intermediate master link. In a four-leg sling each of the two pairs shall be joined by an intermediate master link to the master link.

Be aware that some global standards do not have this requirement and you can find a single master link with all 3 or 4 legs attached.

Uniform Load Rating of a Wire Rope Sling
It has been common practice in the past to calculate the working load limit of a multi-leg sling by reference to either prepared tables or basic mathematics, taking account of the angle to the vertical for each leg of the sling. The WLL of a sling rated by this method is a variable dependent on the angle to the vertical of each leg so that as the angle increases, the working load limit of the sling decreases.

The method of rating slings for general service used in BS EN 13414-1 removes the need for calculation or the use of tables since the sling has a fixed working load limit for a given range of angles. The working load limit of the sling does not increase as the angle to the vertical decreases. So, a sling has a fixed working load limit at all angles between 0° and 45° and the same sling has a lesser working load limit at all angles between 45° and 60°.

Since the upper terminal of the sling assembly, e.g. a master link, will have been selected to match the stated working load limit 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.

For uncommon rope sizes, the WLL of slings is calculated using the following formulas.

Notes:

Working Load Limit of a Wire Rope Sling

Working Load Limit (WLL) of a Single Leg Sling
This is the maximum mass which a sling is authorised to sustain in general service.

The WLL in tonnes, as defined above for a single-leg sling is calculated as follows:

$$\mathbf{WLL = \frac{Fmin\ x\ KT}{Zp\ x\ g}}$$

Where:

- 'Fmin' is the breaking force of the rope in kilonewtons
- 'KT' is a factor which allows for the termination. For ferrule secured terminations this factor is 0.9 and for spliced terminations this factor is 0.8
- 'Zp' is the Working Coefficient and has the value 5
- 'g' is the factor relating mass to the force and has the value 9.806 65

Values of working load limits for the more common rope sizes in grade 1770 shall be in accordance with the values shown in the tables in BS EN 13414-1.

Working Load Limit (WLL) of a Multi-Leg Sling
The WLL in tonnes, for a multi-leg sling shall be calculated as follows:

$$\mathbf{WLL = \frac{Fmin\ x\ KT\ x\ KL}{Zp\ x\ g}}$$

Where:

- 'Fmin' is the breaking force of the rope in kilonewtons
- 'KT'is a factor which allows for the termination. For ferrule secured terminations this factor is 0.9 and for spliced terminations this factor is 0.8
- 'KL' is the leg factor, which for 2 leg slings from 0°-45° is 1.4 and 45°-60° is 1.0. For 3 and 4 leg slings from 0°-45° is 2.1 and 45°-60° is 1.5
- 'Zp'is the Working Coefficient and has the value 5
- 'g'is the factor relating mass to the force and has the value 9.806 65

Values of working load limits for the more common rope sizes in grade 1770 shall be in accordance with the values shown in the tables in BS EN 13414 -1

Note: The WLL of a 4 leg sling is calculated assuming that one leg is redundant.

Notes:

Safety Requirements

Grade of Rope
The rope grade shall be either 1770 or 1960.

Ferrule-Secured Eye Slings
Ferrule secured eyes shall conform to BS EN 13411-3.

The minimum length of plain rope between the inside ends of ferrules terminating a sling leg shall be 20 times the nominal rope diameter.

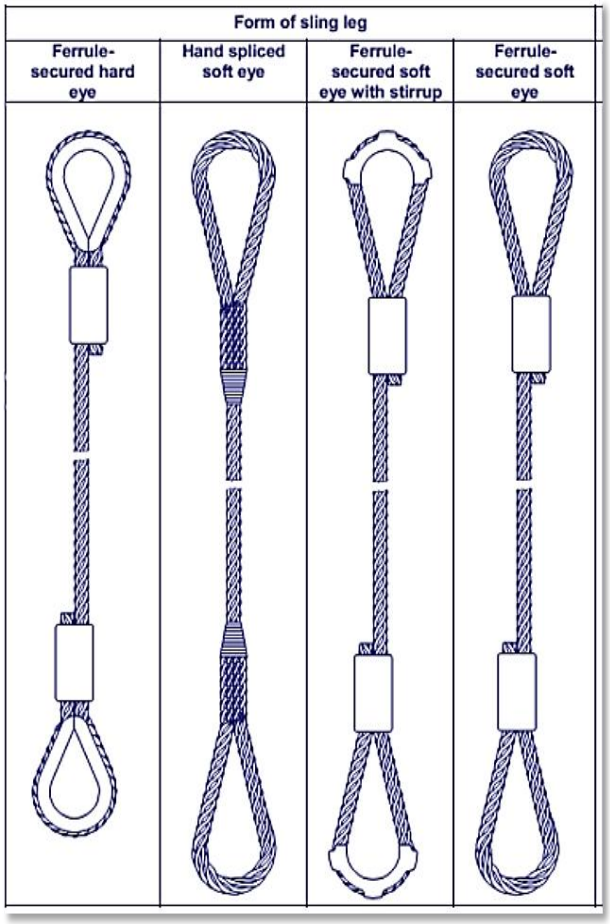
Terminal Fittings
The working load limit of any master link shall be at least equal to that of the sling.

The working load limit of any intermediate link fitted to a three-leg or four-leg sling shall be at least equal to 1.6 times the WLL of one of the legs suspended from it.

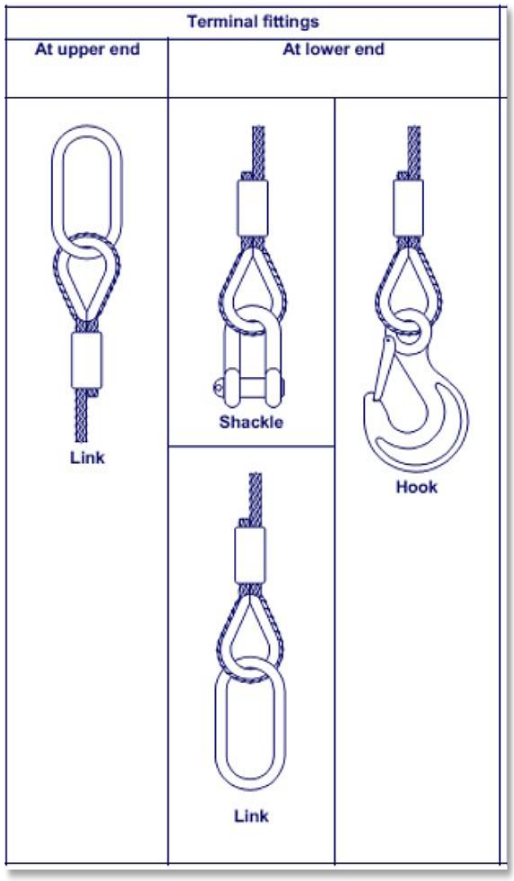
The working load limit of the lower terminal fitting(s) shall be at least equal to that of the leg(s) to which it is/they are fitted.

Single Leg Slings

Single-leg slings shall be one of the types shown in the table below, with or without terminal fittings such as links or hooks.



Where a terminal fitting is used, the eye termination shall always be fitted with a thimble.



Length
The length is measured between the bearing points of the sling.

The measured length of a ferrule-secured sling shall not differ from the nominal length by more than two rope diameters or 1% of the nominal length, whichever is greater.

Bearing to Bearing Measurement

Notes:

Length of Matched Sets
Where single leg slings are intended to be used as matched sets, the difference in length of matched sets of ferrule-secured eye slings shall not exceed the rope diameter, or 0.5% of the nominal length, whichever is greater.

Multi-Leg Sling

Length
The length is measured between the bearing points of the sling.

The measured individual leg lengths shall not differ from the nominal length of the sling by more than two rope diameters or 1% of the nominal length, whichever is greater.

The difference in length between the individual legs of any multi-leg sling under no load shall not exceed 1.5 times the rope diameter or 0.5% of the nominal length, whichever is greater.

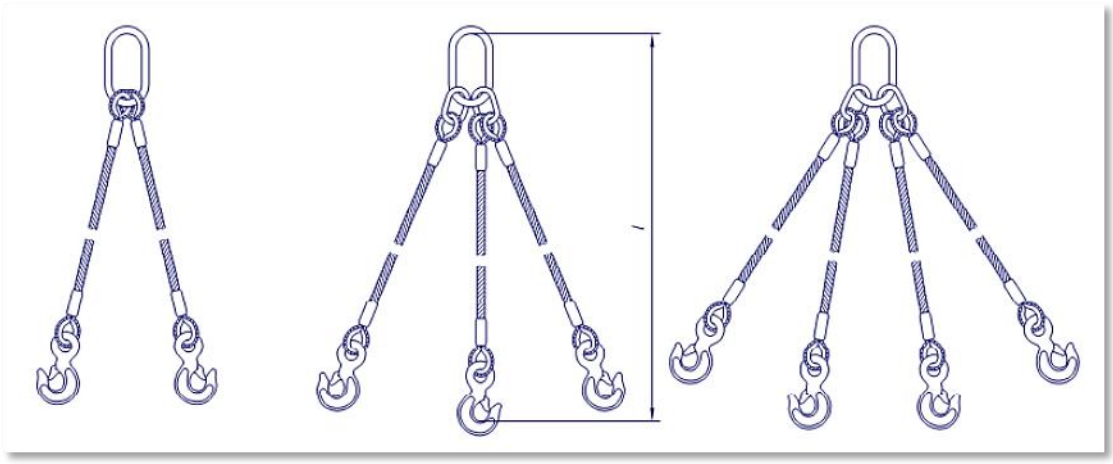
Length of Matched Sets
The difference in lengths of matched sets of ferrule-secured eye slings shall not exceed the rope diameter, or 0.5% of the nominal lengths, whichever are greater.

Formation of Sling
The rope size type and grade for each leg shall be the same.

The legs of two-leg slings shall be joined at their upper ends by a master link.

In a three-leg sling, two of the legs shall be joined by a single intermediate master link to the master link; the third leg shall be connected via a second intermediate master link. In a four-leg sling each of the two pairs shall be joined by an intermediate master link to the master link.

Upper eyes shall always be fitted with thimbles, and if lower terminal fittings are used, the eyes shall always be fitted with thimbles. Thimbles shall conform to EN 13411-1.



As mentioned previously, some global standards allow all the legs of a 3 or 4 leg sling to be joined by a single master link. Before rejecting such slings, refer to the certification of the sling to verify the standard.

Example WLL for slings using steel core d rope in grade 1770 and having ferrule-secured eye terminations.

	1 Leg Sling	2 Leg Sling		3/4 Leg Sling		Endless Sling
Angle to the Vertical	0°	0-45°	45-60°	0-45°	45-60°	0°
						
	Direct	Direct		Direct		Choke
Nominal Diameter	**WLL (t)**					
8	0.75	1.05	0.75	1.55	1.1	1.2
9	0.95	1.3	0.95	2.0	1.4	1.5
10	1.15	1.6	1.15	2.4	1.7	1.85
11	1.4	2.0	1.4	3.0	2.12	2.25
12	1.7	2.3	1.7	3.55	2.5	2.7

	1 Leg Sling	2 Leg Sling		3/4 Leg Sling		Endless Sling
Angle to the Vertical	0°	0-45°	45-60°	0-45°	45-60°	0°
						
	Direct	Direct		Direct		Choke
Nominal Diameter	**WLL (t)**					
22	5.65	7.8	5.65	11.8	8.4	9.0
24	6.7	9.4	6.7	14.0	10.0	10.6
26	7.8	11.0	7.8	16.5	11.5	12.5
28	9.0	12.5	9.0	19.0	13.5	14.5
32	11.8	16.5	11.8	25.0	17.5	19.0

Notes:

Verification of Wire Rope Slings

Components of the Wire Rope Sling
The suppliers records shall be used to confirm that the verification clauses of BS EN 12385-1, BS EN 1677 Parts 1 to 6, BS EN 13411-2 and BS EN 13411-3 have been satisfied for the wire rope, hooks and links, and spliced and or ferrule secured terminations from which the sling is formed.

Rope Construction
The supplier's records shall be used to verify the rope construction, diameter and grade of rope used.

Length of the Sling
The length of a single leg sling and the length of the individual legs of multi-leg slings shall be measured without load and with the widths of soft eyes being approximately half their length.

WLL of Terminal Fittings
The supplier's records shall be used to verify the WLL of terminal fittings used in the construction of the sling.

Formation of a Multi-Leg Sling
The requirements of the Standard shall be confirmed by visual inspection.

Marking Requirements

General
Each sling shall be legibly and durably marked with the information listed:

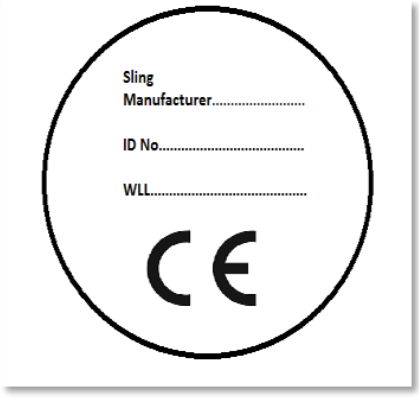
Single-Leg Sling (single part or endless)

- The sling manufacturer's identifying mark
- Numbers and/or letters identifying the sling with the certificate conforming to the certification of the sling
- The working load limit
- Any legal marking

Multi-Leg Sling

- The sling manufacturer's identifying mark
- Number and/or letters identifying the sling with the certificate conforming to the sling certification
- The working load limits and the angles applicable, i.e. the WLL 0° to 45° to vertical and, additionally, the WLL 45° to 60° to the vertical if applicable
- Any legal marking

Note: Within the European Union this means CE marking.



Certification Requirements

A certificate shall be supplied with each sling or batch of slings. This shall identify the sling with the certificate and include a statement that the sling conforms to BS EN 13414-1.

The certificate shall contain at least the following information:

- The name and address of the manufacturer or, where applicable, the authorized representative
- The number and part of this European Standard i.e. BS EN 13414-1
- The description of the sling including all component parts
- The WLL and the appropriate angle(s) to the vertical for multi-leg slings
- The static test coefficient(s) used for design of component(s) (e.g. hook; link; shackle)

Use in Adverse Conditions

High and Low Temperatures

Take account of the maximum temperature that can be reached by the wire rope sling in service. This is difficult in practice but avoid underestimating the temperature.

Termination Type	Ferrule Material	Rope Core	De-Rating as % of WLL					
			Temperature (°C)					
			-40≥100	100≥150	150≥200	200≥300	300≥400	≥400
Turn Back	Aluminium	Fibre	100	N/A	N/A	N/A	N/A	N/A
Turn Back	Aluminium	Steel	100	100	N/A	N/A	N/A	N/A
Flemish Eye	Steel	Fibre	100	N/A	N/A	N/A	N/A	N/A
Flemish Eye	Steel	Steel	100	100	90	75	65	N/A
Spliced	-	Fibre	100	N/A	N/A	N/A	N/A	N/A
Spliced	-	Steel	100	100	90	75	65	N/A

Acidic Conditions

Wire rope slings should not be used immersed in acidic solutions or exposed to acid fumes. Seek the manufacturer's advice where production processes involve acidic solutions, fumes and sprays.

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

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

Use in Hazardous Conditions

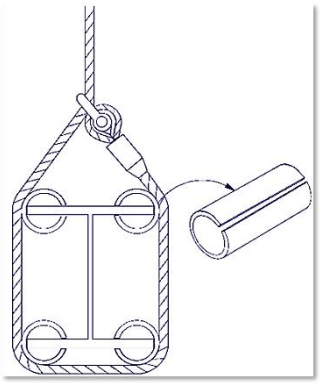
The rating of slings for general lifting service excludes hazardous conditions including offshore activities, the lifting of persons and lifting of potentially dangerous loads such as molten metals, corrosive materials or fissile materials.

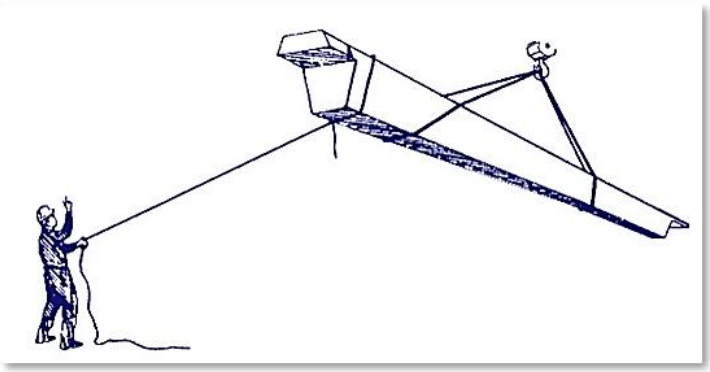
For these circumstances, the degree of hazard should be assessed by a competent person and the working load limit adjusted accordingly.

Safe Use of Wire Rope Slings

Packing may be required where a rope has contact with a load to protect the rope and/or the load. Sharp corners of hard material may bend or damage the rope. Conversely, the rope may damage the load because of high contact pressure. Use corner protection to prevent such damage.

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





When loads are accelerated or decelerated suddenly, dynamic forces occur which increase the stresses in the rope. This is due to snatch or shock loading, e.g. from not taking up the slack rope before starting to lift, and should be avoided.

Mass of the Load

It is essential that the mass of the load to be lifted is known.

Angles for Multi-Leg Slings

When using two-leg, three-leg and four-leg wire rope slings, the attachment points and sling configuration should be selected to achieve angles between the sling legs and the vertical within the range marked on the sling.

Preferably all angles to the vertical should be equal. Angles to the vertical of less than 15° should be avoided if possible as they present a significantly greater risk of load imbalance.

All multi-leg slings exert a horizontal component of force which increases as the angle between the sling legs is increased. Always ensure that the load to be moved is able to resist the horizontal component of force without being damaged.

Notes:

Method of Connection

A wire rope sling is usually attached to the load and the lifting machine by terminal fittings. Sling legs should not be twisted or knotted. The lifting point should be seated well down in a hook, never on the point or wedged in the opening. The sling hook should be free to incline in any direction to avoid bending. For the same reason, the terminal fitting should be free to incline in any direction on the hook to which it is fitted.

The rope may be passed under or through the load to form a choke hitch or basket hitch. When using basket hitch method and where it is necessary to use more than one sling due to the danger of the load tilting, this should preferably be done in conjunction with a lifting beam having two upper connections to the crane hook.

When a wire rope sling is used in a choke hitch, allow the rope to assume its natural angle and do not hammer it down.

When attaching the sling to the lifting hook, ensure that there is adequate clearance to permit articulation and to prevent damage to the sling. Never force, hammer or wedge a sling into position. If there is insufficient clearance, fit a shackle between the sling and the hook.

To prevent the formation of kinks and subsequent weakening of the rope where slings have soft eye terminations, ensure that the effective diameter of the shackle pin/hook is at least twice the diameter of the rope.

For a multi-leg sling, the tip of a sling hook should be directed outwards. No rope should be wrapped around a crane hook.

Choke Hitch

With a choke hitch, sling legs are passed through or under the load and the lower terminal back hooked or reeved onto the rope.

A single-leg sling may be used in a double choke hitch.

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

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

Basket Hitch

There are two methods of forming a basket hitch:

1. Passing a single sling through a load
2. Wrapping two slings around the load.

The second method is not suitable where the slings are able to move towards each other when the load is lifted or when lifting loads which are not held together such as loose bundles; a choke hitch is preferred.

Multi-leg wire rope slings with less than the full number of legs in use

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

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

Types of Sling	Number of Legs	Factor to Apply to Marked WLL
2 Leg	1	1/2
3 and 4 Leg	2	2/3
3 and 4 Leg	1	1/3

Storage of Wire Rope Slings

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

If the wire rope slings are to be 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.

Inspection

General

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

Before each use, inspect the sling for obvious signs of deterioration.
If there is reason to doubt the safe condition of the sling, withdraw it from service and carry out a thorough examination.

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

An inspection is a visual check on the condition of the sling to identify any obvious damage or deterioration that might affect its fitness for use.

The sling should be withdrawn from service and referred to a Competent Person for thorough examination if any of the following is observed before each use:

- Illegible sling markings, i.e. sling identification and/or working load limit
- Wear, distortion and/or cracking of the upper or lower terminals and/or ferrules
- Concentration(s) of broken wires
- Severe rope distortion, such as kinks or protrusion of the core
- Significant rope wear
- Corrosion
- Heat damage

Maintenance

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.

Notes:

Notes:

10. SHACKLES

Shackles are probably the most common and universal lifting accessory; their uses are extensive. They may be used to connect a load directly to a lifting appliance, for the connection of slings to the load and/or lifting appliance, as the suspension for lifting appliances or as the head fitting in certain types of pulley blocks.

The LEEA Code of Practice for the Safe Use of Lifting Equipment, Section 19, deals with shackles and you should refer to this as part of your studies.

Although the old British Standards BS 3032, BS 3551 and BS 6994 have been withdrawn and/or declared obsolete for several years, overseas manufacturers and their importing agents still make shackles generally to BS 3032 available. **The current Harmonised European Standard for forged steel shackles for general lifting purposes is BS EN 13889:2003, which is a standard for Dee and Bow shackles grade 6.**

There is an increasing popularity of shackles to US Federal specifications, RRC 271 and ISO 2415 – Forged shackles for general lifting purposes. ISO 2415 specifies the general characteristics of forged dee and bow shackles in a range of sizes having working load limits of from 0,32t to 100t and in grades 4, 6 and 8, and presents their performance and critical dimensions necessary for their interchangeability and compatibility with other components.

Shackle Manufacture

Shackles are produced by forging.

US Federal specification and similar shackles are usually drop forged; this can be easily identified by the flash line around the body.

Old British standard shackles were bent from billet bar so there would be no flash line.

In either case, the body of the shackle must be in a single piece and there should be no welding.

Harmonised Standard BS EN 13889: 2003 allows for both methods, it says:

"Shackle bodies shall be forged hot in one piece. Excess metal from the forging operation shall be cleanly removed leaving the surface free from sharp edges. After heat treatment, furnace scale shall be removed.

Profiling of blanks other than by bending and forging shall not be used.

Shackle pins shall not be produced by a casting process.

No welding shall be carried out on any part of the shackle body or pin."

Heat Treatment
After forging, but prior to machining and finishing, shackles are hardened and tempered.

Finish
Shackles are supplied in various surface finishes, depending on the standard to which they are made and BS EN 13889 permits many of these, e.g. descaled, electroplated, hot dip galvanised or painted.

Notes:

Types of Shackle Body and Pin

There are two types of shackle pin in common use:

1. **Screw pin**
2. **Bolt, nut and cotter pin**.

Whilst BS EN 13889 specifies and gives relative dimensions of the above pins it also permits other suitable forms of pin head within the specification.

Screwed pins with eye and collar are the most common type of pin and are suitable for a wide range of uses, however, if they are subject to movement and vibration, e.g. by a sling moving over the pin, they can loosen and unscrew.

The bolt with hexagon head, hexagon nut and split cotter pin is used where a positive connection is required as it cannot unscrew unintentionally. They are also ideal where a permanent connection is required, e.g. connecting the top slings to a spreader beam.

Screw Pin

Bolt, Nut and Pin

Bow shackles are designed to enable three or more items to be joined.

Dee shackles are generally used for joining two items in a straight line.

Shackle Marking

BS EN 13889 requires that each shackle is legibly and indelibly marked with the following information, by the manufacturer:

- Working Load Limit in tonnes
- Grade mark
- Manufacturer's name, symbol or code
- Traceability code
- CE Marking

BS EN 13889 requires that pins of less than 13mm diameter are marked with either:

- Grade mark
- Traceability code

Pins greater than 13mm diameter are marked with:

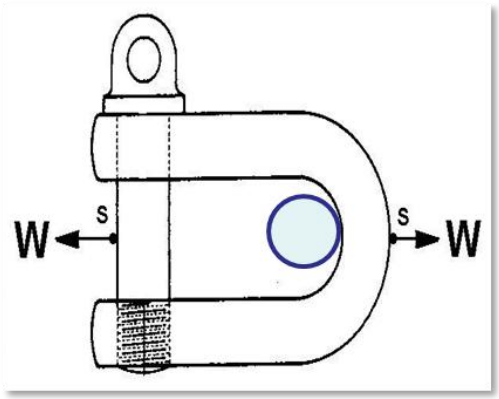
- Grade mark
- Traceability code
- Manufacturer's symbol

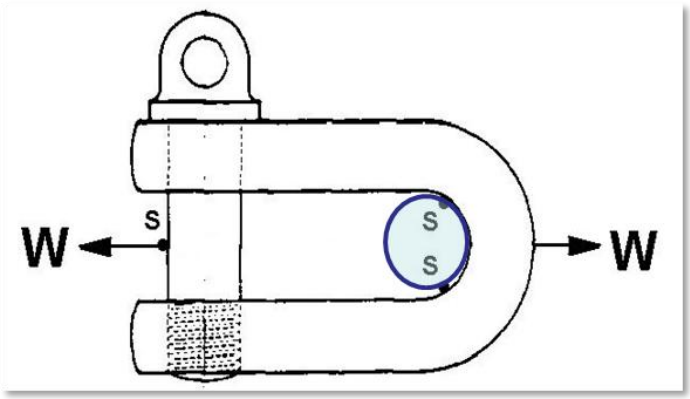
Stress in Shackles

A shackle is designed so that the strength of body and pin are approximately equal, this is due to the pin being larger in diameter than the body. The pin acts as a beam and if subject to a point load, it will be both in a condition of bending and of double shear.

If the jaw is fully filled (load spread evenly over the full width of the pin) it will only be in double shear. For a point load, the maximum tensile stress occurs at the centre on the outward facing side of the pin.

Dependent on the proportions of the shackle body, the maximum stress may occur either at the outside on the crown of the body or at the inside of the sides of the body as shown.





Manufacturer's Tests

Type Tests

To prove the design, material, heat treatment, method of manufacture, and to ensure that the shackles possess the necessary mechanical properties, BS EN 13889 requires that the manufacturer makes certain type tests. The type tests have to be repeated if there is any change of design, specification of material, heat treatment or method of manufacture.

The type tests to be made are:

- Test for deformation on three samples
- Static tensile test on at least three samples
- Fatigue test on three samples
- Charpy impact test on test pieces taken from at least three samples

Manufacturers with an accredited EN ISO 9001 certification

If the manufacturer has a quality system conforming to EN ISO 9001 certified by a certification body accredited to EN 45012 the following tests and examinations must be made:

Proof Load Test
If the production batch is between 1 and 3000 off, they must proof load test 3% of the batch. This decreases to 2% for batches of 3001 to 5000 and to 1% for batches of more than 5000. A manufacturer may elect to operate an alternative test regime of 2% of all production, irrespective of the size of the batches. The proof load applied is twice the WLL.

Non-Destructive Test
After heat treatment and de-scaling, all bodies and pins must be subjected to magnetic particle or dye penetrant examination.

Visual Examination
All shackles must be visually examined. The examination can be carried out on the completed shackles or in stages during the production provided that all relevant features are examined.

Manufacturers without an accredited EN ISO 9001 certification

If the manufacturer does not have a quality system conforming to EN ISO 9001 certified by a certification body accredited to EN 45012, the following tests and examinations must be made:

Proof Load Test
All of the production batch must be proof load tested to twice the WLL.

Static Test and Charpy Impact Test
One sample per production batch must be subjected to a static test and three samples must be subjected to a charpy impact test.

Non-Destructive Test
After heat treatment and de-scaling, all bodies and pins must be subjected to magnetic particle or dye penetrant examination.

Visual Examination
All shackles must be visually examined. The examination can be carried out on the completed shackles or in stages during the production provided that all relevant features are examined.

Use of Shackles

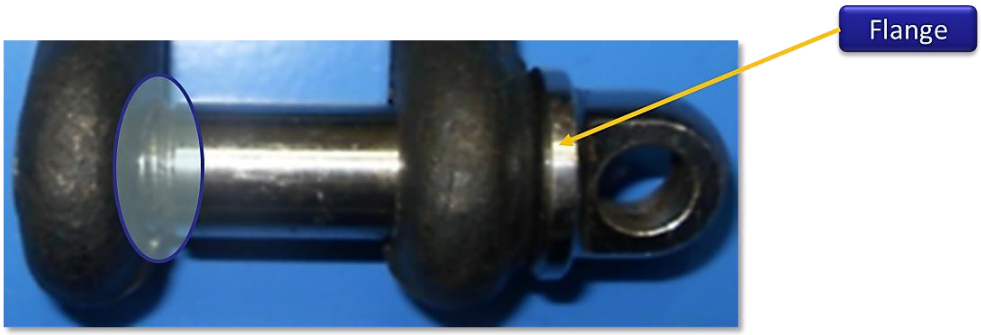
The correct shackle body and pin must be used and they must be of the same grade. Accidents have occurred where the user has put a mild steel pin in an alloy steel body or replaced a screw pin with a nut and bolt.

The shackle must be compatible with all of the other fittings in the slinging arrangement, taking account of increased resultant loads due to angular loading, and it must seat correctly with mating parts.

If the shackle jaw is too small, it will be forced open and/or bent and if it is too wide the shackle may twist under load and take on a permanent set.

The pin must be correctly screwed into the shackle eye, i.e. finger tight, so that the collar of the pin is fully seated on the shackle eye.

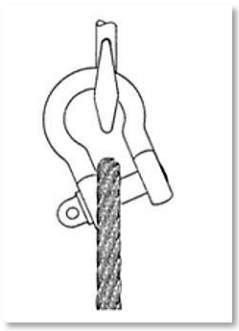
The pin must be the correct length so that it penetrates the full depth of the screwed eye and allows the collar of the pin to bed on the surface of the drilled eye with a maximum of 1½ turns of thread remaining exposed in the jaw.

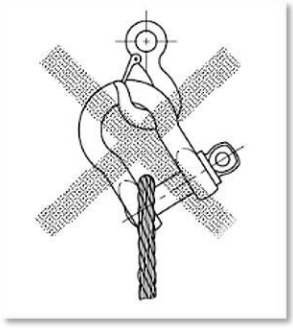


Where shackles are fitted with a bolt and pinned nut, the length of the plain portion of the bolt should be such that the nut will jam on the inner end of the thread and not on the eyes of the shackle, thus leaving the bolt free to rotate. If these steps are not taken, it is likely that the body of the shackle will be closed in and permanently deformed when the pin is tightened.

Shackles which have a positively locked pin, e.g. bolt, nut and split cotter pin, should be used for applications where the shackle cannot be observed or where the pin may unscrew when in service and, in the worst case, release the load. The pin will become scored and gouged if it has been unscrewing, even by a small amount, under load and this will lead to stress raisers.

Eccentric loading will cause the shackle to twist:





Pre-Use Inspection

Before use, the user should carry out a pre-use inspection of shackles, as follows:

- Check the body and pin are identifiable (same size, grade, type, make etc.)
- All markings must be present and readable
- No damaged threads to the pin or body
- No distortion to either the body or the pin
- No excessive wear evident
- No identifiable cracks, cuts, nicks or gouges

Note: If any of the above are found, refer the shackle to a Competent Person for further advice – do not use the shackle!

Notes:

11. LIFTING SET DESIGN

Terms and Definitions

Lifting Set
Items of integrated lifting equipment used to connect the offshore container to the lifting appliance. This can comprise one or multi leg slings (with or without a forerunner/top leg) and shackles, whether assembly secured or not.

Assembly Secured Shackle
A shackle fitted to a sling leg and secured by a seal or similar device, so as to signal unambiguously, whether or not the shackle has been exchanged.

Symbols

WLL	Working load limit
WLL_s	Minimum working load limit of each shackle
WLL_{min}	Minimum calculated working load limit from enhancement factor table
WLL_{off}	Maximum lifting capacity of a lifting set to be used on an offshore container (Symbol required to be marked on the lifting set)
S	Mass of the lifting set in kg

Dimensions and Strength of Lifting Sets

To allow for the dynamic amplification experienced in offshore lifting in adverse weather and sea states, the working load limit of the lifting sets for offshore containers are determined using the tables shown. The greater the maximum gross mass of the container when designed to BS EN 12079, the smaller the enhancement factor.

There are no dynamic factors for containers rated under 2000kg. For these, use a minimum value of 7t.

For intermediate container ratings, the WLL shall be interpolated. (Worked out as mid rating).

BS 7072 required that all lifting sets have a WLL of 1.3 times the Maximum Gross Mass of the offshore container that it was designed for.

The table below shows the large differences that you may find when inspecting lifting sets fitted to different standards of containers.

BS 7072 Maximum Gross Mass	Minimum WLL of Lifting Set	BS EN 12079 Maximum Gross Mass	Minimum WLL of Lifting Set
2000kg	2.6 tonnes	2000kg	7 tonnes
25000kg	32.5 tonnes	25000kg	27.6 tonnes

Determination of Working Load Limit

Container Rating (R) kg	Enhancement Factor	Minimum Required Working Load Limit of the Lifting Set (WLL min) tonnes
500	-	7,00
1000	-	7,00
1500	-	7,00
2000	3.500	7,00
2500	2.880	7,20
3000	2.600	7,80
3500	2.403	8,41
4000	2.207	8,83
4500	2.067	9.30
5000	1.960	9.80
5500	1.873	10.30
6000	1.766	10.60
6500	1.733	11,26
7000	1.700	11,90
7500	1.666	12,50
8000	1.633	13,07
8500	1.600	13,60
9000	1.567	14,10
9500	1.534	14,57
10000	1.501	15,01
10500	1.479	15,53
11000	1.457	16,02
11500	1.435	16,50
12000	1.413	16,95
12500	1.391	17,38

Container Rating (R) kg	Enhancement Factor	Minimum Required Working Load Limit of the Lifting Set (WLL min) tonnes
13000	1.368	17,79
13500	1.346	18,18
14000	1.324	18,54
14500	1.302	18,88
15000	1.280	19,20
15500	1.267	19,64
16000	1.254	20,06
16500	1.240	20,47
17000	1.227	20,86
17500	1.214	21,24
18000	1.201	21,61
18500	1.188	21,97
19000	1.174	22,31
19500	1.161	22,64
20000	1.148	22,96
20500	1.143	23,44
21000	1.139	23,92
21500	1.135	24,39
22000	1.130	24,86
22500	1.126	25,33
23000	1.121	25,79
23500	1.117	26,25
24000	1.112	26,70
24500	1.108	27,15
25000	1.104	27,59

Lifting Set Design

General Requirements

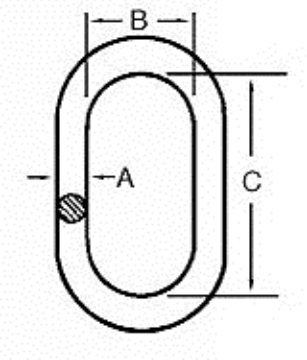
Slings shall be rated for their intended angle of use. All 4 leg slings shall be rated as for 3 leg slings. Do not rate a sling for an angle of the sling leg to the vertical in excess of 45˚.

Note: For specific angles less than 45˚, the sling may be rated at the WLL according to the particular angle of the legs to the vertical. The formula to calculate this:

Sling used at an angle to the vertical	Formula
2 leg sling	**WLL = 2 x WLL_{min} for a single leg x cosine beta angle**
4 leg sling	**WLL = 3 x WLL_{min} for a single leg x cosine beta angle**
2 x 2 leg slings used as a 4 leg sling	Calculate as for a 4 leg sling

Master Links

The recommendation is that the master link to be attached to the crane hook shall have minimum dimensions of (C) 270mm x (B) 140mm internal.



Shackles

Shackles shall meet the requirements of BS EN 13889 or EN 1677-1 or ABNT NBR 13545 with the additional requirement that the tolerance on the nominal diameter of the shackle pin shall be -0/ +3%.

Shackles shall be restricted to bolt type pin with hexagon head, hexagon nut and split cotter pin.

DNVGL-ST-E271 states that the minimum breaking force shall not be taken as less than 5 times the WLL, and the tolerance on the nominal diameter of the shackle pin can be -1/ +3%.

123 The minimum WLL of each shackle shall be calculated as given in the table below.

Required Minimum Shackle WLL		
4-Leg Sling	**2-Leg Sling**	**Single Leg Sling**
$WLL_{min} / (3 \times \cos \beta)$	$WLL_{min} / (2 \times \cos \beta)$	WLL_{min}

Where β is the angle of the sling leg from vertical and the WLLmin is the minimum WLL determined from the tables earlier in this module.

The lifting set shall be of sufficient length to allow easy handling by operators. The top link or master link shall be able to reach down to a height of no more than 1.3m above the container bottom when the sling hangs over the long side of the container. This is why the lifting set is often designed with a 5^{th} leg (Forerunner). It enables the rigger to stay on the deck whilst connecting the container lifting set to the crane hook, instead of standing on the top of the container in hazardous conditions.

Notes:

Chain Slings

Chain slings shall meet all requirements of BS EN 818-4.

DNV allows for other recognized standards and other grades to be used after special consideration.

This would also allow for higher grades of chain to be used, making the lifting set lighter and therefore easier to handle.

Steel Wire Rope

Wire Rope Slings
Wire rope slings shall meet the requirements of BS EN 13414-1 with the following restrictions:

- Wire rope shall be 6-stranded and either 6 x 19 or 6 x 36 construction
- The termination shall be a ferrule secured

Note: As an aid to inspection, ferrules which permit the tail end of the rope to be visible are recommended. This will not always be possible as some rig owners prohibit the use of these parallel ferrules and state that the tapered ferrules shall be used.

Wire rope grade 1770 or 1960 shall be used. If the grade of the rope is unknown, the inspector should always default to the lowest grade.

DNVGL-ST-E271 allows for other recognized standards to be used and states that thimbles will be fitted which is a requirement of BS EN 13414-1 when terminal fittings are fitted.

Lifting Set Design

As shown from the tables included in the standard, there is a requirement for the Working Load Limit (WLL) of the lifting set to be much greater in some cases than the Maximum Gross Mass (MGM) of the offshore container.

The Minimum WLL of the lifting set is calculated by multiplying the MGM of the container by the enhancement factor given for the particular MGM of the container.

Example
A container with a MGM of 10000kg to BS EN ISO 10855-2-2 and DNVGL-ST-E271 must have an enhancement factor of 1.501 applied to give a Minimum WLL of the lifting set of 15.01 tonnes.

For a offshore container to BS EN 7072, the enhancement factor is always 1.3 x MGM of the container. This would mean an offshore container with a MGM of 10000kg designed to BS 7072 would have a lifting set fitted with a Minimum WLL of 13 tonnes.

The tables on the following slides show the WLL of chain and steel wire rope slings and nominal diameters to be used.

The following tables show the WLL of chain and steel wire rope slings and nominal diameters to be used.

Chain – BS EN 818-4

Working Load Limits for 1,2 and 4 Leg Chain Slings at Different Angles											
Nominal Size of Sling (mm)	Working Load Limit in tonnes										
	Single Leg & 5th Leg	4 Leg slings at					2 Leg slings at				
		45°	40°	35°	30°	25°	45°	40°	35°	30°	25°
10	3.15	6.7	7.24	7.7	8.2	8.6	4.5	4.8	5.2	5.5	5.7
13	5.30	11.2	12.2	13.0	13.8	14.4	7.5	8.1	8.7	9.2	9.6
16	8.00	17.0	18.4	19.7	20.8	21.8	11.3	12.3	13.1	13.9	14.5
18	10.0	21.2	23.0	24.6	26.0	27.2	14.1	15.3	16.4	17.3	18.1
19	11.2	23.8	25.7	27.5	29.1	30.5	15.8	17.2	18.3	19.4	20.3
20	12.5	26.5	28.7	30.7	32.5	34.0	17.7	19.2	20.5	21.7	22.7
22	15.0	31.8	34.5	36.9	39.0	40.8	21.2	23.0	24.6	26.0	27.2
23	16.0	33.9	36.8	39.3	41.6	43.5	22.6	24.5	26.2	27.7	29.0
25	20.0	42.4	46.0	49.1	52.0	54.4	28.3	30.6	32.8	34.6	36.3
26	21.2	45.0	48.7	52.1	55.1	57.6	30.0	32.5	34.7	36.7	38.4
28	25.0	53.0	57.5	61.4	65.0	68.0	35.4	38.3	41.0	43.3	45.3
32	31.5	66.8	72.4	77.4	81.8	85.6	44.5	48.3	51.6	54.6	57.1

SWR – BS EN 13414-1 Fibre Core Grade 1770

Working Load Limits for 1,2 and 4 Leg Wire Rope Slings at Different Angles											
Nominal Size of Sling (mm)	Working Load Limit in tonnes										
	Single Leg & 5th Leg	4 Leg slings at					2 Leg slings at				
		45°	40°	35°	30°	25°	45°	40°	35°	30°	25°
18	3.40	7.2	7.8	8.4	8.8	9.2	4.8	5.2	5.6	5.9	6.2
20	4.35	9.2	10.0	10.7	11.3	11.8	6.2	6.7	7.1	7.5	7.9
22	5.20	11.0	12.0	12.8	13.5	14.1	7.4	8.0	8.5	9.0	9.4
24	6.30	13.4	14.5	15.5	16.4	17.1	8.9	9.7	10.3	10.9	11.4
26	7.20	15.3	16.5	17.7	18.7	19.6	10.2	11.0	11.8	12.5	13.1
28	8.40	17.8	19.3	20.6	21.8	22.8	11.9	12.9	13.8	14.5	15.2
32	11.0	23.3	25.3	27.0	28..6	29.9	15.6	16.9	18.0	19.1	19.9
36	14.0	29.7	32.2	34.4	36.4	38.1	19.8	21.4	22.9	24.2	25.4
40	17.0	36.1	39.1	41.8	44.2	46.2	24.0	26.0	27.9	29.4	30.8
44	21.0	44.5	48.3	51.6	54.6	57.1	29.7	32.2	34.4	36.4	38.1
48	25.0	53.0	57.5	61.4	65.0	68.0	35.4	38.3	41.0	43.3	45.3
52	29.0	61.5	66.6	71.3	75.3	78.8	41.0	44.4	47.5	50.2	52.6

SWR – BS EN 13414-1 Steel Core Grade 1770

Working Load Limits for 1,2 and 4 Leg Wire Rope Slings at Different Angles											
Nominal Size of Sling (mm)	Working Load Limit in tonnes										
	Single Leg & 5th Leg	4 Leg slings at					2 Leg slings at				
		45°	40°	35°	30°	25°	45°	40°	35°	30°	25°
18	3.70	7.8	8.5	9.1	9.6	10.1	5.2	5.7	6.1	6.4	6.7
20	4.60	9.8	10.6	11.3	12.0	12.5	6.5	7.0	7.5	8.0	8.3
22	5.65	12.0	13.0	13.9	14.7	15.4	8.0	8.7	9.3	9.8	10.2
24	6.70	14.2	15.4	16.5	17.4	18.2	9.5	10.3	11.0	11.6	12.1
26	7.80	16.5	17.9	19.2	20.3	21.1	11.0	12.0	12.8	13.5	14.1
28	9.00	19.1	20.7	22.1	23.4	24.5	12.7	13.8	14.7	15.6	16.3
32	11.80	25.0	27.1	29.0	30.7	32.1	16.7	18.1	19.3	20.4	21.4
36	15.0	31.8	34.5	36.9	39.0	40.8	21.2	23.0	24.6	26.0	27.2
40	18.5	39.2	42.5	45.5	48.1	50.3	26.2	28.3	30..3	32.0	33.5
44	22.5	47.7	51.7	55.3	58.5	61.2	31.8	34.5	36.9	39.0	40.8
48	26.0	55.2	59.8	63.9	67.5	70.7	36.8	39.8	42.6	45.0	47.1
52	31.5	66.8	72.4	77.4	81.8	85.6	44.5	48.3	51.6	54.6	57.1

SWR – BS EN 13414-1 Fibre Core Grade 1960

Working Load Limits for 1,2 and 4 Leg Wire Rope Slings at Different Angles											
Nominal Size of Sling (mm)	Working Load Limit in tonnes										
	Single Leg & 5th Leg	4 Leg slings at					2 Leg slings at				
		45°	40°	35°	30°	25°	45°	40°	35°	30°	25°
18	3.47	7.4	8.0	8.5	9.0	9.4	4.9	5.3	5.7	6.0	6.3
20	4.30	9.1	9.9	10.6	11.2	11.7	6.1	6.6	7.0	7.4	7.8
22	5.19	11.0	11.9	12.8	13.5	14.1	7.3	8.0	8.5	9.0	9.4
24	6.17	13.1	14.2	15.2	16.0	16.8	8.7	9.4	10.1	10.7	11.2
26	7.25	15.4	16.7	17.8	18.8	19.7	`10.3	11.1	11.9	12.6	13.1
28	8,41	17.8	19.3	20.7	21.8	22.9	11.9	12.9	13.8	14.6	15.2
32	10.98	23.3	25.2	27.0	28.5	29.8	15.5	16.8	18.0	19.0	19.9
36	13.89	29.5	31.9	34.1	36.1	37.8	19.7	21.3	22.8	24.1	25.2
40	17.16	36.4	39.4	42.2	44.6	46.7	24.3	26.3	28.1	29.7	31.1
44	20.74	44.0	47.7	51.0	53.9	56.4	29.3	31.8	34.0	35.9	37.6
48	24.78	52.6	56.9	60.9	64.4	67.4	35.0	38.0	40.6	42.9	44.9
52	29.00	61.5	66.6	71.3	75.3	78.9	41.0	44.4	47.5	50.2	52.6

SWR – BS EN 13414-1 Steel Core Grade 1960

Working Load Limits for 1,2 and 4 Leg Wire Rope Slings at Different Angles											
Nominal Size of Sling (mm)	Working Load Limit in tonnes										
	Single Leg & 5th Leg	4 Leg slings at					2 Leg slings at				
		45°	40°	35°	30°	25°	45°	40°	35°	30°	25°
18	4.1	8.8	9.5	10.2	10.8	11.3	5.9	6.4	6.8	7.2	7.5
20	5.1	10.9	11.8	12.6	13.3	13.9	7.2	7.8	8.4	8.9	9.3
22	6.2	13.2	14.3	15.2	16.1	16.9	8.8	9.5	10.2	10.7	11.2
24	7.4	15.7	17.0	18.1	19.2	20.1	10.4	11.3	12.1	12.8	13.4
26	8.7	18.4	19.9	21.3	22.5	23.6	12.3	13.3	14.2	15	15.7
28	10.0	21.3	23.1	24.7	26.1	27.3	14.2	15.4	16.4	17.4	18.2
32	13.1	27.8	30.2	32.3	34.1	35.7	18.6	20.1	21.5	22.7	23.8
36	16.6	35.2	38.1	40.8	43.1	45.1	23.5	25.4	27.2	28.7	30.1
40	20.6	43.6	47.2	50.5	53.4	55.9	29.1	31.5	33.7	35.6	37.3
44	24.8	52.6	56.9	60.9	64.4	67.4	35	38	40.6	42.9	44.9
48	29.6	62.7	67.9	72.6	76.8	80.3	41.8	45.3	48.4	51.2	53.6
52	34.7	73.6	79.7	85.3	90.1	94.3	49.1	53.1	56.8	60.1	62.9

Sling Diameters

It is vitally important that the inspector can check these tables against the actual diameter of the sling fitted to the container. It is strongly advised that these tables are printed out as an aid to training and also for your future reference as an inspector.

Example

Let's use the example of the container with a MGM of 10000kg. The container lifting set must have a minimum WLL of 15.01 tonnes. If the container has a 4 leg grade 1770, fibre core steel wire rope sling used at a design angle of 45° fitted with a top (5th) leg, then using the tables just shown, the minimum diameter of the 5th leg would be 40mm as this has a WLL of 17.0 tonnes and the 4 leg sling diameter would be a minimum of 26mm as this WLL is 15.3 tonnes at 45°.

If grade 1960 steel core steel wire rope was used in the same configuration- the 5th leg diameter would be a minimum of 36mm with a WLL of 16.6 tonnes and the 4 leg sling at 45° diameter would be a minimum of 24mm with a WLL of 15.7 tonnes.

If chain was the lifting medium for the same 10000kg container, the 5th leg diameter would be at least 23mm giving a WLL of 16 tonnes and the 4 leg sling at 45° would be 16mm giving a WLL of 17 tonnes.

Notes:

Shackle Size

The pad eyes for containers are designed for a specific size of shackle to fit. The designer will use the table below in conjunction with the minimum WLL to calculate the size of shackle and therefore the minimum thickness of the pad eye and the maximum diameter of the pad eye hole.

Example
Use the previous example of a 10000kg MGM container with an enhancement factor of 1.501 to give the minimum WLL of the lifting set of 15.01 tonnes, to calculate the shackle size.

Required Minimum Shackle WLL		
4-Leg Sling	**2-Leg Sling**	**Single Leg Sling**
WLL min / (3 x cos β)	**WLL min / (2 x cos β)**	**WLL min**

WLL min / (3 x cos β)

The WLL minimum is 15.01 tonnes.

15.01 ÷ (3 x cosine45°) → 15.01 ÷ (3 x 0.707) → 15.01 ÷ 2.121 = **7.08** tonnes shackle

This size is not available so the next size up is used – 8.5 tonnes.

Shackle to Pad Eye Size

An 8.5 tonne WLL shackle has the following dimensions that the designer must be aware of when designing the pad eyes:

- A pin diameter of 28mm and inside (jaw) width at pin of 43mm
- The pad eye hole diameter must be a maximum of 6% of the pin diameter, therefore the pad eye hole diameter for an 8.5 tonne shackle must have a maximum diameter of 29.68mm. This is easily calculated by 28 x 1.06 = 29.68mm
- The jaw width must be a minimum of 75% of the pad eye's thickness to stop excess lateral movement in the shackle, therefore for a 8.5 tonne shackle the pad eye must have a minimum thickness of 32.25mm. This is easily calculated by 43 x 0.75 = 32.25mm

Notes:

Lifting Set Size Examples

So, in summary, for an offshore container with a MGM of 10000kg designed to BS EN IOS 10855, the lifting set and pad eye dimensions would be:

- 4 leg grade 1960 steel core steel wire rope sling with a design angle of 45° and a 5th leg to facilitate safe handling
- 5th leg - 36mm diameter
- 4-leg sling at 45° - 24mm
- Shackles fitted - 8.5 tonne
- Pad eye minimum thickness – 32.25mm
- Pad eye maximum hole diameter – 29.68mm

It is strongly recommended that these dimensions are checked to be correct as part of the periodic inspections for offshore containers, especially when replacement lifting sets are fitted as it is commonplace for the lifting set sizes to be incorrectly calculated.

Requirements of the lifting set for an offshore container with a MGM of 25000kg to be constructed from Grade 1960 steel core steel wire rope with a design angle of 45° fitted with a 5th (top) leg:

This has an enhancement factor of 1.104 applied. The minimum WLL of the lifting set to be fitted is 27.59 tonnes.

Using the tables provided for steel wire rope with a steel core grade 1960, the 5th leg would be a minimum of 48mm which gives a WLL of 29.6 tonnes.

Using the tables provided for steel wire rope with a steel core grade 1960, the 4 leg element of the sling would be a minimum of 32mm which gives a WLL of 27.8 tonnes at 45°.

The shackle size is calculated by the formula: **WLL min / (3 x cos β)**

(3 x cos β) = 3 x 0.707 = 2.121

27.59 ÷ 2.121 = 13.008 tonnes = **13.5 tonnes** shackle.

13.5 tonnes shackle has a pin diameter of 38mm and a jaw width of 57mm.

This would then dictate the maximum hole diameter of the pad eye to be 6% larger than the pin diameter:

38 x 1.06 = **40.28mm** Maximum pad eye hole diameter.

The minimum width of the pad eye is required to be within 25% of the shackle jaw width

57 x 0.75 = **42.75mm** Minimum pad eye thickness.

Notes:

Notes:

12. EXAMINATION OF OFFSHORE CONTAINERS

Extract from BS EN 10855-3

Recommended knowledge and experience of staff responsible for inspection of offshore containers
With respect to containers, the inspector should have as a minimum, knowledge and adequate practical experience of:

- The statutory requirements relating to offshore containers
- The provisions of this standard
- The various types of offshore containers in service
- The correct methods of slinging and handling offshore containers
- The loads, stresses and strains affecting containers when handled under adverse offshore conditions, particularly those affecting lifting points
- Methods of testing containers
- Defects likely to be found in containers and acceptable levels of wear, distortion and deterioration in relation to safety in use
- Welding methods and procedures and qualifications of welders
- The various methods of non-destructive examination (NDE) and a good understanding of how they work and their limitations
- The visual inspection as required by this standard and the signs of weakness and defects to look for

Period Schedule: BS EN ISO 10855-3

The table below shows the requirements of BS EN ISO 10855-3 for the periodic inspection, examination and testing of offshore containers.

Time or Interval	Inspection/Examination/Test			
	Lifting Test	Non Destructive Examination (NDE)	Visual Inspection	Marking to be made on Plate
Initial Certification	As required by BS EN ISO 10855-1			
At Intervals not Exceeding 12 Months	Not Applicable (b)	Not Applicable (b)	YES	V
At Intervals not Exceeding 48 Months	Not Applicable (b)	YES	YES	VN
After Substantial Repair or Alteration (a)	YES	YES	YES	T

a. A substantial repair or alteration means any repair and/ or alteration carried out which may in the opinion of an inspection body, affect the primary elements of the offshore container or elements which contribute directly to it's structural integrity.
b. The inspection body may require other additional inspections, examination and or tests.

Period Schedule: BS 7072

The table below shows the requirements of BS 7072 for the periodic inspection, examination and testing of offshore containers for any containers that may be encountered built to this standard.

Time or interval	Inspection/Examination/Test			
	Proof Load Test 2 x MGM	Non Destructive Examination (NDE) of the Lifting Points	Visual Inspection	Marking to be made on Plate
Initial Certification	YES	YES	YES	T
At Intervals not Exceeding 6 Months	NO	At the discretion of the competent person	YES	V or VN
At Intervals not Exceeding 12 Months	NO	YES	YES	VN
At Intervals not Exceeding 24 Months	YES	YES	YES	T
After Substantial Repair or Alteration	YES	YES	YES	T

Periodic Schedule: DNVGL-ST-E271

The table below shows the requirements of DNVGL-ST-E271 for the periodic inspection, examination and testing of offshore containers.

Time or Interval	Type of Inspection			
	Lifting Test	Non Destructive Examination (NDE) of Pad Eyes(2)	Visual Inspection	Marking to be made on Plate
At Intervals not Exceeding 12 Months	Not Applicable	Not Applicable	YES	V
At Intervals not Exceeding 48 Months	Not Applicable	YES	YES	VN
After Substantial Repair or Alteration (1)	YES	YES	YES	T

1. A substantial repair or alteration means any repair and/ or alteration carried out which may, in the opinion of the surveyor, affects the primary elements of the offshore container or elements which contribute to it's structural integrity.
2. Including supporting structure if relevant.

IMDG Requirements

Offshore tanks for the carriage of dangerous goods are required under the IMDG code undergo 2.5 year periodic inspections.

2.5 year inspection shall include but not be limited to:

- General visual survey of piping, valves, instruments, tank structure, insulation, markings etc.
- Internal visual inspection
- Leak tightness test of the tank and its connections
- Corrosion protection

Offshore tanks for the carriage of dangerous goods are required under the IMDG code to undergo 2.5 year periodic inspections.

5 year inspection shall consist of all items listed under the 2.5 year inspection and in addition the following:

- All valves to be serviced and proven tight
- Relief valves to be serviced, reset and tested to correct specified pressure
- All instrumentation to be calibrated
- Insulation to be inspected, if hard insulation is provided to be removed to allow thorough inspection of tank underneath
- If vacuum insulated, the outer shell integrity to be proven by a leak test
- Thickness measurements, especially where corrosion is likely to occur
- NDT and close up internal inspections of the shell welds to be completed

Note: It may not be within the scope of your inspection/test to carry out this mandatory inspection/ testing and you should always make that clear on the inspection test report that you complete.

Notes:

Periodic Visual Inspection

The visual inspection shall be of the exterior and the interior of the container without cargo to ensure that the container is fit for its intended use. Inspect all load bearing parts, especially the base structure. For containers with fixed equipment, the inspector shall determine whether access to load bearing parts is adequate.

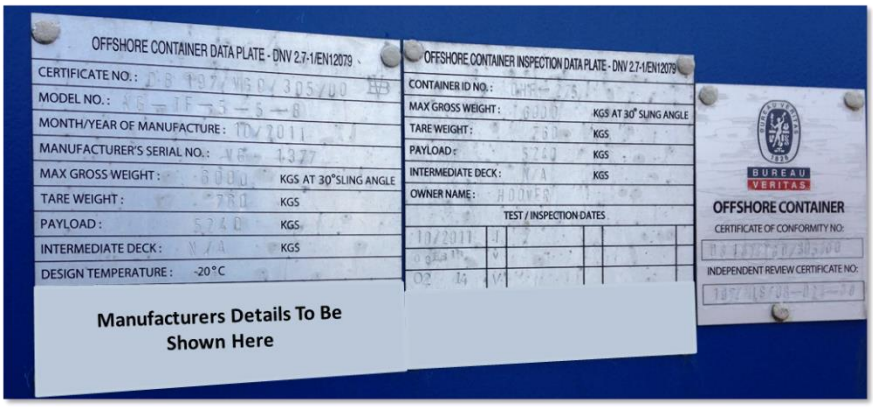
A simple walk around the container may indicate some faults with the unit before the in-depth inspection commences and may also identify additional hazards that are not identified on the risk assessment. Control measures would then need to be taken before continuing with the inspection.

Carry out the inspection in a location with sufficient lighting and other facilities necessary to allow it to be carried out safely and effectively. The facility shall include suitable means of lifting and supporting the container for the purposes of inspecting the under-side.

The image shown below shows a hole in the bottom side rail of the container which had been previously identified during a visual inspection and had not been repaired. The structure underneath should be closely inspected for defects such as this and defects such as heavy corrosion, gouges, cuts, and cracks. If there is no facility to enable the container underside to be inspected, this should be reported as a limited inspection.

Markings

Check the markings and plates to ensure they meet the requirements of BS EN ISO 10855-1 and are clear and legible. This includes the safety markings on the container, such as any perimeter boundary markings. If these are not clear, there could be an incident in poor light conditions where anyone on the top of the container may fall.



Welds

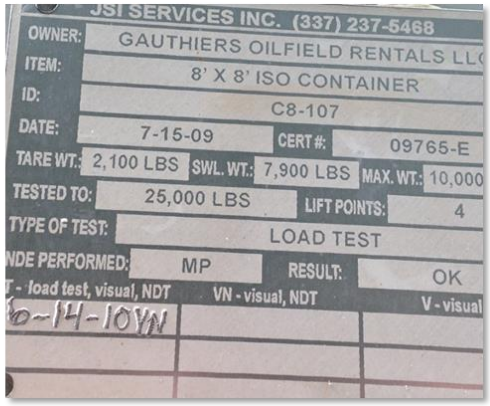
Visually inspect welds in the primary structure to ensure there are no visible defects. Also visually inspect welds on the intermediate deck supports if fitted, as these decks are often loaded.

The image on the left shows a weld that has been very poorly repaired. Any suspected cracks in the primary structure welds should then have the most suitable method of NDE carried out.

Pad Eyes and Lashing Points

Visually inspect all pad eyes and lashing points for distortion, mechanical damage or other sign of distress or overload. Often the damage caused to pad eyes is by other containers impacting with the pad eye.

The image on the left shows a pad eye that has been welded on to a normal ISO container; this was identified only because of the data plate (shown below on the right) and, as is shown, it was inspected and NDE carried out.



Structure

Visually inspect the structure for corrosion, mechanical damage or injurious deformation. An offshore container will often have protective sacrificial plates fitted to protect the primary parts of the container. Do not mistake these for the primary structure or you may be carrying out more testing than is required.

Door Closures
Visually inspect doors, frames, seals, hinges, locks, etc. and perform a functional check to ensure that they operate in a satisfactory manner without undue force being required. The locking bars connected to the door header and sill are often bent due to the impact of other containers. These can easily be identified during an inspection as they will have a springy attitude when released.

Floor
Visually inspect the floor to check that it is not deformed and that it shows no signs of distress or overload. Inspect drainage facilities where fitted, e.g. drain holes shall be clear of debris. Note that any water that enters the container will naturally settle in the corners, causing more corrosion there.

Marking of the Inspection Plate

On satisfactory completion of the inspection, examination and tests (when applicable), permanently mark the plate with:

The date (YYYY-MM-DD) of the inspection, examination and tests, together with the unique identification mark of the competent person and one of the following suffices:

- Suffix T indicating proof load test, non-destructive examination, and visual inspection; or
- Suffix VN indicating non-destructive examination and visual inspection; or
- Suffix V; indicating visual inspection only

If the inspector is in doubt about the condition of any offshore container, they should always use the appropriate method of non-destructive examination (NDE) to confirm their suspicions. Often an inspector is asked to carry out a single trip inspection to enable the container to be backloaded from the installation. The inspector should use the appropriate method of NDE to confirm the safety of the operation. If this is unfeasible, then the container should be backloaded within another serviceable container.

Then the inspection report should be completed and issued to the owner. The minimum requirements for this report are on the next slide.

Inspection Report Contents

After the container has been examined and passed fit for purpose, the inspector will make a report containing the following minimum information:

- Container identification (including owner's container number)
- Name of owner or delegated nominee
- Report number
- Statement that the container is suitable for service
- Total gross mass in kg, applicable to the all points lifting test and the method of test (where relevant)
- Details of NDE if carried out
- Statement that the container described was inspected/ examined and or tested and that the particulars are correct
- Reference to any report issued to the owner arising from the process
- Confirmation that the Inspection Plate was marked; date of examination (and date of signature or report if different from date of examination)
- Name of organization, person and authentication by the person carrying out the inspection, examination or test either by signature or other secure means
- Comments on any limits to the scope of inspection

Note 1: Details of the examination of the lifting set may also be given on the inspection report for the container.

Note 2: This report may be combined with the initial Certificate of Conformity.

Damage and Repair Procedures

The owner shall ensure that:

- Containers are maintained in accordance with the standard
- If a container is damaged so that it does not comply with the standard, it is not used until it is repaired and inspected by an inspection body
- Repairs are carried out in accordance with the requirements for design and manufacture of containers set out in BS EN ISO 10855-1
- Repair facilities used can ensure the quality of the procedures and facilities by a quality assurance system at least in accordance with EN ISO 9001 or EN ISO 3834-2;
- Following repair, the container is inspected and where relevant tested by the inspection body. The owner shall provide the inspection body with full details of the repairs that have been carried out
- Following modification, the container is submitted for re-certification

Note 1: If the user or any of his agents detects any structural damage or corrosion which may affect the load bearing integrity of the container, it is strongly recommended that they advise the owner as soon as

practicable.

Note 2: Where a need for repair is identified, it will be necessary to make adequate arrangements for the safe transportation of the damaged container, to the location specified by the owner.

Notes:

13. EXAMINATION OF LIFTING SETS

Extract from BS EN ISO 10855-3

Recommended knowledge and experience of staff responsible for inspection of lifting sets intended for use with offshore containers

Regarding lifting sets, the inspector should have as a minimum, a knowledge and adequate practical experience of:

- Statutory requirements relating to lifting sets
- Provisions of this standard
- Various types of offshore containers in service
- Correct methods of slinging and handling offshore containers
- Loads, stresses and strains affecting the lifting sets when used for lifting offshore containers in adverse offshore conditions
- Methods of testing lifting sets
- Defects likely to be found in lifting sets and acceptable levels of wear, distortion and deterioration in relation to safety in use
- Various methods of NDE and a good understanding of how they work and their limitations
- Visual examination as required by this standard and the signs of weakness and defects to look for

Periodic Schedule: BS EN ISO 10855-3

The table below shows the requirements of BS EN ISO 10855-3 for the periodic inspection, examination and testing of the lifting sets fitted to offshore containers. The sling components and chain sling leg marking is dependent upon whether tested or NDE is carried out.

<table>
<tr><th rowspan="2">Time or Interval</th><th rowspan="2">Applicable to</th><th colspan="4">Inspection/Examination/Test</th></tr>
<tr><th>Load Test</th><th>Non Destructive Examination (NDE)</th><th>Visual Inspection</th><th>Marking to be made on Tag</th></tr>
<tr><td>Initial Certification</td><td>Complete Lifting Set</td><td colspan="4">As required by BS EN ISO 10855 - 2</td></tr>
<tr><td>Intervals not Exceeding 12 Months</td><td>Complete Lifting Set</td><td>-</td><td>Not Applicable</td><td>YES</td><td>V</td></tr>
<tr><td rowspan="4">Intervals not Exceeding 48 Months</td><td>Sling Components</td><td colspan="2" rowspan="2">Either Load Test or NDE</td><td>YES</td><td>T or VN</td></tr>
<tr><td>Chain Sling Legs</td><td>YES</td><td>T or VN</td></tr>
<tr><td>Shackles</td><td>Not Applicable</td><td>Not Applicable</td><td rowspan="2">YES</td><td rowspan="2">N/A</td></tr>
<tr><td>Wire Rope Legs</td><td>Not Applicable</td><td>Not Applicable</td></tr>
<tr><td>After Substantial Repair or Alteration</td><td>Complete lifting set</td><td>YES</td><td>YES</td><td>YES</td><td>T</td></tr>
</table>

Periodic Schedule: BS 7072

BS 7072 instructs that the lifting set is visually thorough examined at the time of the container inspection. This would be with intervals not exceeding 6 months.

There is no direction given as to any testing or NDE periods. In line with LOLER, the NDE and any load testing of the lifting set would be carried out at the discretion of the Competent Person.

Periodic Schedule: DNVGL-ST-E271

The table below shows the requirements of DNVGL-ST-E271 for the periodic inspection, examination and testing of lifting sets fitted to offshore containers.

Time or Interval	Applicable to	Inspection/Examination/Test			
		Load Test	Non Destructive Examination (NDE)	Visual Inspection	Marking to be made on Tag
Intervals not Exceeding 12 months	Complete Lifting Set	Not Applicable	Not Applicable	YES	V
Intervals not Exceeding 48 Months	Sling Components	Either Load Test or NDE		YES	T or VN
	Chain Sling Legs			YES	T or VN
	Shackles and Wire Rope Legs	Not Applicable	Not Applicable	YES	V
After Substantial Repair or Alteration	Complete Lifting Set	YES	YES	YES	T

Periodic Visual Inspections: Lifting Sets

The lifting set periodic visual inspections shall be carried out at the set periods in the respective standards. This inspection should be carried out in a methodical manner to minimise the chances of missing vital areas of the lifting set. The inspection shall be carried out with normally corrected vision, in a situation providing sufficient light and other facilities necessary to allow it be carried out safely and effectively.

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- Is the area clear from contaminants that can harm the equipment under examination or the examiner themselves?
- Is the examination area safe from hazards, moving traffic, ongoing lifting operations etc.?

If the examiner is concerned for their own safety, it will not allow 100% concentration on the equipment examination.

Periodic Visual Inspections: Lifting Sets - Wire Rope Slings

Steel wire rope slings shall be inspected in accordance with the requirements of BS EN 13414-2.
Chain slings shall be inspected in accordance with BS EN 818-6.

Markings
Check the markings for the lifting set are clear and legible; unidentifiable lifting sets can be a danger. You may even find an incorrect size lifting set is fitted.

Master Link
Start with the master link that is fitted to either the top leg of the sling or the master link that is fitted to a 2 leg sling. Inspect the master link for:

Distortion or twisting

Excessive corrosion (pitting)

Wear that is over 8% of diameter

Cracks in the weld? NDE?

Top Leg
Moving logically down the sling, the top leg is next to be visually inspected.

The number of allowable broken wires in accordance with BS EN 13414-2 are as follows:

Randomly Distributed Broken Wires
6 randomly distributed broken outer wires in a length of 6d but no more than 14 randomly distributed broken wires in a length of 30d where d is the nominal rope diameter.

Concentrated Broken Wires
3 adjacent broken outer wires in one strand.

Loss of Nominal Diameter of the Wire Rope
Over 10% loss of the nominal diameter.

The sling should be withdrawn from service if there is wear, distortion or cracking of the ferrules.

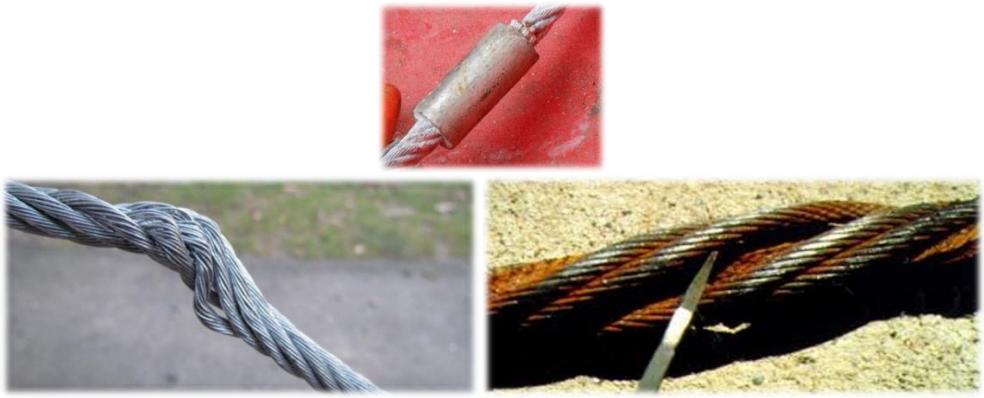
The thimbles that are fitted should have no signs of twisting out of the eye and overloading, which would be indicated by the lengthening of the eye. The image below shows a substandard example of thimble fitting. This image was taken of a new sling.

The wire rope should show no indications of being pulled out of the ferrule.

Inspect the rope for kinks, core or strand protrusion, bird caging and loose strands.

A common cause of crushed wire ropes is when the lifting set is permanently fitted and is impacted by swinging loads whilst hanging over the sides of the offshore container.

The wire rope shall not have heavy corrosion which causes pitting of the wires, affecting the strength of the rope.



Inspect the whole length of the top leg.

It is recommended that the lifting set is removed from the container prior to the inspection to facilitate a thorough inspection. If the inspector is using ladders or an uncomfortable access method, it is more likely that the inspector will miss vital areas of the inspection. The inspector would also require more control measures to be put in place due to the fact they are working at height.

Master Link Assembly & Sub Links

As the inspection progresses down the sling, we come to inspect the master link assembly and the sub links for

Distortion or twisting

Excessive corrosion (pitting)

Wear to be under 8% of diameter

Cracks in weld? NDE?

4 Legs
Moving logically down the sling, the 4 leg part of the sling is next to be visually inspected.

The same defects should be inspected for during this as the top leg, ensuring all the legs are inspected.

The number of allowable broken wires in accordance with BS EN 13414-2 are as follows:

Randomly Distributed Broken Wires
6 randomly distributed broken outer wires in a length of 6d but no more than 14 randomly distributed broken wires in a length of 30d where d is the nominal rope diameter.

Concentrated Broken Wires
3 adjacent broken outer wires in one strand.

Loss of Nominal Diameter of the Wire Rope
Over 10% loss of the nominal diameter

The thimbles that are fitted should have no signs of twisting out of the eye and overloading, which would be indicated by the lengthening of the eye. The image below shows a substandard example of thimble fitting. This image was taken of a new sling.

The wire rope should show no indications of being pulled out of the ferrule.

Inspect the rope for kinks, core or strand protrusion, bird caging and loose strands.

A common cause of crushed wire ropes is when the lifting set is permanently fitted and is impacted by swinging loads whilst hanging over the sides of the offshore container.

The wire rope shall not have heavy corrosion which causes pitting of the wires, affecting the strength of the rope.

The whole 4 legs are required to be inspected.

It is recommended that the lifting set is removed from the container prior to the inspection to facilitate a thorough inspection. If the inspector is using ladders or an uncomfortable access method, it is more likely that the inspector will miss vital areas of the inspection. The inspector would also require more control measures to be put in place due to the fact they are working at height.

Shackles

The shackles that are fitted to the lifting set are the last component part of the lifting set that requires periodic inspection. Remove all shackles to enable a thorough inspection to take place.

Notes:

Periodic Visual Inspections: Lifting Sets - Chain Slings

Markings

Check the markings for the lifting set are clear and legible; unidentifiable lifting sets can be a danger. You may even find an incorrect size lifting set is fitted.

Master Link

Start with the master link that is fitted to either the top leg of the sling or the master link that is fitted to a 2 leg sling.

Inspect the master link for:

Distortion or twisting

Wear over 8% of diameter

Excessive corrosion (pitting)

Cracks in link weld? NDE?

Notes:

Top Leg

Inspect the chain top leg for wear, distorted links, elongation due to overloading, elongation due to wear at load bearing points, corrosion, articulation, nicks, cracks, gouges. Examine all 4 sides of the chain.

Elongation due to overloading 0%

Elongation due to wear maximum of 5%

Chain wear LEEA recommend maximum of 8%

As the inspection progresses down the sling, the master link assembly and the sub links are inspected next for:

Distortion or twisting

Wear over 8% of diameter

Excessive corrosion (pitting)

Cracks in welds? NDE?

Check all four chain legs for wear, distorted links, elongation due to overloading, elongation due to wear at load bearing points, corrosion, articulation, nicks, cracks, gouges. Pay particular attention to the chain at the area where it hangs over the side of the container. Examine all 4 sides of the chain of all 4 legs of the chain.

Elongation due to overloading 0%

Elongation due to wear maximum of 5%

Chain wear LEEA recommend maximum of 8%

Notes:

14. TESTING OF OFFSHORE CONTAINERS

Periodic Schedule: BS EN ISO 10855-3

The table below shows the requirements of BS EN ISO 10855-3 for the periodic inspection, examination and testing of offshore containers. The highlighted column shows the testing requirements.

Time or Interval	Inspection/Examination/Test			
	Lifting Test	Non Destructive Examination (NDE)	Visual Inspection	Marking to be made on Plate
Initial Certification	As required by BS EN ISO 10855 - 1			
At Intervals not Exceeding 12 Months	Not Applicable (b)	Not Applicable (b)	YES	V
At Intervals not Exceeding 48 Months	Not Applicable (b)	YES	YES	VN
After Substantial Repair or Alteration (a)	YES	YES	YES	T

a. A substantial repair or alteration means any repair and/ or alteration carried out which in the opinion of an inspection body, affects the primary elements of the offshore container or elements which contribute to it's structural integrity.
b. The inspection body may require other additional inspections, examination and or tests.

Periodic Schedule: BS 7072

The table below shows the requirements of BS 7072 for the periodic inspection, examination and testing of offshore containers for any containers that may be encountered built to this standard. The highlighted column shows the testing requirements.

Time or interval	Inspection/Examination/Test			
	Proof Load Test 2 x MGM	Non Destructive Examination (NDE) of the Lifting Points	Visual Inspection	Marking to be made on Plate
Initial Certification	YES	YES	YES	T
At Intervals not Exceeding 6 Months	NO	At the discretion of the competent person	YES	V or VN
At Intervals not Exceeding 12 Months	NO	YES	YES	VN
At Intervals not Exceeding 24 Months	YES	YES	YES	T
After Substantial Repair or Alteration	YES	YES	YES	T

Periodic Schedule: DNVGL-ST-E271

The table below shows the requirements of DNVGL-ST-E271 for the periodic inspection, examination and testing of offshore containers. The highlighted column shows the testing requirements.

Time or Interval	Type of Inspection			
	Lifting Test	Non Destructive Examination (NDE) of Pad Eyes(2)	Visual Inspection	Marking to be made on Plate
At Intervals not Exceeding 12 Months	Not Applicable	Not Applicable	YES	V
At Intervals not Exceeding 48 Months	Not Applicable	YES	YES	VN
After Substantial Repair or Alteration (1)	YES	YES	YES	T

1. A substantial repair or alteration means any repair and/ or alteration carried out which in the opinion of the surveyor, affects the primary elements of the offshore container or elements which contribute to it's structural integrity.
2. Including supporting structure if relevant.

IMDG Requirements

It may not be within the scope of your inspection/test to carry out this mandatory inspection/ testing and you should always make that clear on the inspection test report that you complete.

Offshore tanks for the carriage of dangerous goods are required under the IMDG code to undergo 2.5 year periodic inspections.

2.5 year inspection shall include but not be limited to:

- General visual survey of piping, valves, instruments, tank structure, insulation, markings etc.
- Internal visual inspection
- Leak tightness test of the tank and its connections
- Corrosion protection

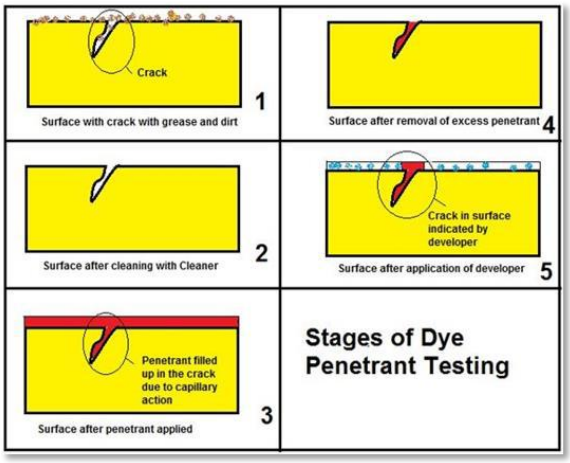
5 year inspection shall consist of all items listed under the 2.5 year inspection and in addition the following:

- All valves to be serviced and proven tight
- Relief valves to be serviced, reset and tested to correct specified pressure
- All instrumentation to be calibrated
- Insulation to be inspected; remove hard insulation to allow thorough inspection of tank underneath
- If vacuum insulated, the outer shell integrity to be proven by a leak test
- Thickness measurements, especially where corrosion is likely to occur
- NDT and close up internal inspections of the shell welds to be completed

Types of Tests

Liquid/Dye Penetrant Testing (PT)

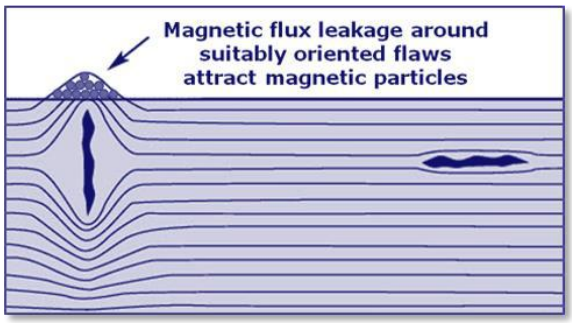
Penetrant testing locates surface-breaking discontinuities by covering the item with a penetrating liquid, drawn into the discontinuity by capillary action. After removal of excess penetrant, the indication is made visible by applying a developer (colour contrast or fluorescent).



Magnetic Particle Inspection

Magnetic particle inspection (MPI) is used to locate surface and slightly sub-surface discontinuities in ferromagnetic materials by introducing a magnetic flux into the material.

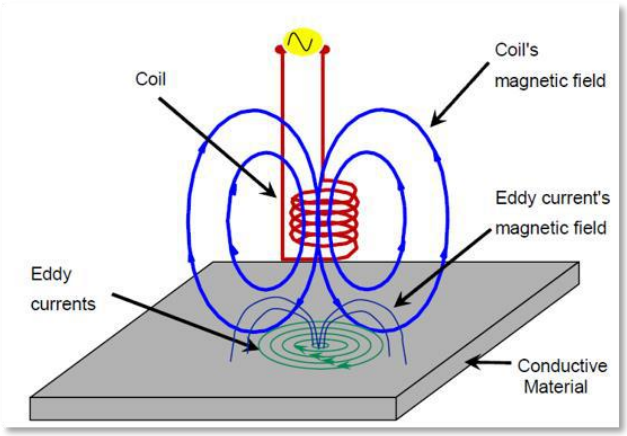
- White background lacquer is applied to the area to be inspected
- Items are magnetized and then sprayed with a solution of suspended iron filings
- Cracks or imperfections near the surface will distort the magnetic field
- Will attract the iron filings revealing the flaw by an accumulation of particles along the line of the crack
- Sub-surface defects by an accumulation in the area over the fault

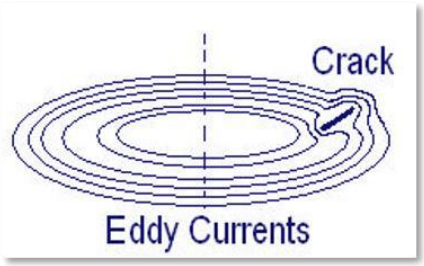


Notes:

Eddy Current Inspection

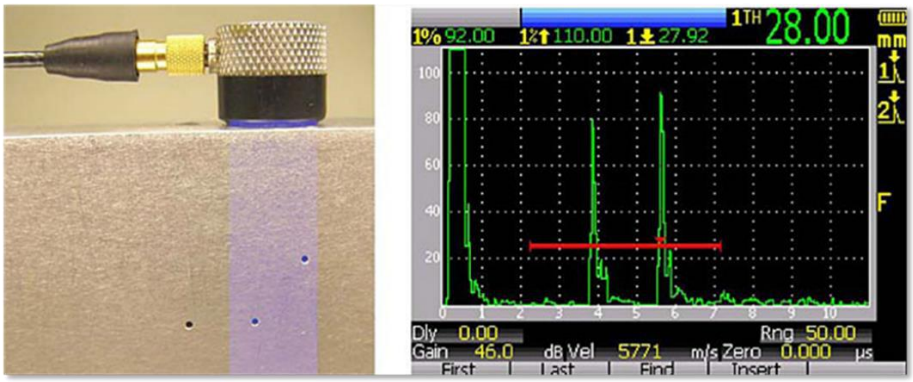
Eddy current inspection is based on inducing electrical currents in the material being inspected and observing the interaction between those currents and the material. Eddy currents generated by coils in the test probe are monitored by measuring the coils electrical impedance. As it is an electromagnetic induction process, direct electrical contact with the sample is not required; but the material must be an electrical conductor.





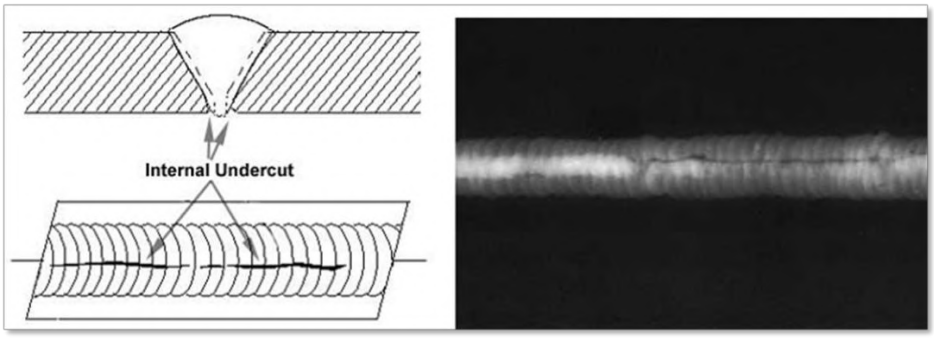
Ultrasonic Testing

Ultrasonic testing (UT) measures the time for high frequency (0.5-50MHz) pulses of ultrasound to travel through the inspection material. If a discontinuity is present, the ultrasound returns to the probe in a period other than would be expected of a fault free specimen.



Radiography

Radiography testing (RT) monitors the varying transmission of ionising radiation through a material with the aid of photographic film or fluorescent screens to detect changes in density and thickness. It will locate internal and surface-breaking defects. As shown on the weld defect below, this would have been impossible to detect with a surface only method of NDT.



Container Lifting Test

When the container is to be load tested it will have a total mass of 2.5R.

All pad eyes must be used for test.

Observe the following when applying the test load:

- Evenly distribute load inside container
- Add load outside container if it cannot be accommodated inside
- Where internal shelf is fitted, split load between floor and shelf
- Fully load floor separately as an additional test to above if shelf is adjustable

The container shall be lifted by a lifting set with an angle to the vertical equal to the design angle and shall be held, clear of the ground, throughout the test.

Lifting Set Caution

Where the lifting set intended for use with the container is used for the lifting test, take care to ensure that no overloading, deformation or distortion is induced in the lifting set. If the lifting set normally fitted to the container is used for the lifting test, visually inspect it after the load test by an inspection body as per the requirements of this standard.

Lift the container carefully so that no significant acceleration forces occur. Hold it in lifted position for 5 minutes before taking measurements.

No deflections during testing shall be greater than 1/300 of the span of the member. The offshore container shall show no permanent deformation or other damage after testing.

Test Equipment and Calibration

Apply the force using calibrated weights and lift the container with a lifting appliance or suitable test rig.

Non-Destructive Examination of the Welds

Welds on pad eyes and adjoining structures shall be carried out in accordance with the schedule of examination and tests specified in the table below.

Non-destructive examination (NDE) operators shall be qualified to a minimum of level 2, in accordance with ISO 9712.

A full report describing number of repairs carried out, method of testing used and confirmation of acceptance and rejection must be made following testing.

Table from BS EN ISO 10855-3:

Visual	Magnetic Particle	Dye Penetrant	Ultrasonic	Radiography
ISO 17637	ISO 17638	ISO 3452-1	ISO 17640	ISO 17636-1 and ISO 17636-2a

Non-Destructive Examination Operators
Non-destructive examination (NDE) operators shall be qualified to a minimum of level 2, in accordance with ISO 9712.

NDE operators shall undertake non-destructive examination in accordance with the table on the previous slide and issue reports describing quality, containing the following information as a minimum:

- Number of repairs carried out to meet the specified acceptance standard
- NDE methods and procedures used
- NDE-parameters necessary for a proper assessment
- Confirmation of acceptance or rejection

Notes:

Non-Destructive Examination of the Welds

BS EN ISO 10855-3 includes the following:

Use of Eddy Current Testing at Periodic Inspections
For periodic inspections eddy current testing (ET) can be accepted.

Eddy Current Testing is a recognized NDE method that can be performed without stripping off the paint on a welded connection.

Note 1: ET can only be used on painted surfaces provided the surface to be investigated is free from damage. Structures with very rough and/or damaged surfaces shall not be inspected by ET. If indications are found in the ET inspection, the paint is to be stripped off and the weld shall be inspected by means of the relevant NDE techniques and acceptance criteria.

Personnel performing ET shall be qualified and certified to ET level 2 or 3 in accordance with EN ISO 9712 or other equivalent recognised standard or certification schemes.

Note 2: Since no acceptance criteria are specified for ET, only experienced and competent operators should perform such inspections.

Notes:

Notes:

15. TESTING OF LIFTING SETS

Extract from BS EN 10855-3

Recommended knowledge and experience of staff responsible for inspection of lifting sets intended for use with offshore containers

Regarding lifting sets, the inspector should have as a minimum, a knowledge and adequate practical experience of:

- Statutory requirements relating to lifting sets
- Provisions of this standard
- Various types of offshore containers in service
- Correct methods of slinging and handling offshore containers
- Loads, stresses and strains affecting the lifting sets when used for lifting offshore containers in adverse offshore conditions
- Methods of testing lifting sets
- Defects likely to be found in lifting sets and acceptable levels of wear, distortion and deterioration in relation to safety in use
- Various methods of NDE and a good understanding of how they work and their limitations
- Visual examination as required by this standard and the signs of weakness and defects to look for

Periodic Schedule: BS EN ISO 10855-3

The table below shows the requirements of BS EN ISO 10855-3 for the periodic inspection, examination and testing of the lifting sets fitted to offshore containers. The sling components and chain sling leg marking is dependent upon whether tested or NDE is carried out.

<table>
<tr><th rowspan="2">Time or Interval</th><th rowspan="2">Applicable to</th><th colspan="4">Inspection/Examination/Test</th></tr>
<tr><th>Load Test</th><th>Non Destructive Examination (NDE)</th><th>Visual Inspection</th><th>Marking to be made on Tag</th></tr>
<tr><td>Initial Certification</td><td>Complete Lifting Set</td><td colspan="4">As required by BS EN ISO 10855 - 2</td></tr>
<tr><td>Intervals not Exceeding 12 months</td><td>Complete Lifting Set</td><td>-</td><td>Not Applicable</td><td>YES</td><td>V</td></tr>
<tr><td rowspan="4">Intervals not Exceeding 48 months</td><td>Sling Components</td><td colspan="2" rowspan="2">Either Load Test or NDE</td><td>YES</td><td>T or VN</td></tr>
<tr><td>Chain Sling Legs</td><td>YES</td><td>T or VN</td></tr>
<tr><td>Shackles</td><td>Not Applicable</td><td>Not Applicable</td><td>YES</td><td>N/A</td></tr>
<tr><td>Wire Rope Legs</td><td>Not Applicable</td><td>Not Applicable</td><td>YES</td><td>N/A</td></tr>
<tr><td>After Substantial Repair or Alteration</td><td>Complete Lifting Set</td><td>YES</td><td>YES</td><td>YES</td><td>T</td></tr>
</table>

Lifting sets shall be periodically inspected, examined and tested by an inspection body in accordance with the schedule shown on the previous slide.

When the schedule requires a load test, the lifting set shall be both visual inspected and non- destructively examined after the load test.

The inspection body may require other or additional inspections, examinations and tests, also the installation owner may require inspections, examination and tests be carried out at shorter periods to bring

all the lifting equipment into line with their local regulations. Very often the procedure will require the same requirements as BS 7072.

Load Testing of Chain Sling Legs
A test load equal to 2.5 x WLL of a single leg rated in accordance with EN 818-4:1996 + Amendment 1:2008 +/- 2 %, shall be applied to each leg without shock. The load shall be applied for a minimum of 5 minutes before measurements are taken.

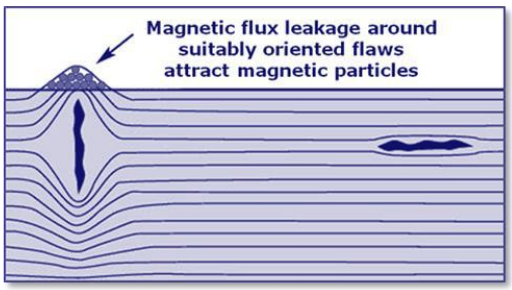
This is generally only carried out on welded construction chain slings as the mechanically constructed slings are allowed to be visually examined to ensure freedom from defects. The Competent Person in this case should also ensure each component is certified as being subject to the manufacturing tests required by the relevant parts of BS EN 1677.

Non-destructive examination of sling components except wire rope legs
Magnetic particle examination shall be undertaken in line with the table below, this does not apply to steel wire rope sling legs.

Types of Tests

Magnetic Particle Inspection
Magnetic particle inspection (MPI) is used to locate surface and slightly sub-surface discontinuities in ferromagnetic materials by introducing a magnetic flux into the material.

- White background lacquer is applied to the area to be inspected
- Items are magnetized and then sprayed with a solution of suspended iron filings
- Cracks or imperfections near the surface will distort the magnetic field
- Will attract the iron filings revealing the flaw by an accumulation of particles along the line of the crack
- Sub-surface defects by an accumulation in the area over the fault



Notes:

Periodic Schedule: BS EN 7072

The instruction given in BS 7072 for the periodic examination of the lifting set is that the lifting set is visually thorough examined at the time of the container inspection. This would be with intervals not exceeding 6 months.

There is no direction given as to any testing or NDE periods. In line with LOLER, the NDE and any load testing of the lifting set would be carried out at the discretion of the Competent Person.

Periodic Schedule: DNVGL-ST-E271

The table below shows the requirements of DNVGL-ST-E271 for the periodic inspection, examination and testing of lifting sets fitted to offshore containers. The highlighted columns show the requirement for non-destructive examination and testing.

Time or Interval	Applicable to	Inspection/Examination/Test			
		Load Test	Non Destructive Examination (NDE)	Visual Inspection	Marking to be made on Tag
Intervals not Exceeding 12 months	Complete Lifting Set	Not Applicable	Not Applicable	YES	V
Intervals not Exceeding 48 Months	Sling Components	Either Load Test or NDE		YES	T or VN
	Chain Sling Legs			YES	T or VN
	Shackles	Not Applicable	Not Applicable	YES	V
	Wire Rope Legs	Not Applicable	Not Applicable	YES	N/A
After Substantial Repair or Alteration	Complete Lifting Set	YES	YES	YES	T

There are slight differences in DNVGL-ST-E271:

Load testing of chain sling legs
A test load equal to 2 × WLL of a single leg rated in accordance with EN 818-4 +/- 2%, shall be applied to each leg without shock. The load shall be applied for a minimum of 2.5 minutes before measurements are taken.

Non-destructive examination of sling components except wire rope legs
Magnetic particle examination shall be carried out according to the requirements of EN ISO 17638.

When the schedule requires a load test, the lifting set shall be both visual inspected and non- destructively examined after the load test.

Notes:

16. INSPECTION REPORT REQUIREMENTS

Inspection Report Contents

The inspection report for an Offshore Container should contain at least the following:

1	Container identification (including owner's container number)
2	Name of owner or delegated nominee
3	Report number
4	Statement that the container is suitable for service
5	Total gross mass in kg, applicable to the all points lifting test and the method of test (where relevant)
6	Details of NDE carried out (where relevant)
7	Statement that the container described was inspected/examined and or tested and that the particulars are correct
8	Reference to any report issued to the owner arising from the process (where relevant)
9	Confirmation that the Inspection Plate was marked; date of examination (date of signature or report also to be shown if different from date of examination)
10	Name of organization, person and authentication by the person carrying out the inspection, examination or test either by signature or other secure means
11	Comments on limits to the scope of inspection
Note:	• Details of the examination of the lifting set may also be given on the inspection report for the container. • This report may be combined with the initial Certificate of Conformity

Notes:

17. PRE-TRIP INSPECTIONS

The course modules so far have covered the in-depth inspection and testing that is required for offshore containers. This final module will cover the user pre-trip inspection that is required before shipping.

This is a very basic level inspection carried out as a final check but is often just as important as the periodic inspections and tests because it may have been some time since the periodic inspection/test and the container and lifting set's condition may have deteriorated.

Immediately before transporting a container offshore and before its return trip, the container shall be inspected by a person appointed by the user. The user shall ensure that the person appointed is competent for this purpose.

The appointed Competent Person shall check the validity of the certification by reference to the inspection plate, and verify that the container, including its lifting set, is free from obvious defects rendering it unfit for use.

The appointed Competent Person shall confirm, by signature and date, that the inspection has been carried out in accordance with the minimum requirements below and that the container and lifting set comply with all elements before being released for shipment. This confirmation of inspection shall be retained at least until the end of the trip, or, where the container has been involved in an incident, until the completion of related investigations.

Pre-Trip Inspections – Minimum Required Checks	
1	Check the inspection plate(s) to ensure that inspection dates are current
2	Check the container for obvious signs of damage or excessive corrosion
3	Check the lifting set for obvious signs of damage
4	Check the lifting set to ensure correct and secure connection and all parts are present and correct
5	Check the container roof, forklift pockets and frames on open framed containers for potential dropped objects
6	Check the container doors are closed and the locking mechanism secured

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TRAINING

Operative training for all the equipment covered in these course study materials should always take the manufacturer's information and instructions for use into account.

FEEDBACK

We would be grateful for your feedback regarding these Course Study Materials – you can use the note box below to list anything you would like to bring to our attention.

We value your views and will use your comments to help our continual improvement of our learning and development materials.

Thank you for your participation.

Andrew Wright
LEEA Deputy Chief Executive Officer

Course Study Materials - feedback to LEEA: